LINKAGES FROM THE FARM SECTOR TO THE AUSTRALIAN MACROECONOMY - TOWARDS A THEORETICAL AND EMPIRICAL ANALYSIS

Laurence Paul O'Mara

February 1985

A thesis submitted for the degree of Doctor of Philosophy of The Australian National University.

Declaration of Original Work

The thesis contains eleven chapters.

Chapters I to IX and Chapter XI are entirely my own work.

Chapter X is based on joint work undertaken with officers of the Bureau of Agricultural Economics, Canberra - Dr D.T. Nguyen, Mr P.D. Adams and Mr D. Vanzetti.

In Chapter X, a relatively large theoretical simulation model is presented, along with a range of simulation results obtained from that model. Within this exercise, I was primarily responsible for:

(1) providing the detailed specification of the theoretical simulation model - the specification being largely identical to that of a theoretical model developed earlier in the thesis;

(2) assigning numerical values to the parameters in the model;

(3) interpreting and assessing the simulation results; and

(4) preparing the three versions of this material which have been finalised to date - Chapter X of the thesis, O'Mara, Nguyen and Adams (1983) and O'Mara, Nguyen and Adams (1984).

Dr Nguyen provided valuable guidance and assistance on various technical issues associated with the application of the theoretical simulation technique. Mr Adams was primarily responsible for the computing aspects of this project, with some assistance also provided by Mr Vanzetti.

Some extensive simulations were also performed with a modified version of the theoretical simulation model. Unfortunately, space limitations have precluded a detailed reporting of this material in the thesis. However, it has been presented in O'Mara and Vanzetti (1985) and some of the main results are summarised briefly in Chapter X. In this exercise, I was primarily responsible for:

(1) modifying the specification of the model, with the alternative specification being based on theoretical work contained in the thesis;

(2) interpreting and assessing the simulation results; and

(3) preparing the material contained in O'Mara and Vanzetti (1985).

Mr Vanzetti was primarily responsible for the computing aspects of the project.

L. Paul O'Mara

(Laurence Paul O'Mara)

Acknowledgements

I am grateful to Malcolm Gray, Dr Tom Nguyen and Professor John Pitchford for supervisory assistance and to Professor Fred Gruen for some valuable comments on earlier drafts.

I am indebted to my parents for providing moral support and to the Bureau of Agricultural Economics for financial support during my course of study.

Some diligent typing was undertaken by Rae Carson, Marion Pollard, Marti Pascall and Jill Russom.

Abstract

The volatile fortunes of the Australian farm sector in recent years, and particularly the severe drought of 1982-83, has renewed interest, amongst policy makers and policy advisers, in the impact which developments in the farm sector may have on the macroeconomy. However, in the Australian literature, there are few detailed theoretical or empirical analyses of farm/macro linkages. Further, the existing Australian macroeconomic models do not provide a fully suitable framework for undertaking such an analysis.

In view of these gaps or inadequacies in the existing literature, the objective of the present thesis is, firstly, to make a contribution towards the development of a macroeconomic model framework which is suitable for analysing the role of the farm sector in the Australian macroeconomy and, secondly, to undertake some of the associated analysis.

To that end, a relatively large theoretical model is developed in which the linkages between the farm sector and the macroeconomy are emphasised. The model proves to be too large and complex to be tractable using strictly formal algebraic techniques. Therefore, in the first instance, the analysis is undertaken using a slightly less rigorous geometric characterisation of the model. After this geometric approach is fully exploited, some parts of the analysis are extended and refined using theoretical simulation techniques.

A number of important results are established in these theoretical analyses. It is shown that, in principle, the marketing and institutional environment in which the farm sector operates is of major importance in influencing the macroeconomic implications of production and price shocks originating in the farm sector. It is also demonstrated that shocks to the volume of farm production or to farm prices may influence macroeconomic variables such as non-farm G.D.P., the interest rate and the state of the balance of payments in a direction which is at variance to that suggested by intuition or conventional wisdom. For example, an exogenous (drought induced) decline in farm production could have a beneficial impact on non-farm output and the state of the balance of payments. Alternatively, a drought which has a (more intuitive) adverse effect on the overall level of economic activity may place upward pressure on the interest rate. In a similar vein, an exogenous increase in the price of farm commodities on overseas markets may reduce domestic economic activity and worsen the balance of payments.

Because of the time and resources required to develop and use a relatively large theoretical simulation model, it is not feasible, within the context of the thesis, to apply theoretical simulation techniques to each of the analyses which are undertaken less formally using the geometric characterisation of the model. However, the foundations are laid to permit the ready extension of the theoretical simulation technique to these remaining cases as part of a future research exercise. The existence of the theoretical simulation model and analyses should also facilitate the eventual development of an empirical version of the model.

Given that some further post thesis research will be required in order to develop an empirical version of the full model structure, it was decided to seek some tentative and preliminary empirical results from a very simple empirical version of the model. A major conclusion to emerge from this empirical analysis is that the farm sector may not have declined in relative importance as a source of change in non-farm output over the period since the early 1950s and may even have increased in importance. Such a result serves to provide some additional motivation for persisting with the line of research commenced in the thesis.

Table of Contents

PART A

Introduction

CHAPTER I

THE MOTIVATION, OBJECTIVE AND STRUCTURE OF THE THESIS

Introduction: The Need for a Macro/Farm Analytical Framework

The volatile fortunes of the Australian farm sector in recent years has rekindled an interest, amongst policy makers and policy advisers, in the impact which developments in the farm sector may have on the macroeconomy. This, of course, was brought to the fore by the severe drought which afflicted Eastern Australia in 1982-83 and the remarkable improvement in seasonal conditions which occurred in 1983-84. The drought was widely considered to have made an important contribution to the marked recession in 1982-83, while the breaking of the drought has been seen as having a major influence on the subsequent economic recovery:

> 'The economy sank deep into recession in 1982-83 as the forces instrumental in bringing the earlier expansion to a halt - principally large increases in domestic costs, international recession and high domestic and overseas interest rates - exerted a continuing influence, and as widespread drought took its toll.' (Budget Statements, 1983-84: Budget Paper No.1, A.G.P.S. Canberra, 1983, p.12) (emphasis added).

> '.... the dominant word for 1982 was the drought in the eastern States. The drought is expected to cost our farmers nearly $1400m in 1982-83. With multiplier effects, the cost to the nation as a whole may be double that figure.' (Stoeckel (1983), p.86).

'Following almost two years of decline, the Australian economy rebounded strongly in 1983-84. Important influences were the sizable fiscal stimulus, the breaking of the drought, developments in the stock cycle and generally favourable conditions abroad.' (Budget Statements, 1984-85: Budget Paper No.1, A.G.P.S., Canberra, 1984, p.12) (emphasis added).

Even the much less severe drought of 1980-81 was viewed as having some macroeconomic significance. In reviewing the state of the Australian economy in that year, the then Secretary to the Treasury, J.O. Stone, argued that:

'Since those forecasts [prepared at the time of the 1980-81 Budget] were set down, the most obvious developments affecting the economy have been, domestically, the drought and, internationally, the even flatter outlook for the world economy than had been contemplated at the time of the Budget ... I might say of these otherwise unwelcome changes that, had they not occurred, we would currently be facing in Australia what might almost be described as an economic 'boom' of a kind we have nearly forgotten.' (p.28) (emphasis added).

In view of this perceived significance of the farm sector for the performance of the Australian economy, it is important that the linkages between the farm sector and the macroeconomy are thoroughly understood. The ideal vehicle for gaining such an understanding would be a macroeconomic model in which these linkages were emphasised. At a theoretical level, such a model could be used to clarify and analyse a range of issues. For example, the various linkages themselves could be readily identified in the model, and some feel gained for their structure.

Some theoretical analysis could then be undertaken in order to establish the likely direction of the change in some important macroeconomic variables which might be expected in response to various shocks originating in the farm sector.

In some instances, of course, the theoretical results may be ambiguous or equivocal. Nevertheless, such ambiguity would help to pinpoint areas in which detailed empirical analysis could be most beneficial. It would also serve as a warning that, until such empirical analysis has been successfully undertaken, any forecasts, projections or policy prescriptions which focus on these less certain variables should be made with due caution.

Building on the foundations laid by the theoretical analysis, an empirical version of the model could be used to obtain some detailed numerical results for the Australian economy. For example, historical data could be examined within the context of the model in order to assess the contribution made by the farm sector to the short and medium term changes which have occurred in some important macroeconomic variables. Access to the empirical model would also help to clarify or resolve, from a practical viewpoint, at least some of the ambiguities which might emerge from the theoretical analysis, as noted above. In addition, macroeconomic forecasts or projections could be made confidently in the presence of a significant actual or hypothetical shock in the farm sector.

At present, there is no such ideal framework for analysis in Australia. There are, of course, several macroeconomic or general equilibrium models which have been developed for the Australian economy. The main features of the farm/macro linkages incorporated

into those models are reviewed in Chapter VIII. There, it is argued that, in each of these models, the farm/macro linkages are unsatisfactory from either a theoretical and/or an empirical viewpoint. For example, in two of the models, the main farm sector variables are exogenously determined while, in another, no distinction is drawn between the farm and the non-farm components of most major aggregates. Several of the models abstract from variables such as the demand for money, the interest rate and the overall state of the balance of payments - variables which are of direct relevance to the present study. Further, the specification employed in those models may not adequately capture the sorts of consumption and investment responses by farm households which are suggested by the literature.

It should be emphasised that such considerations do not necessarily represent a criticism of these existing models, given the numerous diverse roles which they have been designed to fulfil. However, it does cast serious doubt on their suitability as a vehicle for analysing the interactions between the farm sector and the macroeconomy.

In Chapter IX, it is argued that, in the Australian literature, there are relatively few theoretical or empirical analyses of the role of the farm sector in the macroeconomy. It is also suggested that this reflects, at least in part, the lack of a suitable model framework for undertaking such analyses. It is significant, too, that the most noteworthy Australian study - that undertaken by Gray and Gruen (1981, 1982) and subsequently revised and refined by Gray (1984) - utilised a model developed by those authors quite independently of any of the pre-existing Australian

models. Further, that study was directed towards a wide range of issues, so that the role of the farm sector in the macroeconomy was not the major consideration. Finally, it is suggested that the results of the study, as they relate to the role of the farm sector in the macroeconomy, may be suspect because of a failure to satisfactorily capture several important farm/macro linkages.

In view of these gaps or inadequacies in the existing literature, the objective of this thesis could be briefly stated as that of making a contribution towards the development of an 'ideal' model framework, as described above, and of undertaking some of the associated analysis.

Section II The Objective of the Thesis

More definitively, the objective of the thesis is to make significant progress towards:

(1) the development of a consistent analytical framework in which farm/macro linkages are emphasised;

(2) the use of that framework to assess the short to medium term impact of production and price shocks in the farm sector on some important macroeconomic variables in Australia - including major policy variables such as non-farm and total G.D.P., employment, the price level, nominal and real wages, the interest rate and the state of the balance of payments; and

(3) an assessment of the extent to which the macroeconomic implications of shocks in the farm sector are influenced by the marketing and institutional environment in which the relevant farm industries operate.

Section III An Overview of the Thesis

III(1) The Mode of Analysis

The mode of analysis adopted in the thesis has a strong bearing on the overall content and achievements of the thesis. It is useful, therefore, to briefly discuss the various modes of analysis which could have been adopted, in principle, in the present exercise, and the reasons for the actual choices which were made in this regard.

While the structure of the model developed and used in the thesis is reasonably conventional, the relationships which it embodies are sufficiently numerous and complex to render intractable any extensive use of formal algebraic analysis. In such a situation, there would seem to be three modes of analysis which could be adopted, as set out below. It must be stated at the outset, however, that our basic philosophy is that these should be regarded more as complements than as substitutes.

The first mode of analysis involves the foregoing of some strict formal rigour in order to develop and use an approximate geometric characterisation of the model. The geometric structure would allow some useful and instructive analysis to be undertaken and some (perhaps tentative) theoretical results to be established. The main advantage of this approach is its relative ease. Further, once such a geometric structure is developed, it can usually be

readily modified in order to capture the essential features of any variations which might be made to the structure of the underlying algebraic model. Finally, as we shall see, the tentative results and insights gained from the geometric analysis prove to be a valuable guide to the interpretation and assessment of the results gained from the second mode of analysis - the theoretical simulation approach. The geometric approach is, in fact, adopted in the theoretical analysis presented in Chapters III to VII.

Secondly, the theoretical analysis could be extended by applying theoretical simulation techniques to the model. This would facilitate a greater degree of formal rigour in the analysis than is possible using the geometric approach, and would permit a wider range of variables to be explicitly considered.

Unfortunately, the successful development of a theoretical simulation model as large as the model structure employed in the thesis makes very heavy demands on time and resources. It is also time consuming to test and fine tune the model on each occasion that even a relatively minor change is made to its structure. Therefore, while the theoretical simulation technique is used extensively in the thesis, it proved impracticable to apply the technique to all of the analysis attempted geometrically elsewhere in the thesis.

There are also several important respects in which it is felt that theoretical simulation can serve as a forerunner of, and complement to, the third mode of analysis - econometric estimation. Theoretical simulation facilitates an assessment of some of the more general properties and characteristics of the model, across a wide range of parameter values, before attention becomes focussed

on a particular set of estimated parameters. Theoretical simulation also permits model builders to abstract, in the first instance, from institutional and other detail which may not be central to the analysis but which would need to be catered for in any attempt to obtain unbiased econometric estimates of the parameters.

Further, given the existence of a theoretical simulation variant of the model, it is probable that the emergence of an empirical variant would not be distinct or discrete. Rather, some reliance would be placed on the numerical results which were obtained from the model even before all of the behavioural equations were actually estimated. In other words, as some of the more sensitive equations and parameters were estimated and hence the empirical model became better able to replicate some actual historical episodes, then gradually increasing reliance would be placed on the specific numerical results obtained. In that sense, the development of a theoretical simulation variant of the model in the thesis represents an important step towards the eventual development of an empirical variant of the model.

In general, then, the theoretical simulation approach is regarded, in the thesis, as the second major step in the development and refinement of the model and the associated analysis, building on the foundations laid by the geometric analysis and, in turn, building some foundations for econometric analysis.

As noted above, econometric estimation and analysis represents part of the ultimate objective of the line of research commenced in the present thesis. However, it is unrealistic to suppose that

this could be satisfactorily accomplished within the confines of a single thesis. The development of an econometric model of the size of the model framework used in the thesis would require even more time and resources than the theoretical simulation approach. In addition, the fact that the structure of the model is modified slightly on several occasions, in order to further the analysis, raises obvious problems for econometric estimation. Further problems are posed for econometric estimation by the data deficiencies for a number of important variables, such as those disussed in Chapter VIII.

Such considerations serve to reaffirm the view that, as a mode of analysis, econometric estimation is best embraced after the theoretical and theoretical simulation approaches have been fully exploited.

III(2) The Content and Scope of the Thesis

As the first step in the analysis, the marketing and institutional arrangements which have operated in the major Australian farm industries are reviewed. The focus of attention, of course, is on issues which are likely to be of importance at a macroeconomic level, rather than the more commonly discussed microeconomic and welfare issues. In the light of this review, five paradigms (or scenarios) are identified as having major commodity relevance and hence are put forward as a basis for the subsequent macroeconomic analysis. These paradigms differ either in terms of the marketing and institutional environment in which the farm sector is assumed to operate, or in the nature of the shock which is assumed to affect the farm sector, ie, either a production shock, a price shock or a combination of the two.

A macroeconomic model is then presented in which the linkages between the farm sector and the macroeconomy are emphasised. The model is too large to be tractable using a conventional algebraic mode of analysis. Therefore, in line with the philosophical approach set out in Section III(1) above, a slightly less rigorous geometric characterisation of the model is developed. Some analysis of the macroeconomic implications of each of the five paradigms is then undertaken, in turn, using this geometric framework.

In order to capture the essential features of the various alternative marketing and institutional environments in which the farm sector is assumed to operate, it proves necessary to make relatively minor modifications to the model as the analysis proceeds from one paradigm to the next. For ease of exposition and to facilitate cross comparisons, it was found to be convenient to distinguish clearly between these different versions of the model. In particular, the model as originally specified and used to undertake some analysis of the first paradigm, is referred to as Model I. The subsequent, marginally different, versions of the model used to analyse the second, third, fourth and fifth paradigms are referred to as Models II, III, IV and V respectively.

Building on the foundations laid by the geometric analysis, an attempt is then made to further the analysis using the theoretical simulation technique, as suggested in Section III(1). To that end, a theoretical simulation variant of the model - or, more particularly, Model I - is developed, and the first paradigm is re-examined within that simulation framework. In many cases, the results serve to clarify and reinforce results and insights gained

more tentatively from the earlier analysis of the first paradigm undertaken within the geometric characterisation of Model I. The greater analytical power of the simulation framework also permits some consideration of a number of variables, and associated issues, which were, by necessity, ignored in the geometric analysis. Of course, the complementarity of the two approaches works in both directions. In particular, the insights gained from the geometric analysis often prove invaluable as an aid to the interpretation of the simulation results.

A similar exercise was also undertaken for the analysis of the second paradigm within the Model II framework. The results are reported in detail in O'Mara et al (1985). Unfortunately, space limitations permit only a very brief summation of the main results to be included in the thesis.

Similarly, time and space limitations do not permit the theoretical simulation technique to be extended to the analysis of the three remaining paradigms. However, the geometric analyses of these three paradigms that are undertaken with Models III, IV and V, coupled with the successful development of theoretical simulation variants of Models I and II should ensure that these remaining theoretical simulation exercises can be readily accomplished as part of a post-thesis research programme.

As suggested in Section III(1), these various theoretical simulation analyses should also serve to facilitate the eventual development of an empirical version of the model from which detailed quantitative results could be obtained which were of direct relevance to the Australian economy. However, some further,

post thesis, research will be required to bring the project to such a stage of development. In view of that, and also in view of the paucity of other relevant empirical studies in the Australian literature, it was considered desirable, as an interim measure, to seek some tentative or preliminary quantitative results for the Australian economy.

To that end, it was decided to develop a very much simplified quantitative version of the model structure used in the thesis. This simple quantitative model captures some of the linkages between the farm sector and the macroeconomy which are incorporated into the full model, and retains the basic philosophy of the full model, but is simple enough to be amenable to some limited analysis of actual historical data. It is used to obtain some estimates of the short-term (annual) impact of shocks in the farm sector on non-farm and total G.D.P. in Australia over the period from 1953-54 to 1982-83.

A number of interesting implications emerge from the results obtained in this exercise. One of the more important of these is that the farm sector may not have declined in importance as a source of instability in the macroeconomy over this period and, indeed, may have increased in importance. Such a result may seem somewhat counterintuitive, in view of the sharp decline which has occurred over this period in the relative contribution made by the farm sector to variables such as G.D.P. and employment. Some possible rationales for this result are offered in the relevant chapter - Chapter IX. It is suggested there that a major contributing factor has been the increased volatility of farm prices since the early 1970s.

Amongst other things, this result reinforces the potential importance of an Australian macroeconomic model in which farm/macro linkages are emphasised. In other words, it provides an additional motivation for persisting with the line of research commenced in the thesis - in particular, undertaking and completing the theoretical simulation analyses and moving on towards the development of a quantitative version of the full model structure. It also serves to define one of the first tasks which should be undertaken within the context of a quantitative version of the full model - to assess whether the above result, obtained from the simple quantitative model, is supported or overturned by the results obtained from the full model.

Section IV The Structure of the Thesis

IV(1) Some General Comments

In the light of the overview of the thesis presented in Section III, we are now in a position to consider the actual structure of the thesis.

The thesis is divided into five parts. Part A is simply the present, introductory chapter. Parts B, C and D comprise the main body of the thesis, whilst Part E is the concluding chapter, Chapter XII. In Part B (ie. Chapters II to VII) the focus of attention is on the definition of the five paradigms, the philosophy and structure of the macroeconomic model used in the thesis, and the analysis of the five paradigms within the geometric characterisation of the model. A range of empirical issues and results are presented in Part C (Chapters VIII and IX). Then, in Part D (Chapter X) the theoretical simulation analysis is presented.

IV(2) Some Theoretical Analysis of the Five Paradigms (Part B)

The marketing and institutional environment in which the major Australian agricultural industries have operated is discussed in Chapter II, based on an extensive review of the relevant literature. In the light of that discussion, the five paradigms to be carried forward into the subsequent macroeconomic analysis are defined.

Chapter III deals with the philosophy and theoretical underpinnings of the macroeconomic model used in the thesis, including an extensive review of the relevant macroeconomic literature. The actual structure of the model - or more particularly, Model I - is presented algebraically in the first instance, after which a less rigorous geometric characterisation is developed and discussed. This geometric framework is then used to undertake some analysis of the macroeconomic implications of the first paradigm - a shock to the volume of farm production in the presence of a perfect residual export market for farm commodities.

In Chapter IV, Model I is modified slightly to form Model II. Model II differs from Model I only to the extent necessary to allow for the presence of an effective constraint on the volume of farm exports , which forces the change in farm production to be absorbed on the domestic market. In this second paradigm, it is further assumed that there is no buffer stockholding of farm commodities, so that clearance of the domestic market is brought about by an appropriate change in the domestic price of farm commodities. Again, the analysis is undertaken within the geometric characterisation of the model. An interesting result to emerge from the analysis is that, under the second paradigm, an exogenous

(drought induced) decline in the volume of farm production could gave a beneficial impact on non-farm production.

In Chapter V, another slight modification is made to the model in order to form Model III, which allows for the existence of buffer stockholding of farm commodities. Under this third paradigm, there is no necessary requirement for a change in the domestic price of farm commodities in response to a change in the volume of farm production, even though the volume of farm exports is again assumed to be unchanged.

Under the fourth paradigm, analysed in Chapter VI, the nature of the shock which is assumed to occur in the farm sector changes from a production shock, or a production shock coupled with an induced price shock, to a pure price shock. In particular, it is assumed that an exogenous change in the price of farm commodities occurs on overseas markets, which then flows through into the prices received by local producers and paid by domestic consumers. The analysis is undertaken in the context of Model IV. An interesting result to emerge in this case is that an exogenous increase in farm prices could have a deleterious impact on non-farm output and the overall state of the balance of payments.

In the next, the fifth paradigm, it is explicitly recognised that advance payment schemes have traditionally operated in some farm industries - most notably the wheat industry - and that some change has occurred over time in the method of financing these advance payments. Up until the late 1970s, the advance payments were financed by an injection of domestic credit from the Reserve Bank. This, of course, represented a special linkage from the farm sector to the macroeconomy via the domestic credit component of the

high powered money stock. In more recent years, a gradual shift towards commercial financing of the advance payment has occurred - thus weakening and finally eliminating this special linkage. In Chapter VII, the historical background to these arrangements is discussed in more detail, and some analysis is undertaken of the macroeconomic implications of the alternative means which have been used to finance the advance payment. For this purpose, the model is modified to form Model V. It is suggested that, under a wide range of circumstances, the method of funding the advance payment may be of little, if any, consequence for the two variables most commonly cited in this regard - the money supply and the interest rate.

IV(3) Some Empirical Issues and Preliminary Results (Part C)

One of the most important linkages from the farm sector to the macroeconomy that is incorporated into Models I to V, as used in Part B, is consumption and investment expenditure originating from farm households. In Chapter VIII, the existing empirical literature on consumption and investment behaviour by farm households is reviewed in some detail. This review serves three major purposes:

(1) firstly, it provides some feel for the possible quantitative significance of this linkage from the farm sector to the macroeconomy which, up to that point in the thesis, had been discussed only from a theoretical viewpoint;

(2) secondly, in conjunction with the theoretical analyses presented in Part B, it facilitates an assessment of the adequacy of the treatment of the farm sector in the

major Australian macroeconomic and general equilibrium models. This assessment is presented in the latter part of Chapter VIII;

(3) it also serves to establish a resume of the empirical literature in this area, which is subsequently drawn upon in the development of the simple, quantitative version of the model.

In Chapter IX, the simple quantitative version of the model and the associated results are presented and discussed in detail. The relatively limited Australian literature which is available in this area is also reviewed in Chapter IX. An important study - that undertaken by Gray and Gruen (1981, 1982) and Gray (1984) is examined in detail, and those results are contrasted, as far as possible, with the results obtained in the present study. The analysis of the macroeconomic effects of the 1982-83 drought that was undertaken by Campbell, Crowley and Demura (1983), using the Orani framework, is also examined in some detail.

IV(4) Towards a Theoretical Simulation Analysis (Part D)

The theoretical simulation variant of Model I is presented and discussed in Chapter X, including the rationale behind the combinations of numerical values assigned to the parameters in the model, and various other more technical issues associated with the application of the theoretical simulation technique. Selected simulation results of direct relevance to the analysis of the first paradigm are then reported and discussed in some detail.

A very brief summary of the results obtained from the theoretical simulation variant of Model II - as reported in O'Mara et al (1985) - is also included in Chapter X.

IV(5) Conclusion (Part E)

In Chapter XI, the broad achievements of the thesis are reviewed and some of the more important theoretical and empirical results are re-iterated. The thesis concludes with a listing and discussion of the numerous avenues for important future research which have been recognised or opened up as a direct consequence of the analysis in the thesis.

PART B

Some Theoretical Analysis of the Five Paradigms

CHAPTER II

AN OUTLINE OF THE MARKET STRUCTURES OF THE MAJOR AGRICULTURAL INDUSTRIES IN AUSTRALIA: FIVE 'PARADIGMS'

Introduction

In Chapters III to VII, some macroeconomic consequences of output and price shocks originating in the farm sector are analysed using a theoretical macroeconomic model which focuses on farm/macro linkages. The basic model structure used in each of those chapters is the same. The main distinction between the analyses in those chapters is that they focus on different types of shock in the farm sector and/or on different sets of marketing and institutional arrangements within the farm sector which may influence the macroeconomic consequences of the shock. The purpose of the present chapter is to briefly review the marketing and institutional arrangements which have been operative in the main rural industries in Australia, in order to justify the choice of the five scenarios or paradigms which are taken up in Chapters III to VII.

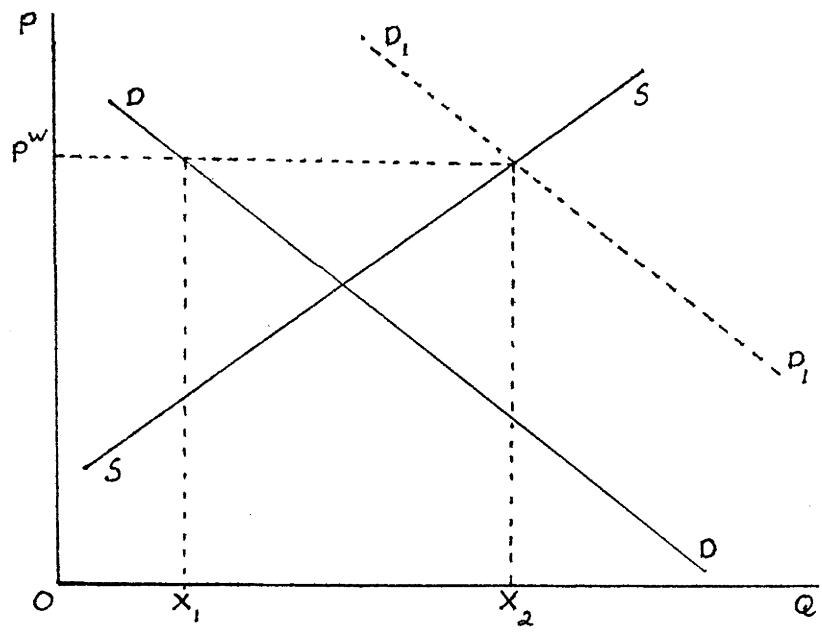
It must be emphasised that, in this review, we are not concerned with the more detailed microeconomic consequences of the various arrangements - for example, their implications for allocative efficiency or income distribution. There is a substantial existing literature on such issues for most of the main industries. Rather, our focus is on the broader macroeconomic implications, which are of immediate relevance to the present study, and which have been largely neglected in the literature.

In Section II, an extremely simple market structure is outlined for some hypothetical agricultural industry - which might be thought of as an industry which is free of any institutional rigidities, and which operates as a price taker in the presence of a perfect residual export market. The main consequences of such a structure, for the purposes of the present macro oriented study, are identified. Then, in subsequent sections, the actual marketing and institutional arrangements which have been operative in the wheat, sugar, wool, beef, mutton and lamb, horticultural, intensive livestock and dairying industries are outlined briefly. The points of similarity to, and points of departure from, the essential features of the hypothetical industry, discussed in Section II, are noted. The analysis is drawn together in Section VIII, where the five paradigms to be carried forward into the subsequent chapters are set out and reiterated.

Section II A Simple Hypothetical Market Structure

Consider the case of a hypothetical agricultural industry which operates in a marketing environment completely free of government intervention in the form of, for example, a statutory marketing authority or an administered home consumption price. Also suppose that the commodity is exportable, and that any output not absorbed willingly on the domestic market can be exported at given prices. Such a market structure could be represented as in Figure II(1).

FIG.II(1)



In Figure II(1), DD represents domestic demand for the hypothetical agricultural commodity, SS the domestic supply curve, and p^W the local equivalent of the price available on overseas markets. It is trivial that, given p^W, quantity ox_2 is produced, of which ox_1 is absorbed on the local market and the balance, ox_2-ox_1, is exported.

Of more interest, for present purposes, is the behaviour of such a market structure in the presence of an output or a price

shock. Suppose that, because of adverse seasonal conditions, the supply curve moved temporarily to the left. It is clear that:

(i) provided that output remained above ox_1, the price paid by local consumers and received by domestic producers would remain at p^W;

(ii) the volume and nominal value of the commodity absorbed on the local market would be unchanged;

(iii) the volume and total value of exports of the commodity would fall; and

(iv) producer incomes would fall ie they would move in the same direction as the volume of output.

Conversely, if SS were to move to the right (because of, for example, highly beneficial seasonal conditions, or because of a return to normal seasons following a drought), then p^W and the volume and value of sales on the domestic market would be unaffected, while the volume and value of exports and producer incomes would increase.

Now consider a shock to p^W - in particular, suppose that p^W were to increase.[1] In general:

(i) the volume of domestic sales would decline from ox_1;

(ii) the nominal value of those domestic sales could increase, decrease or remain unchanged, depending on the own price elasticity of demand;

(iii) the volume and nominal value of farm output would increase - even in the absence of a volume response, the nominal value of output would still increase;

---

1 We will restrict our attention, of course, to changes in the <u>relative</u> level of p^W.

(iv) producer incomes would increase; and

(v) the volume and nominal value of exports would increase.

An analogous set of implications would emerge, of course, for a decline in p^W.

There are, in general, two types of change in the level of p^W which should be distinguished for present purposes. Firstly, the price of the commodity may rise or fall on overseas markets, relative to the prices of other goods and services, reflecting international supply or demand developments for that commodity. There would seem to be considerable intuitive appeal in regarding such price changes, and their effects, as being, in some sense, a farm sector shock.

Alternatively, however, the change in p^W could be brought about by a change in the real exchange rate in the local economy. In this case, the change in the price of the farm commodity relative to the prices of a range of other goods and services would be part of a more general change in the relative price of traded and non-traded goods. There are various sources of such a change in the real exchange rate - see, for example, Gregory (1976), Bilson (1978, 1979), Dornbusch (1976), Frankel (1979), Krugman (1978), Officer (1980), Snape (1977), O'Mara, Carland and Campbell (1980). It is quite possible that a real exchange rate movement could result from a sharp change in the volume of farm exports and/or in the overseas price of farm commodities. In this case, of course, the intuitive appeal in regarding such relative price changes as being part of a farm sector shock remains strong. However, a real exchange rate movement may also result from influences such as, for example, structural change associated with

mineral development, or from the short term side effects of sharp changes in fiscal and monetary policy. In these latter cases, there would seem to be more appeal in interpreting such relative price changes as being, in some sense, a shock originating in the non-farm sector. However, as the sources of a change in the relative prices of farm and non-farm commodities are obviously difficult to isolate, this conceptual problem will be largely ignored in most of the ensuing analysis in the thesis.

Finally, consider the effect of movements in the DD schedule in Figure II(1). A rightward[2] movement of DD, for example, would:

(i) leave p^W unchanged;

(ii) leave the volume and value of production unchanged;

(iii) increase the volume and nominal value of farm output absorbed on the local market; and

(iv) reduce the volume and nominal value of exports.

It seems reasonable to suppose that, in general, the magnitude and impact of relatively short term movements in DD would be small compared to the movements in SS and p^W. In other words, the impact of developments in the macroeconomy on the farm sector, as they work through the DD schedule alone, seems unlikely to be a significant source of instability in the farm sector in the short run.

---

2 Of course, if DD were to move to the right of D^1D^1 in Figure II(1), our hypothetical industry would be converted to an import competing industry.

Section III Marketing and Institutional Arrangements in the Australian Wheat and Sugar Industries

It is beyond the scope of the present chapter to review, in detail, the structure of the main Australian agricultural industries, and the marketing and institutional arrangements which exist in those industries. Further, for most of the main industries, there is a substantial existing literature which, as well as providing this background information, also provides some analysis of the microeconomic effects of the various marketing and institutional arrangements, such as their effects on economic efficiency and welfare. Little would be gained by replicating such material here. For our purposes, it is sufficient to note the main features of these marketing and institutional arrangements, so that they can be compared and contrasted with the corresponding elements in the simple, hypothetical market structure outlined in Section II.

A statutory marketing authority for wheat, the Australian Wheat Board (A.W.B.), was established in 1948. Since that time, all wheat produced in Australia has, with only very limited exceptions, been acquired by the A.W.B., and it has held a monopoly over local and overseas sales. The price of wheat sold on the domestic market, particularly wheat for human consumption, has been regulated under the operation of a home consumption price scheme. Up until the late 1970s, the level of, and movements in, the home consumption price have borne little resemblence to the level of, and movements in, the export price. Rather, the home consumption price was based more on the assessed cost of producing wheat in Australia, and was adjusted from time to time in line with movements in that assessed cost. In recent years, the formula used

for setting the home consumption price has been modified to allow some, but still very limited, role for the export price to influence the local price. Wheat producers have received a price which has been equalised across the returns from local and export sales. Further, while local and export sales of wheat proceed over the course of a marketing year, or longer, wheat producers have typically received a first advance payment from the A.W.B., equal to a varying, but substantial, proportion of the total return from the crop, immediately on delivery of the wheat to the A.W.B. This has imposed a substantial borrowing requirement on the A.W.B., and, up until the late 1970s, this borrowing requirement was financed by domestic credit creation by the Reserve Bank. For more detail on these various arrangements, including the gradual changes which have emerged over the period since 1948, see, for example, Longworth (1966, 1967), Longworth and Knopke (1982), I.A.C. (1978), O'Mara (1979).

The A.W.B. also serves as the major holder of Australian wheat stocks. While the level of carryover stocks by the A.W.B., from one marketing year to the next, has often been relatively stable for a number of years, there have also been periods when annual variations in the carryover stocks have been substantial - see, for example, Alaouze et al (1978), (Table 1, p176). It seems probable that such variations have been at least partly due to the logistical problems caused by above average crop sizes. However, Alaouze et al also suggest that the sharp build up in wheat stocks during the late 1960s may have been a reflection of the fact that the A.W.B. possessed some degree of price searching ability in the world wheat market in that period, and was reluctant to impose

additional downward pressure on wheat prices in order to increase export sales. In general then, while changes in the volume of wheat exports have undoubtedly absorbed a significant proportion of the variations in wheat production, active and passive stockholding by the A.W.B. has also been of some consequence, at least in some periods.

From this brief sketch it is clear that, from a microeconomic viewpoint, the marketing and institutional arrangements in the Australian wheat industry have differed substantially to the simple, hypothetical market structure outlined in Section II. However, from the viewpoint of the broader issues which are of concern at a macroeconomic level, there are some significant points of similarity between the two:

(i) since the establishment of the A.W.B. in 1948 (and, indeed, for many years prior to that), export sales, largely at given world prices, are likely to have absorbed a substantial proportion of the annual variations in wheat production;

(ii) changes in the volume of wheat production have had little bearing on the volume or value of wheat sales on the local market; and

(iii) changes in world wheat prices, or in the real exchange rate, have had a substantial impact on the real prices received by local wheat producers, and hence on real farm incomes.

The main points of departure between the two market structures, from a macroeconomic viewpoint, are that:

(i) in some periods, annual changes in the volume of wheat production have been at least partly absorbed by A.W.B. stocks in the short run. This is an issue not directly recognised or captured in the simple hypothetical market structure;

(ii) at least up until recently, changes in the export price of wheat, or in the real exchange rate, have had little, if any, bearing on the price of wheat paid by local consumers; and

(iii) an advance payment scheme has traditionally operated in the industry, funded, up until recently, by domestic credit creation. This clearly represents a direct linkage from the farm sector to an important macroeconomic variable - the domestic credit component of the high powered money stock - which is not explicitly recognised in the simple hypothetical market structure.

From a macroeconomic viewpoint, the Australian sugar industry shares a number of features in common with the wheat industry. It is a highly export oriented industry, with well in excess of 50 per cent of production being exported in most years in recent decades - see, for example, B.A.E. (1980). Like the wheat industry, the sugar industry has a relatively long tradition of centralised marketing, on both the domestic and export markets - although in the case of sugar, largely under the control of a public company, C.S.R., rather than a statutory marketing authority.[3] Also like

---

3 Controls on the volume of cane production have been imposed by sugar mills in some periods. The wheat industry also experienced a brief period of quota controls on production during the late 1960s.

wheat, the price of sugar sold on the domestic market has been legislatively determined and based, in part, on the assessed cost of sugar production in Australia - see, for example, Lawrence, Borrel and Tsolakis (1983), I.A.C. (1979).

On that basis, it is reasonable to conclude that:

(i) as is the case in the wheat industry, and as implied by the simple model in Section II, a major proportion of the shocks to the volume of sugar production have been absorbed via an appropriate change in the volume of sugar exports. The value of production, the value and volume of exports, and the level of real farm income would almost certainly move in the same direction as the volume of production, with little change in the value and volume of local sales;

(ii) changes in the local equivalent of the overseas price of sugar would result in some movement in the value and volume of sugar production, the value and volume of sugar exports and real incomes of sugar producers, all in the same direction as the price change. Because of the home consumption price arrangements, the impact of an overseas price change on these variables would, of course, be less precise than implied by the simple model. Also like the wheat case, but unlike the simple model, changes in overseas prices would have little bearing on the volume and value of domestic sales;

(iii) like the wheat case, but unlike the simple model, some proportion of the shocks to the volume of sugar production may be absorbed, in the short run, by changes in the volume of stocks held by C.S.R.;

(iv) unlike the wheat industry, the linkage between the volume and value of sugar production on the one hand, and the domestic credit component of the money supply on the other, has not been an issue in the sugar industry.

Section IV The Australian Wool Industry

Unlike the wheat industry, direct intervention in the Australian wool market by a statutory authority - the Australian Wool Commission, and more recently, the Australian Wool Corporation (A.W.C.) - has been only a relatively recent development, dating from the early 1970s. There was considerable discussion and debate about the establishment of some form of floor price/price stabilisation arrangements in the wool industry during the 1960s and early 1970s, which provided the motivation for some theorising by economists - see, for example, Duloy and Parish (1964), Duloy and Nevile (1965), Parish (1972), Lloyd (1972), Tisdell (1972, 1973), Chapman and Foley (1973). However, the final motivation for the establishment of the A.W.C. came from the sharp downturn in wool prices in the early 1970s.

The role of the A.W.C. has changed gradually over the period (see, for example, A.W.C.). Initially, the emphasis was on price stabilisation/buffer stockholding, but since the mid 1970s, the main role of the A.W.C. has been to implement the government guaranteed minimum average price for wool. Both roles, of course, have involved substantial stockholding in some periods.

While there is some uncertainty as to the extent to which Australia is a price taker on the world wheat market, the situation in the wool market is much clearer. It is generally recognised

that Australia plays a dominant role in the market, and, indeed, the "world" price for raw wool is often defined as the Australian auction price. This, of course, implies that the export demand curve for Australian wool is not perfectly price elastic. In fact, there is some degree of empirical support for the hypothesis that overseas demand for Australian wool is price inelastic - see, for example, Campbell, Gardiner and Haszler (1980), Horner (1952), Smallhorn (1973), Philpott (1955), Donald, Lowenstein and Simon (1963), Throsby and Rutledge (1977, 1979). It is interesting to note, however, that in an early study of some of the macroeconomic consequences of a hypothetical reserve price scheme for wool, Duloy and Nevile (1965) found it useful to consider both price elastic and inelastic demand for wool - see, also, Freebairn (1978).

We can now proceed to examine the broader implications of this marketing structure. Suppose that domestic demand for wool is negligible relative to the average level of Australian production, and that overseas demand is price elastic, but not perfectly so. Under such circumstances, an exogenous change in the volume of wool production would cause some change in the price. This, of course, would invalidate the assumption of a given price incorporated into the simple model in Section II. However, it is clear that the value of wool production, the value of wool exports, and real incomes accruing to wool producers would all move in the same direction as the volume of wool production. This more general result is consistent with the corresponding result which emerged from the simple model.

Alternatively, suppose that the exogenous change in wool production had been matched by an exactly offsetting change in the level of stocks held by the A.W.C., so that the change in production

did not result in any change in the price of wool. In this case, it is clear that the change in the value of production would be proportionate to the change in the volume of production, and that this would be largely reflected in the real value of farm incomes. However, the value and volume of exports, in the short run, would be unchanged. Such an outcome is similar to the one which was shown to be of relevance for the wheat industry in some periods, but was not recognised in the simple model.

Now suppose that the demand curve was price inelastic. In the absence of any offsetting action by the A.W.C., a change in the volume of wool production would cause the value of production and exports, and the real value of farm incomes, to move in the opposite direction to the change in the volume of production. This would represent a more significant violation of the results obtained from the simple model. Such an outcome, however, would be of relevance only for the wool industry, which produces a large proportion of world output. It seems highly improbable that any other major Australian agricultural industry would face a price inelastic demand on overseas markets.

The distinction between the cases of elastic and inelastic overseas demand is not relevant, for our purposes, where the change in wool production is completely absorbed in a change in A.W.C. stocks. In either case, the change in the value of production will be proportionate to the change in the volume of production, the change in the volume and value of production will be largely reflected in farm incomes, and the value and volume of exports will be unchanged.

We can now move on to consider some implications of exogenous overseas developments on the wool market. Unlike the simple model, it is clear that it does not make sense to consider an exogenous price change for wool on overseas markets flowing through to the Australian price. However, it is quite sensible to conceptualise an exogenous change in some argument in the demand function for wool in an overseas country, with this shift in demand then influencing the market clearing price in Australia. Suppose that such an 'exogenous' price change occurred, and was not met by a change in A.W.C. stocks. It can be easily verified that the analysis of an exogenous price change undertaken with the simple model in Section II would largely carry over to the present case regardless of whether overseas demand was price inelastic or price elastic. In other words, the value and volume of wool production would move in the direction of the price change, as would the value and volume of wool exports, and real farm income. Further, except in the extreme case where the change in demand was <u>completely</u> offset by a change in A.W.C. stocks, A.W.C. stockholding policy would not affect the direction of these movements - although the relative magnitudes of the changes in, for example, the value and volume of wool production and the value and volume of wool exports would be affected.

In the extreme case where all of the demand change was met by a change in A.W.C. stocks, then there would be no change in the wool price, no change in the value and volume of wool production, no change in real farm incomes, but a change in the value and volume of wool exports. Such an outcome could arise if, for example, a decline in overseas demand for wool were to occur in a period when the wool price was equal to its guaranteed minimum level.

On that basis, then, there are two points of broad similarity between the implications of the marketing and institutional arrangements in the wool industry, and the corresponding implications which emerged from the simple model:

(i) it is possible that a change in wool production could result in a change in the value of wool production, real farm incomes and the value and volume of wool exports in the same direction as the change in the volume of wool production; and

(ii) a change in the wool price could occur as a result of an exogenous change in overseas demand for wool, and the price change could then produce a change in the value and volume of production and exports, and real farm income, in the same direction as the price change.

The main points of departure from the implications of the simple model are that:

(i) an output change may be absorbed by a change in A.W.C. stocks, so that the output change is associated with a change in the value of production and real farm incomes in the same direction as the change in the volume of production, but with no change in the value or volume of exports. This is a feature shared in common with the wheat market;[4]

---

4 Of course, the basic motivation for absorbing output changes via changes in stocks is likely to have been different in the wool and wheat industries. In the wool industry, price support/stabilisation has been the major consideration whereas, in the wheat industry, logistical problems caused by above average harvests have probably been more important, with the possible exception of a relatively brief period in the late 1960s.

(ii) a change in the volume of wool production could be associated with a change in the value of production and exports, and in the level of real farm income, in the opposite direction to the change in the volume of wool production. Such an outcome would require the overseas demand for Australian wool to be price inelastic, and, at most, only limited intervention in the market by the A.W.C. This scenario would almost certainly not be shared by any other major Australian rural industry;

(iii) an exogenous change in overseas demand may be entirely absorbed by a change in A.W.C. stocks, in which case the price level, the value and volume of wool production, and the level of real farm income would be unaffected but the value and volume of wool exports would be changed.

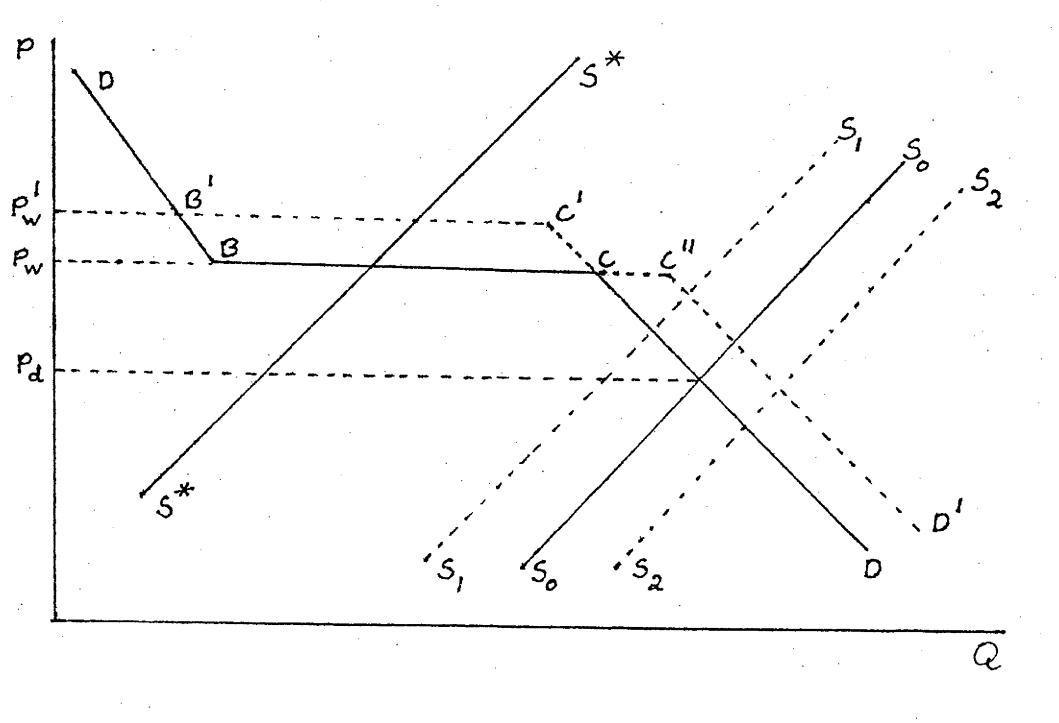
Section V The Australian Beef, Mutton and Lamb Industries

Unlike the Australian wheat and wool industries, the beef industry has traditionally operated in a marketing environment largely free of domestic government intervention, or involvement by some form of statutory authority. The suggestion of establishing a buffer fund scheme for beef has, however, been put forward on several different occasions and, while not being taken up, has motivated some debate amongst agricultural economists - see, for example, Parton (1978) and Bain (1978).

The lack of direct intervention in the beef market has not, however, ensured that the operation of that market, for our purposes, has closely replicated the simple model described in Section II. Firstly, beef is not an entirely homogeneous product. For example, it can be readily categorised into table beef and manufacturing quality beef, and the domestic market is a much more important outlet for the former than the latter - see, for example, Bain and Longmire (1980), Hinchy (1978), Harrison and Richardson (1980), B.A.E. (1982). Further, the main export markets for Australian beef - U.S.A., Japan and more recently, South Korea - each impose quotas on the volume of imports. In the high price markets, such as Japan, such import quotas would almost certainly represent an effective constraint on the volume of imports. The beef price differential between the U.S. and Australia, however, has tended to be less marked, so that it is not necessarily the case that the import quota imposed by the U.S. would be effective at all points in time. For more detail on these arrangements, see, for example, Reeves and Longmire (1982), Longworth (1976, 1978), Houck (1974), B.A.E. (1982).

It is instructive to assess some of the implications of these arrangements in the context of Figure II(2).

FIG.II(2)



In Figure II(2), S*S* and S_oS_o are two alternative, hypothetical positions for the Australian supply curve for beef. DBCD is the demand curve for beef facing Australian producers. The horizontal region in the demand curve represents the level of imports allowed into the U.S. market under quota. In particular, the length of the horizontal region, BC, represents the volume of the quota, and its height ie p_w, is the Australian equivalent of the U.S. price. The import quotas imposed by other, higher price markets, such as Japan, are not explicitly represented in the diagram, but could be readily conceptualised as shorter horizontal regions in DD at higher price levels than p_w. The lack of strict homogeneity between various grades of beef will be ignored for the moment.

Suppose that the relevant domestic supply curve for beef was S_oS_o. Also suppose that some exogenous shift occurred in its position to (say) S_1 S_1 or to S_2S_2. It is clear that the change in output would need to be absorbed on the domestic market, with an appropriate change in the relative price of beef on the domestic market, p_d. As the change in p_d would be in the opposite direction to the exogenous change in beef production, then the direction of the change in the value of beef production, and the direction of the change in the value of domestic sales of beef, may be in the same or in the opposite direction to the change in the volume of production - depending, of course, on the price elasticity of demand across the relevant arc of the demand curve. Further, as the overseas import quota is effective in this case, the volume of exports would be unchanged. Provided that the quota was held by domestic residents, the value of exports would also be unchanged and quota profits would rise or fall inversely with p_d. On the other hand, if the quota was held by an overseas resident, the value of the export revenue would rise or fall in line with the movements in p_d, while quota profits accruing to the overseas quota holders would again move inversely with p_d.[5]

Alternatively, suppose that the relevant domestic supply curve was S*S*. In this case, the import quota imposed by the overseas market would be ineffective. In other words, the market clearing price would be the local equivalent of the price on the export market, p_w, and the exportable surplus available at that price

---

5 The case of a domestically held quota is of relevance for beef exports to the U.S., while the institutional arrangements for beef exports to Japan and Korea conform more closely to the case of an overseas held quota.

would be less than the permissable level of exports under quota. Consider an exogenous movement in S*S* which left its point of intersection with DD somewhere in the horizontal region of DD. It is clear that the analysis undertaken with the simple model in Section II would carry over to this case. In other words, the change in the volume of production would be entirely absorbed in an equivalent change in exports, with no change in the price paid by domestic consumers or received by producers.

This latter scenario may be made a little more complex once some account is taken of the lack of strict homogeneity between the various grades and categories of beef. In particular, even where overseas import quotas are ineffective, sharp exogenous changes in the volume of beef production could still impose some pressure on the price of those grades of beef which are largely absorbed on the domestic market. The extent of such pressure, however, would almost certainly be less than in the case where overseas import quotas were effective and hence where the change in the volume of production needed to be absorbed entirely on the domestic market.

We can now proceed to consider some implications of an exogenous change in the price of beef on overseas markets. Suppose, initially, that the relevant supply curve was S*S*, so that the overseas import quota was ineffective. Also suppose that p_w increased to p_w^1, so that the demand curve became DB^1C^1D and hence the quota remained ineffective. It is clear that the change in p_w would flow through to the local price paid by domestic consumers and received by producers. The value and volume of production would change, as would the value and volume of local sales, and the value and volume of exports. In other words, the corresponding analysis undertaken with the simple model largely carries over to the present case.

Now suppose that the relevant supply curve was S_oS_o, so that the quota was effective in the initial situation. Also suppose that, as drawn in Figure II(2), the quota remained effective following the price change. It is clear that the price received by producers and paid by domestic consumers, and the volume and value of production and local sales would be unaffected. If the quota was held by domestic residents, then export revenue would rise or fall in line with movements in p_w. On the other hand, if the quota was held by overseas residents, export revenue would be unchanged ie. the overseas quota holders would continue to pay price p_d in order to obtain supplies on the domestic market.

As before, the fact that beef is not a strictly homogenous product would slightly complicate this analysis of an exogenous price change. In particular, in those cases where the quota was ineffective, so that a change in p_w flowed through to the domestic price, the extent of the change in the domestic price would tend to be relatively less for those grades of beef which are absorbed primarily on the domestic market.

In the analysis of the Australian wool market in Section IV, it proved useful to adopt a broader definition of 'exogenous overseas developments' than one which focussed simply on price changes on overseas markets. The same would seem to apply in the present case. In particular, as well as considering changes in p_w, it is also useful to consider changes in the size of the overseas import quota itself. The importance of examining this issue is further enhanced by the fact that the size of the import quotas imposed by the main markets for Australian beef have, in

fact, been varied quite sharply on a number of occasions - see, for example, Houck (1974), Longworth (1976, 1978).

In Figure II(2), a change in the size of the import quota could be represented by a lengthening or shortening of the perfectly elastic region of DD. Suppose that the relevant supply curve was S*S*, so that the quota was ineffective, and that it remained ineffective following the change in its size. In that case, the change in the size of the quota would have no bearing at all on the beef market. In other words, the price paid by domestic consumers and received by producers, the value and volume of production, the value and volume of domestic sales, and the value and volume of exports would be unaffected.

Suppose, however, that the relevant supply curve was S_oS_o, so that the original quota was effective, and that it remained effective following the change in the quota volume. It is clear that the change in the length of the horizontal region of DD would shift the position of DD for all price levels below p_w. In particular, an increase in the quota volume would shift DD to the right to (say) $DBC^{11}D^1$, placing upward pressure on p_d, and conversely. Such a change in p_d would carry largely the same implications as those identified for an exogenous change in the world price in the simple model in Section II. For example, a rise in p_d, following an increase in the quota volume, would raise the value and volume of production, lower the volume of domestic sales, have an ambiguous effect on the value of domestic sales, and be associated with an increase in the value and volume of exports.

Several other points, relating to the nature of the likely supply response in the beef industry, should be noted. Firstly, it

is intuitively appealing to conceptualise an exogenous decrease in beef production as being caused by, for example, a drought, and an exogenous increase in production as being associated with a recovery from drought. In reality, the converse may be more correct. In other words, a drought may be associated with an increase in beef production as cattle numbers are reduced, with beef production falling during the early part of a recovery from a drought as cattle are held off the market in order to increase breeding herds. This, of course, does not affect the preceding analysis because the exact cause of the exogenous shocks to production was not at issue.

A second issue, however, may be of more consequence. It is widely recognised that the beef supply response to a change in the relative price of beef may be perverse - see, for example, B.A.E. (1982). In other words, an increase in the beef price may lead to a decline in the volume of beef production in the short run as producers attempt to increase their cattle numbers, and conversely. Such an outcome could be readily incorporated into the analysis, but at the expense of some additional complexity - in particular, the supply curves would assume a negative slope. In any event, a more conventional supply response would probably remain relevant for exogenous price changes which were widely interpreted by producers as being only temporary.

In summary then, the operation of the Australian beef market would seem to share several features in common with the simple model examined in Section II:

(i) exogenous changes in beef production may, at least in some periods, be largely absorbed in exports, with only modest pressure on domestic beef prices;

(ii) changes in the export price of beef, may, at least in some periods, largely flow through to the prices paid by domestic consumers and received by producers; and

(iii) while the existence of effective import quotas on beef imposed by overseas markets is a possibility not recognised in the simple model, an exogenous change in the size of such quotas can result in changes in the domestic price of beef which, once established, carry largely the same implications as an exogenous change in the local equivalent of the world price, as examined in the simple model.

The main points of departure from the simple model are that:

(i) exogenous changes in beef production may, in some periods, be largely absorbed on the domestic market, requiring an appropriate change in the relative price of beef paid by consumers and received by producers. The volume of beef exports would be unaffected and, depending on whether the quota is held by domestic or overseas residents, export revenue may also be unaffected;

(ii) an exogenous change in the local equivalent of the price on overseas markets may have little bearing on the price paid by domestic consumers and received by producers, and hence on the volume and value of production and domestic sales. Export revenue may or may not be affected, depending on whether the quota was held locally or overseas.

Finally, the Australian mutton and lamb industries, while traditionally much smaller than the beef industry - see, for example, B.A.E. (1980), - have market structures which, for our purposes, are broadly similar to that of the beef industry. In particular, like beef, these industries are largely free of intervention in the local market.[6] While exports of mutton and lamb have been substantial, the local market has absorbed well in excess of 50 per cent of output in most years. In fact, the local market is of overwhelming importance to the lamb industry in all but the Spring months, when local production is at its peak. Further, access to export markets is subject to various restrictions and imperfections. In consequence, weather induced fluctuations in mutton and lamb production have often been largely absorbed on the domestic market, necessitating an appropriate change in relative prices. Exogenous overseas developments, however, can also exert some influence on the local mutton and lamb prices - for example, increased or reduced access to particular overseas markets, or the increased scope for exports of live sheep to the Middle East in recent years.

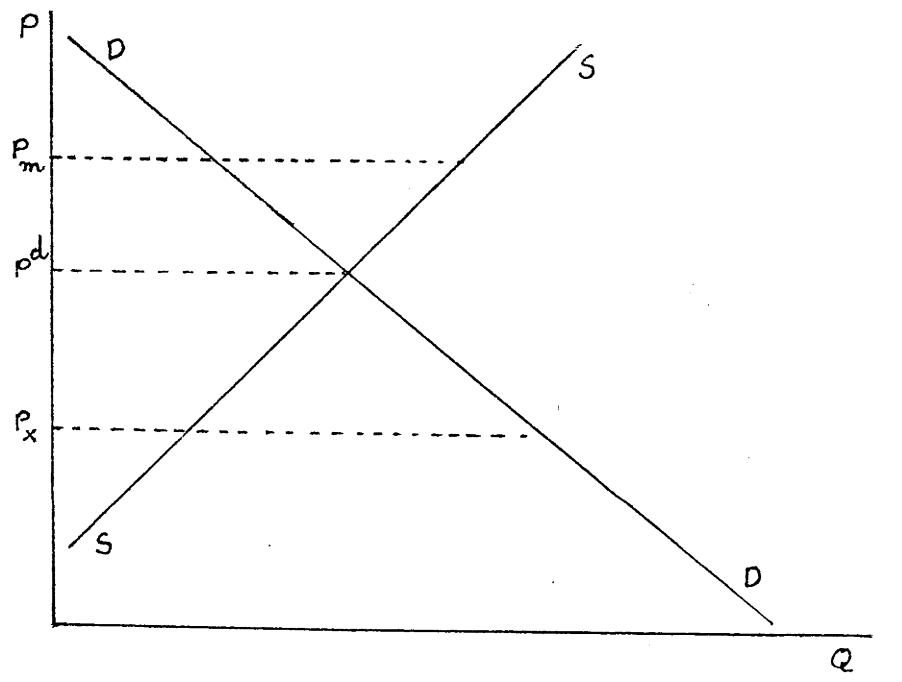
---

6. A degree of protection against imports from New Zealand has been provided and typically becomes effective during the non-Spring seasons of the year when local production experiences a relative decline.

Section VI Non-Traded Agricultural Commodities

It is interesting and instructive to consider a hypothetical market structure which is, in some sense, at an opposite extreme to that considered in Section II - in particular, the market structure of a non-traded commodity.

FIG.II(3)



In Figure II(3), DD is the domestic demand curve for the hypothetical commodity, and SS the domestic supply curve. p_m is the minimum price which would need to rule before imports of the commodity would be attracted. Similarly, exports would commence if the domestic price fell to p_x. For all market clearing prices between p_m and p_x - such as p^d in Fig.II(3) - the commodity would be non-traded.

For our purposes, such a market structure carries a number of important implications. Firstly, consider an exogenous movement in the position of the supply surve, SS. It is clear that, provided

the new market clearing price remained between p_m and p_x, the change in output would be absorbed entirely on the domestic market. The value of production and real farm incomes may move in the same direction, or in the opposite direction, to the change in the volume of production. The volume of domestic sales would move in line with the volume of production, but the direction of the movement in the value of sales would be ambiguous. Finally, of course, the value and volume of exports of the commodity would be unchanged at zero.

Alternatively, consider an exogenous change in p_m and/or p_x. Unless such a price change was large enough to violate the condition that $p_x < p^d < p_m$, then it would have no bearing at all on the market - the value and volume of production and sales would be unchanged, as would the level of real farm income.

Also, of course, shifts in the position of the DD curve could result in changes in p^d, and hence in the volume and value of production, the volume and value of sales, and real farm incomes. As noted in Section II, however, it seems reasonable to suppose that such shifts in the DD curve would be a less substantial source of instability in Australian agricultural industries than would short term movements in, for example, the SS curve.

In the light of the above discussion, non-traded agricultural industries can be approximately identified as those industries for which exports absorb, at most, only a negligible proportion of output, and for which imports satisfy, at most, only a negligible proportion of domestic demand.[7] On that basis, a number of the

---

7 Some industries, of course, may move regularly between the exportable and the non-traded category, depending on the season of the year. The most notable example is probably the lamb industry, as noted above.

relatively less important agricultural industries in Australia could be readily categorised as non-traded - see, for example, B.A.E. (1980). The list would include virtually all vegetable commodities - see, also, Jones (1982) - and a number of fruit commodities such as citrus and bananas. Some other important fruit industires are more difficult to classify. For example, exports of canned peaches, pears, apricots and pineapples have been of some significance, which would indicate that those industries more closely resemble the simple model of Section II, rather than the present paradigm of non-traded commodities. The grape industry also represents an interesting case. For some grape varieties, fresh sales on the local market are important. However, substantial quantities of other varieties are channeled into dried vine fruits, for which export outlets can be significant. The wine industry also absorbs large quantities of grapes. The wine industry, in turn, could be conceptualised variously as an import competing, non-traded or perhaps an exporting industry, depending on the geographic location, the grape variety and the season - see, for example, O'Mara (1981).

The intensive livestock industries in Australia would also seem to largely satisfy the criterion of the non-traded paradigm. Production of pigmeat and poultry meat has been heavily geared towards supplying the domestic market, with negligible export sales or import competition - see, also, for example, Bennett (1982), Griffith (1977). The egg industry has also been geared to the domestic market. However, unlike the pigmeat and poultry meat industries, the egg industry has traditionally been characterised by a complex set of administrative arrangements to control

production and prices - see, for example, Beck (1974), Hunter (1981), Yapp (1983), B.A.E. (1983). Exports of egg pulp have often occurred during certain times of the year - typically at prices well below those ruling on the domestic market. This outcome has been largely a reflection of the production of surplus eggs induced by the relatively high administered price for eggs on the domestic market.

It should be noted that the levels of production in these intensive livestock industries are, by virtue of their production processes which more closely resemble those of manufacturing industries, much less sensitive to short term variations in weather conditions than are most other Australian agricultural industries. This implies, of course, that supply side shocks are likely to be less important as a source of instability in these industries.

Finally, it is interesting to observe that the authors of the Rural Green Paper - see Harris et al (1974) - when discussing some general issues associated with production and price variability in the Australian rural sector, emphasised the likelihood of a strong inverse relationship between movements in production and in prices. This would seem to suggest that they were basing their analysis, at least in part, on the non-traded paradigm:

> 'In Australia, and in all other high income countries, the demand for farm products is generally unresponsive to price changes; this is increasingly so as living standards rise. Admittedly, for some products, especially those for which there are close substitutes, demand is quite responsive to price changes; for example, pigmeats in Australia. But the responsiveness of pigmeat consumption results from consumers substituting pigmeats for other meat or vice-versa, with total meat consumption being relatively unresponsive to changes in the general level of meat prices. Similarly, total food consumption is fairly constant, so that in years when most farm industries have favourable (unfavourable) seasons, the general level of farm prices often falls (rises) quite sharply.' (p58, para 4.10)

Section VII The Dairy Industry

The dairy industry has traditionally been one of the more highly protected of Australia's agricultural industries, operating under a complex regime of market intervention - see, for example, Parish (1962), Parish and Kerdpibule (1968), Lewis (1972), I.A.C. (1975, 1976), Barrett (1981), Albon (1976). While significant exports of dairy products have occurred over recent decades - see B.A.E. (1980) - there is some suggestion that, stripped of the various forms of intervention in the market, the dairy industry could be an import competing industry - see Parish (1962).

For our purposes, there are several important features of these dairy marketing arrangements. Firstly, the price of fluid milk sold in the main metropolitan markets has traditionally been administratively determined, and set at a level substantially in excess of the price paid for milk used for manufacturing purposes. To limit the supply of fluid milk forthcoming at these administered prices, supplies have typically been drawn from only a limited number of dairy farms, under a quota arrangement.

Milk used for manufacturing purposes has attracted a substantially lower price than that for fluid milk. Nevertheless, the manufacturing milk price has traditionally been supported by a high level of protection from imported dairy products. For a time, a measure of protection was also provided against a major dairy substitute, margarine. In addition, substantial direct subsidies to dairy farmers have been paid over lengthy periods.

While the marketing and institutional arrangements in the dairy industry have been very complex at a microeconomic level, the broader macroeconomic implications are, fortunately, reasonably clear:

(i) as was the case in the simple model in Section II, there has been at least some scope for exogenous changes in the volume of milk production to be absorbed in changes in the volume of exports of dairy products, with little pressure on the value and volume of local sales of dairy products;

(ii) to the extent that the export market for Australian dairy products is imperfect, there may also be some buffering role played by stocks of manufactured dairy products in the short run;

(iii) to the extent that administered prices of fluid milk are based, in part, on the assessed cost of milk production in quota areas, then sharp changes in seasonal conditions may have some influence on the fluid milk price;

(iv) the value and volume of dairy production, the value and volume of dairy exports, and real farm incomes would be affected, to some extent, by exogenous changes in the overseas prices of dairy products, and probably in the conventional direction implied by the simple model in Section II. The relative magnitudes of such effects, of course, would be substantially distorted compared to the very straight forward linkages implied by the simple model. As was also the case for wheat and sugar, the local prices paid by domestic consumers for either fluid milk, or for manufactured dairy products, would be minimally affected by such overseas price developments.

Section VIII The Five Paradigms

It is clear that, from a microeconomic viewpoint, few, if any, of Australia's major agricultural industries operate under a regime of marketing and institutional arrangements which closely resemble the simple, hypothetical market structure set out in Section II. However, from our macroeconomic viewpoint, there are several broad implications of the simple model which are shared, at least to some degree, by the actual workings of the market structure in a number of Australia's rural industries:

(i) in the simple model, exogenous changes to the volume of production are largely absorbed by an appropriate change in the volume of exports, with no significant pressure on prices, and hence with no significant change in the volume and value of sales on the domestic market. The value of production, the value of exports and real farm incomes move in the same direction as the change in the volume of production. Such a scenario would seem to be a reasonable description of the actual workings of the wheat, sugar, beef, mutton and lamb, dairy and some horticultural industries, at least in some periods. In addition, while an exogenous change in the volume of wool production would, ceteris paribus, impose significant pressure on wool prices, it is not inconceivable that the more general conclusion - that the value of production and exports, and real farm incomes, would move in the same direction as the volume of production - would remain valid. It would seem useful, therefore, to consider the macroeconomic

implications of a paradigm where an exogenous shock to the volume of farm production occurs and is absorbed entirely by exports at unchanged prices. This will be referred to as the 'first paradigm', and will be considered in detail in Chapter III;

(ii) in the simple model, an exogenous change in the local equivalent of the overseas price of farm commodities would cause the value and volume of production, the value and volume of exports, and real farm incomes, to move in the same direction as the change in price. The volume of local sales would move in the opposite direction to the change in price, and the change, if any, in the value of local sales would be ambiguous. Such a scenario is a reasonable description of the outcome in the beef, mutton and lamb industries in some periods. Further, if a broader definition of exogenous overseas developments was adopted, which included changes in some arguments in overseas demand functions for Australian farm produce, or changes in the volume of imports allowed in under quota, such a scenario would become even more relevant for the beef, mutton and lamb industries, as well as becoming relevant for the wool industry. In several other industries, such as wheat, sugar and dairying, such overseas developments can influence the volume and value of production, the volume and value of exports, and real farm income, in the conventional direction but have little, if any, bearing on the volume and value of local sales. Despite this

latter qualification, it would seem useful to consider a paradigm where an exogenous change occurs in the local equivalent of the overseas price of farm commodities, and which flows through into the value of production and exports, the value and volume of local sales, and real farm incomes. This will be referred to as the 'fourth paradigm' and will be taken up in Chapter VI.

In addition, there are several important scenarios which we have seen to be relevant to at least some farm industries, but which were not explicitly identified in the context of the simple model:

(iii) an exogenous change in the volume of farm production may need to be absorbed entirely on the domestic market, requiring an appropriate change in the domestic price of farm commodities - in other words, there is no change in the volume of exports, and no buffer stockholding. The value of production, the value of local sales and real farm incomes may move in the same, or in the opposite, direction to the change in the volume of production. Such a paradigm is relevant for non-traded agricultural commodities - for example, a wide range of horticultural commodities, and several intensive livestock industries. It is also likely to be relevant for the beef, mutton and lamb industries in some periods - for example, when constraints on the volume of exports to the main overseas markets are effective. This will be referred to as the 'second paradigm', and is taken up in Chapter IV;

(iv) in a number of farm industries, short term changes in the volume of production are, in some periods, likely to be at least partly absorbed in buffer stocks. The value of production and real farm incomes would move in the same direction as the volume of production, while the value and volume of exports and non-inventory sales on the domestic market would be largely unchanged. This paradigm, which will be referred to as the 'third paradigm', and which is taken up in Chapter V, is relevant to the wheat and wool industries in some periods and, perhaps to a lesser extent, the sugar and dairying industries;

(v) there has been, until recently, a direct linkage between changes in the value and volume of wheat production and changes in the domestic credit component of the high powered money stock. As we shall see in Chapter VII, this issue has been the subject of some debate in policy circles, and a significant change in the policy stance adopted by the monetary authorities has occurred in recent years. In view of this, it would seem useful to examine a paradigm - the 'fifth paradigm' - in which an advance payment scheme for a farm commodity is explicitly introduced, and the macroeconomic implications of the various alternative means of financing that advance payment are considered. The 'fifth paradigm' is taken up in Chapter VII.

It is clear, of course, that these five paradigms do not exhaust the range of potentially interesting and important issues identified in the review of the marketing and institutional

arrangements in the various rural industries, undertaken in the present chapter. For example, amongst the issues which have been noted but which will not be developed further are:

(1) the possibility that an exogenous change in the volume of wool production could, in some periods, result in a more than proportionate change in the wool price, so that the value of production and exports, and real farm incomes, would move in the opposite direction to the change in the volume of wool production and the volume of wool exports;

(2) the possibility that the value of farm exports may change, with no impact on the volume and value of production or domestic sales, or the level of real farm income. Such an outcome could be of relevance to the wool industry in some periods - for example, if an exogenous change in overseas demand for wool was met entirely out of A.W.C. stocks. It could also be relevant for the beef, mutton and lamb industries - for example, if a change in the local equivalent of the overseas prices of those commodities was to occur in the presence of an effective constraint on the volume of exports and if export quotas were held by local residents.

The decision not to expand further upon such cases is not to deny their potential importance. Rather, it is a reflection of time and space limitations within the context of the thesis, and the judgement that the five paradigms actually taken up may be of relatively more importance. Of course, these remaining issues could be readily examined within the model framework developed in the thesis, as part of a future research project.

CHAPTER III

MODEL I: PHILOSOPHY, STRUCTURE AND SOME ANALYSIS OF THE FIRST PARADIGM

Introduction

In Chapter II, in the light of a review of the marketing and institutional arrangements which have operated in Australia's major farm industries, five paradigms, relating to shocks originating in the farm sector, were identified and put forward for further analysis. These paradigms differed in either the nature of the shock in the farm sector, or in the broad features of the marketing and institutional arrangements in the relevant farm industries. In the present chapter, we will focus on the first, and perhaps the most simple, of these paradigms. In particular, we will consider the case of an exogenous shock to the volume of farm production in the presence of a perfect residual export market.

The shock in the farm sector could be conceptualised as any influence which results in a sharp, and relatively short term, change in the farm production function - for example, a drought, a recovery from an existing drought, or perhaps the advent of above average seasonal conditions. The assumption of a perfect residual export market means that any part of the change in the volume of farm production which is not absorbed voluntarily on the domestic market, at given prices, would be absorbed on the export market at given prices. In Chapter II, it was argued that such a paradigm is likely to be of <u>some</u> relevance for the wheat, sugar, beef, mutton and lamb, dairy and some of the horticultural industries, at least in some periods.

The plan of the remainder of this chapter is as follows.

In Section II, the broad philosophy and structure of the macro-economic model to be used in the analysis, Model I, is presented and discussed. Most of this discussion, of course, is also relevant for the other versions of the model - Models II, III, IV and V - which are used in subsequent chapters to analyse the four remaining paradigms. It is also largely relevant for the theoretical simulation variants of Model I and Model II, which are developed in Chapter X and O'Mara et al (1985) respectively and which, amongst other things, allow a more rigorous and complete analysis of the first and second paradigms.

As a point of departure, and for reasons of clarity and ease of exposition, the analysis presented in Section III abstracts from explicit balance of payments considerations and from movements in wages and non-farm prices. In Section IV, the analysis is extended by incorporating explicit balance of payments considerations. Then, in Section V, the analysis is further extended by endogenising nominal wages and non-traded goods prices.

In each of these three sections, III to V, a similar modus operandi is adopted. Firstly, the structure of the relevant variant of Model I is set out algebraically. In each case, the model proves to be too large and complex to manipulate using strictly formal algebraic techniques. Therefore, a geometric characterisation of each variant of the model is presented which, while being less rigorous than an algebraic approach, is conducive of some useful and enlightening analysis. The implications of the first paradigm are then analysed within these geometric frameworks.

Finally, Section VI contains some concluding remarks.

Section II Philosophy and Structure of the Model

It is assumed that the farm sector of the model can be characterised as the aggregate of a group of price taking producers operating in the presence of a perfect residual export market for farm output. This, of course, is the specification dictated by the first paradigm.

There are two main complications built into this largely classical structure. Firstly, it is assumed that the volume of gross fixed capital formation in the farm sector is influenced, in the short run, by the level of farm internal liquidity or 'residual funds'. As we shall see in Chapter VIII, there is an extensive theoretical and empirical literature, both in Australia and overseas, supporting the significance of such a relationship. Secondly, a separate consumption function is specified for the farm sector in order to reflect the finding in the literature, again as reviewed in Chapter VIII, that the short run response of farm households to a change in measured income may differ to that of non-farm households.

In the non-farm sector of the model, a distinction is drawn between the non-farm traded goods sector, and the non-traded goods sector. The former could be conceptualised as the aggregate of non-farm exporting industries and import competing industries. It is assumed that, like the farm sector, the non-farm traded goods sector operates along neo-classical lines. In particular, producers take as given the local equivalent of the prices ruling on overseas markets, and set their output and employment so as to maximise profits, given their capital stock, the state of technology and the real wage. This implies, of course, that production of non-farm traded goods is independent of the level of demand for non-farm traded goods in the domestic economy, other factors unchanged.

A sharp distinction exists between the philosophy underlying the farm and non-farm traded goods sectors on the one hand, and the non-traded goods sector on the other. Using the classification suggested by Corden (1978), the philosophy underlying the non-traded goods sector could be described as 'Popular Keynesian', rather than 'General Theory Keynesian' or 'Classical'. It is assumed that, in general, the non-traded sector of the economy is dominated by firms possessing at least some price searching capability, and that there are some (unspecified) rigidities in price movements in response to a change in demand for non-traded goods in the short run. This implies that the level of output and employment in the non-traded goods sector is not necessarily consistent with simple, classical optimising behaviour at all points in time. Within this general framework, it could be assumed that non-traded goods prices are either completely unresponsive to demand changes, or are only partially responsive. In much of the analysis undertaken in Chapters III to VII the former assumption is adopted for simplicity. The main exception is the analyses undertaken in Section V of the present chapter. Of course, when we move on to consider the theoretical simulation variant of Model I, in Chapter X, we will be able to assess a variety of assumptions as to the degree of responsiveness of non-traded goods prices.

There now exists a wide body of literature on rationed equilibrium theory, which has largely succeeded in placing this 'Popular Keynesian' approach on a firm theoretical base. Some of the important contributions to this literature include Clower (1965), Barro and Grossman (1971, 1976), Malinvaud (1977), Muellbauer and Portes (1978) and more recently, Backhouse (1980) and Roberts (1982). Useful reviews of the literature in this area have been provided by Drazen (1980) and Gordon (1981). Much of this work has taken as

given the existence of price rigidities. However, there has also emerged a significant literature attempting to provide a theoretical rationale for such price rigidities - see for example, Gordon (1981) and Blinder (1982).

Most of the early rationed equilibrium literature focussed on closed economy models. However, in two important papers, Dixit (1978) and Neary (1980) extended the approach to models of an open economy. They emphasised that the distinction between traded and non-traded goods is likely to be particularly important in rationed equilibrium theory. More specifically, the theory is likely to be more relevant to the non-traded goods sector of an open economy, where producers are likely to have some price searching ability, than for the traded goods sector where prices are strongly influenced by overseas developments and where imports and exports tend to serve as residual or balancing items. For present purposes, the importance of the Dixit and Neary analyses is that they established the theoretical basis for macroeconomic models of an open economy in which the specification of the non-traded goods sector is 'Popular Keynesian' and the traded goods sector is 'Classical'.

Theoretical models of an open economy which adopt such a combination of 'Popular Keynesian' and 'Classical' philosophies in their specification are relatively uncommon in the literature. However, two recent and important applications are Gordon (1977) and Grossman, Hanson and Lucas (1982). The model developed in the present thesis is very close, in spirit, to those two models.

In the present model, it is assumed that nominal wages move in line with expected movements in consumer prices, modified to some extent by the presence of a gap between the actual level of employment, and the 'natural' level of employment. The natural level of employment is defined as that level which encourages trade unions to

seek, or accept, movements in nominal wages just sufficient to compensate for expected movements in consumer prices. Therefore, there is no necessary presumption that the natural level of employment would accord with a more general definition of full employment. In much of the ensuing analysis in Chapters III to VII - with the exception of Section V of the present chapter - it is assumed, for simplicity, that there is no response of wages to a gap between the actual and the natural level of employment. As actual and expected consumer prices are assumed to be fixed, this implies that the nominal and the real wage are also fixed. A range of non-zero responses are considered in the theoretical simulation variant of Model I, in Chapter X.

This approach to price/nominal wage dynamics is consistent with the 'Popular Keynesian' view of the Phillips Curve relationship - see, for example Lipsey (1981), Laidler (1981), Tobin (1980, 1981), Meade (1981), Okun (1980), Sutton (1981), and the review of various theories of inflation presented by Laidler and Parkin (1975). Short term variations in output and employment are viewed primarily as 'Popular Keynesian' quantity adjustments in the face of shocks to the level of aggregate demand - these quantity adjustments then creating pressure for gradual adjustment of wages and prices.

Hargreaves Heap (1980) has argued that there is wide acceptance of the Phillips Curve concept amongst economists and that acceptance owes much to the existence of alternative explanations for the relationship which are acceptable to the various schools of economic thought. For example, neo-classical economists would typically assume that, in the present contect, non-traded goods prices were perfectly flexible in response to changes in demand for non-traded goods. Therefore, producers in the non-traded goods sector would always be operating at their classical, profit maximising optimum level of output and employment. The level of output and employment would vary

significantly in the short run only to the extent that some imperfection in the labour market forced the real wage to move away from its full employment level in the face of a shock to aggregate demand - for example, because wage demands were based on adaptively formed price expectations,or because of multi-period nominal wage contracts. Laidler and Parkin (1975) review much of the literature in this area - see also Laidler (1981), Pitchford (1981), Nelson (1981), Brecher and Heady (1979), Lucas (1980, 1981), McCallum (1980), Fellner (1980), Azariadis (1981), Begg (1982), Dickinson, Driscoll and Ford (1982), Sargent and Wallace (1975).

Given the lack of consensus in the literature as to the validity of the 'Popular Keynesian' assumptions versus the neo-classical assumptions in short to medium term analyses, it would be interesting to replicate the present exercise with a neo-classical specification for the non-traded goods sector and labour market. However, this will be left to a later date or to other researchers.

The other main issue which warrants discussion is the treatment of the balance of payments in the model. In much of the analysis presented in Chapters III to VII and X, the state of the balance of payments is endogenously determined. In general, it is assumed in those analyses that the nominal exchange rate is fixed, international capital flows are responsive to interest rate differentials - but insufficiently so to ensure interest rate parity at all times - and that expected exchange rate movements are zero.

There are several reasons for the choice of a fixed nominal exchange rate in the model. Firstly, this seems to be the most realistic characterisation of the actual Australian experience over recent decades. Even following the significant change in Australian exchange rate policy in 1976 - see, for example, Reserve Bank of

Australia (1976) - movements in the nominal exchange rate have been insufficient to avoid substantial short term surpluses and deficits in the balance of payments. Secondly, the inclusion of flexible nominal exchange rates in macroeconomic models tends to produce several technical problems. It becomes necessary to endogenise expected movements in the exchange rate, and it seems sensible to assume that foreign exchange markets are efficient, and that expectations in that market are formed rationally - see, for example, Caves and Feige (1980), Turnovsky and Ball (1983) and Frenkel (1981). However, the combination of flexible exchange rates, interest rate parity and rationally formed expectations of exchange rate movements are likely to result in dynamic instability in the model - see, for example, Turnovsky and Kingston (1977, 1979), Gray and Turnovsky (1979), Turnovsky (1981, 1983), Bhandari (1981). Dornbusch (1976) demonstrated that, even with regressively formed exchange rate expectations, the phenomenon of exchange rate overshooting was likely to emerge. On a different plane, Levin (1980) demonstrated that the current account may also contribute substantially to instability or volatility under a flexible exchange rate regime, particularly in the presence of short-term 'J-curve' effects.

These sorts of problems, of course, do not, in themselves, justify the decision to adopt a fixed nominal exchange rate in the present model. However, in view of the relevance of the fixed exchange rate assumption to the past Australian experience - and hence to analyses of historical data - and the problems which could emerge under an alternative, flexible exchange rate specification, it was considered prudent to concentrate on the fixed exchange rate case in the first instance. Further, the fixed nominal exchange rate does not prevent movements in the real exchange rate from occurring within the model. It also permits an examination of the five paradigms, identified in Chapter II, in a model framwork which

is consistent with the monetary approach to the balance of payments. Finally, the inclusion of a more flexible exchange rate regime would represent an interesting and important avenue for future development of the model, particularly in view of the change in the procedure for determining the Australian exchange rate which occurred at the end of 1983.

The assumptions made with respect to the degree of international capital mobility also warrant some comment. In Chapters III to VII, consideration is sometimes given to both of the cases of perfect and imperfect capital mobility. However, where the case of perfect capital mobility is considered, this is largely treated as a useful point of departure, rather than as an end in itself. In the theoretical simulation analysis in Chapter X, imperfect capital mobility is assumed throughout.

The literature does not provide clear guidance on the most appropriate assumption as to the degree of capital mobility. Porter (1974) estimated that the effects of changes in the domestic credit component of the money supply in Australia were rapidly dissipated through offsetting balance of payments deficits or surpluses. Such a finding is suggestive of international capital flows which are very responsive to interest rate differentials. However, subsequent work has suggested that the speed at which these offsetting monetary movements occur, as estimated by Porter, may have been overstated, at least to some extent - see Hunt and Valentine (1978), Porter (1978), Pope (1979). Various overseas studies have suggested very substantial, but less than perfect, capital mobility in the short to medium term - for example, Feldstein and Horioka (1980), Beenstock and Longbottom (1981), Kreicher (1981). Amongst the recent theoretical models, an assumption of perfect capital mobility is common -

for example, Turnovsky and Kingston (1977, 1979), Gray and Turnovsky (1979), Roper and Turnovsky (1980), Turnovsky (1981, 1983), Burton (1980). An exception, however, is Bhandari (1981).

With this background to the philosophy and structure of the model, we can now proceed to consider the specification of the model in detail and to undertake some analysis.

Section III The Specification of Model I and Some Analysis

III (1) Notation

The notation used to present the algebraic specification of Model I is set out below. A consistent notation is used, as far as practicable, throughout the thesis.

Z - aggregate real final expenditure

Z_{NFT} - that component of Z directed onto non-farm traded commodities

Z_F - that component of Z directed onto farm commodities

Z_{NT} - total demand for non-traded goods, including both final and intermediate expenditures.

C_P - real private consumption expenditure

C_P^{NF} - real private consumption expenditure originating from non-farm households

C_P^F - real private consumption expenditure originating from farm households

C_G - real government consumption expenditure

I_P - real private investment expenditure

I_P^{NF} - real private investment expenditure in the non-farm sector

I_P^F - real investment expenditure by unincorporated enterprises in the farm sector

I_G - real government investment expenditure

R - farm 'residual funds'

Y - aggregate volume of final production

Y_{NFT} - the volume of production of non-farm traded goods

Y_{NT} - the volume of production of non-traded goods

Y_F - real gross farm product (i.e. real value added in the farm sector)

J - the volume of non-primary (ie. intermediate) inputs used in the farm sector and assumed to be drawn entirely from the non-traded goods sector

O_F - the gross volume of farm production

Y_F^{NF} - that part of real gross farm product which accrues to non-farm households

Y_F^{F} - that part of real gross farm product which accrues to farm households

K_{NFT} - the capital stock employed in the non-farm traded goods sector

K_F - the capital stock employed in the farm sector (which, for simplicity, is assumed to include a land component)

K_{NT} - the capital stock employed in the non-traded goods sector

α_{NFT} - the state of technology in the non-farm traded goods sector

α_F - a shift factor, representing the state of weather and the the state of technology in the farm sector

α_{NT} - the state of technology in the non-traded goods sector

L - aggregate demand for labour

E - aggregate employment

L_{NFT} - the demand for labour in the non-farm traded goods sector

L_F - the demand for labour in the farm sector

L_{NT} - the demand for labour in the non-traded goods sector

L_{NT}^{*} - the profit maximising level of L_{NT}

L_{NT}^{D} - the level of L_{NT} in the presence of an effective constraint on the demand for non-traded goods

L^S - the supply of labour

v - a real wage 'unit', defined as 'a' units of non-traded goods, 'b' units of non-farm traded goods, and 'c' units of farm goods, where a, b and c are constants

n - the real wage, defined as the number, n, of real wage units, v.

p_{NFT} - the price of non-farm traded goods

p_F - the price of farm goods on the domestic market

p_{NT} - the price of non-traded goods

r - the nominal interest rate

m^D - the demand for nominal money balances

m^S - the supply of nominal money balances

w - the nominal wage

ε - a preference mapping which can be used to separate aggregate real final expenditure into those components which are directed onto non-farm traded goods, farm goods, and non-traded goods.

Finally, in setting out the algebraic structure of the model, signs have been accorded to the variables to indicate the assumed sign of the ordinary partial derivatives.

III (2) Model Specification

Farm Sector

As a starting point for the model, we can specify a production function for the farm sector:

$$(1) \quad O_F = O_F(\overset{+}{K_F}, \overset{+}{L_F}, \overset{+}{J}, \overset{+}{\alpha_F})$$

Noting that K_F, J and α_F are assumed to be exogenous to the model, the demand for labour in the farm sector (or equivalently, farm employment) is assumed to be determined according to a conventional, profit maximising process:

$$\frac{\delta O_F}{\delta L_F} \cdot p_F = n.(ap_{NT} + bp_{NFT} + cp_F)$$

and hence, in general

$$(2) \quad L_F = L_F(\overset{+}{\frac{\delta O_F}{\delta L_F}}, \overset{+}{\frac{p_F}{p_{NT}}}, \overset{+}{\frac{p_F}{p_{NFT}}}, \overset{-}{n}, \overset{?}{v})$$

where $\frac{\delta O_F}{\delta L_F}$ is the marginal physical product of labour in the farm sector, and the terms $\frac{p_F}{p_{NT}}$, $\frac{p_F}{p_{NFT}}$, n and v combine to determine the real wage as a cost to farm employers. In particular, given v and n, the real wage as a cost to farm employers will be lower the higher is p_F relative to p_{NT} and p_{NFT}.

Given O_F and J, then gross farm product (or value added in the farm sector) is determined from the identity:

$$(3) \quad Y_F = O_F - J$$

Note that, for simplicity, J is assumed to be drawn entirely from the non-traded goods sector, i.e. farm and non-farm traded commodities are assumed to be of negligible importance as intermediate inputs in the farm sector.

It is assumed that Y_F accrues partly to farm households, and partly to non-farm households:

(4) $Y_F^F = \beta Y_F$ where β is some constant factor of proportionality.

(5) $Y_F = Y_F^F + Y_F^{NF}$

Y_F^F could be broadly conceptualised as the return to labour supplied by farm owner operators, and the return to land and fixed capital employed in the farm sector and owned by farm households. Similarly, Y_F^{NF} could be conceptualised as the return to hired labour in the farm sector, interest payments by farm households on funds borrowed from off farm sources and rents paid to landowners in the non-farm sector.

Consumption expenditure by farm households is assumed to be a function of Y_F^F and the interest rate, r (noting, of course, that with all prices fixed, the real and the nominal interest rate are identical).

(6) $C_P^F = C_P^F(\overset{+}{Y_F^F}, \overset{-}{r})$

Farm residual funds are determined from the identity:

(7) $R = Y_F^F - C_P^F$

Finally, it is assumed that the volume of gross fixed capital formation in the farm sector is a function of the interest rate and farm residual funds:

(8) $I_P^F = I_P^F(\overset{+}{R}, \overset{-}{r})$

Equation (8) could be conceptualised as a very simple reduced form of some largely classical investment model, but one which allows some role for residual funds to influence farm capital formation in the short run.

This basic specification of the farm sector is employed, with only minor modifications, in each of the theoretical variants of Models I, II, III, IV and V in Chapters III to VII. The broad thrust of the specification is also utilised in the theoretical simulation variant of Models I& II in Chapter X and O'Mara et al(1985). In the latter cases, however, some additional detail is also provided. For example, the usage of non-primary inputs in the farm sector, J, is determined endogenously, and the separation of Y_F into its Y_F^F and Y_F^{NF} components is endogenised more rigorously. An attempt is also made to provide a structural basis for the specification of farm investment, I_P^F.

The eight variables which are treated as endogenous to the farm sector in the present specification are:

(1) O_F (2) L_F (3) Y_F (4) Y_F^F (5) Y_F^{NF} (6) C_P^F (7) R (8) I_P^F

The variables impinging upon the farm sector of the model which are exogenous to the model as a whole are:

(1) K_F (2) J (3) α_F (4) p_F (5) p_{NFT} (6) p_{NT} (7) v

In addition, the interest rate, r, is exogenous to the farm sector of the model but endogenous to the non-farm sector.

Non-Farm Sector and Macroeconomic Aggregates

Aggregate production in the economy is obtained by summing the outputs of the three sectors identified in the model:

(9) $Y = Y_{NT} + Y_{NFT} + Y_F$

Y_F has been determined endogenously within the farm sector of the model. The task, then, is to determine Y_{NFT} and Y_{NT}. We can specify a production function for the non-farm traded goods sector:

(10) $Y_{NFT} = Y_{NFT}(\overset{+}{K}_{NFT}, \overset{+}{L}_{NFT}, \overset{+}{\alpha}_{NFT})$

It is assumed, for simplicity, that the non-farm traded goods sector does not draw any non-primary inputs from either of the other sectors of the model, so that the gross output of non-farm traded goods is equal to value added in that sector. The demand for labour (or, equivalently, employment) in the non-farm traded goods sector is assumed to be a function of the marginal physical product of labour in that sector, and the real wage as a cost to employers.

$$(11) \qquad L_{NFT} = L_{NFT}\left(\overset{+}{\frac{\delta Y_{NFT}}{\delta L_{NFT}}}, \overset{+}{\frac{p_{NFT}}{p_{NT}}}, \overset{+}{\frac{p_{NFT}}{p_F}}, \overset{-}{n}, \overset{?}{v}\right)$$

Equations (10) and (11) are consistent with the assumed 'classical' operation of the non-farm traded goods sector. Producers in that sector continually operate at their classical, profit maximising level of output and employment. With other factors unchanged, output and employment is largely independent of the level of demand for non-farm traded goods in the domestic economy. Any divergence between Y_{NFT} and local demand for non-farm traded commodities, Z_{NFT}, is implicitly assumed to be absorbed in an (unspecified) non-zero trade balance.

Similarly, we can specify a production function for the non-traded goods sector:

$$(12) \qquad Y_{NT} = Y_{NT}(\overset{+}{K_{NT}}, \overset{+}{L_{NT}}, \overset{+}{\alpha_{NT}})$$

We again assume, for simplicity, that no non-primary inputs are used in the non-traded goods sector, so that there is no requirement to distinguish between gross output and value added in that sector.

Our popular Keynesian view of the non-traded goods sector requires the specification of a rather complex demand for labour function in that sector. In particular, we need to specify a classical demand for labour function which would be relevant in the long run, or where there was no effective constraint on the demand

for non-traded goods, and a 'Popular Keynesian' demand for labour function which is relevant in the short run in the presence of an effective demand constraint.

$$(13) \qquad L_{NT} = \begin{cases} L_{NT}^{*}\left(\overset{+}{\frac{\delta Y_{NT}}{\delta L_{NT}}}, \overset{+}{\frac{p_{NT}}{p_{NFT}}}, \overset{+}{\frac{p_{NT}}{p_{F}}}, \overset{-}{n}, \overset{?}{v}\right) & \text{for } Z_{NT} = Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) = Y_{NT}^{*} \\ L_{NT}^{D}\left(\overset{-}{K_{NT}}, \overset{-}{\alpha_{NT}}, \overset{+}{Z_{NT}}\right) & \text{for } Z_{NT} \neq Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) \end{cases}$$

The first part of (13) i.e. $L_{NT} = L_{NT}^{*}$, is identical in structure to the demand for labour functions assumed in the farm and non-farm traded goods sectors. In other words, it is a classical, profit maximising demand for labour function. However, it is constrained to apply only to circumstances in which the total demand for non-traded goods, Z_{NT}, is equal to the classical, profit maximising level of Y_{NT}, Y_{NT}^{*}. If $Z_{NT} \neq Y_{NT}^{*}$ then L_{NT} takes on the 'Popular Keynesian' structure i.e. $L_{NT} = L_{NT}^{D}$.

Note that, in the 'Popular Keynesian' component of L_{NT}, Z_{NT} appears as an argument. In other words, given K_{NT} and α_{NT}, the effective constraint on output and employment in the non-traded goods sector is the demand for non-traded goods, and not the real wage as a cost to employers, as is the case in L_{NT}^{*}. This is reflected in the assumed signs of the ordinary partial derivatives of L_{NT}^{D} with respect to K_{NT} and α_{NT}. An increase in either K_{NT} or α_{NT} would be expected, in general, to raise the marginal physical product of labour in the non-traded goods sector, and hence to raise L_{NT}^{*}, other factors unchanged. However, the increase in the marginal physical product of labour is not relevant for L_{NT}^{D}. Here, the important consequence of the increase in K_{NT} or α_{NT} is the rise in the <u>average</u> product of labour thus brought about, so that fewer workers would be required in order to produce the given, demand constrained, level of output in that sector.

In the present variant of the model, non-traded goods prices are assumed to be fixed. It is interesting to note, however, that equation (13) provides an important point of reference when some gradual adjustment of non-traded goods prices is allowed, in some later analyses. In particular, it would seem sensible and consistent to assume that movements in non-traded goods prices would be influenced by the gap between the classical optimum level of non-traded goods production (ie. the level associated with L_{NT}^{*}) and the actual level of non-traded goods production (the level associated L_{NT}^{D}).

The next step is to determine Z_{NT} - which, of course, will then allow L_{NT} and Y_{NT} to be determined, assuming that the non-traded goods sector continually faces an effective demand constraint in the short run. Z_{NT} can be determined from the demand side of the model, as follows. First, we need to consider consumption expenditure by non-farm households.

$$(14) \qquad C_P^{NF} = C_P^{NF}(\overset{+}{Y_{NT}}, \overset{+}{Y_F^{NF}}, \overset{+}{Y_{NFT}}, \overset{-}{r})$$

It is assumed that consumption expenditure by non-farm households is a function of production in the non-traded and non-farm traded goods sectors, that part of value added in the farm sector which accrues to non-farm households, and the interest rate.

Aggregate private consumption expenditure is then defined to be the sum of the consumption expenditures by farm and non-farm households:

$$(15) \qquad C_P = C_P^{F} + C_P^{NF}$$

It is assumed that investment expenditure in the non-farm sector is a function of the change in non-traded goods production, and the interest rate:

$$(16) \quad I_P^{NF} = I_P^{NF}(\overset{+}{\Delta Y_{NT}}, \overset{-}{r})$$

This could be interpreted as a very simple reduced form of a structural investment model which features 2 separate modules: (1) an accelerator model of investment in the non-traded goods sector (which would seem to be a plausible complement to the 'Popular Keynesian' specification of the non-traded goods sector); and (2) a more classical investment model in the non-farm traded goods sector, which emphasises changes in r.

Aggregate private investment expenditure is then defined as the sum of farm and non-farm investment expenditures:

$$(17) \quad I_P = I_P^F + I_P^{NF}$$

Aggregate final expenditure in the economy is defined as the sum of these private consumption and investment expenditures, and their counterparts in the public sector:

$$(18) \quad Z = C_P + C_G + I_P + I_G$$

Given Z, we can readily ascertain the level of domestic demand for non-farm traded goods and non-traded goods:

$$(19) \quad Z_{NFT} = Z_{NFT}(\overset{+}{Z}, \overset{-}{\frac{p_{NFT}}{p_{NT}}}, \overset{-}{\frac{p_{NFT}}{p_F}}, \overset{?}{\varepsilon})$$

$$(20) \quad Z_{NT} = Z_{NT-J}(\overset{+}{Z}, \overset{-}{\frac{p_{NT}}{p_{NFT}}}, \overset{-}{\frac{p_{NT}}{p_F}}, \overset{?}{\varepsilon}) + J$$

The R.H.S. of (20) is made up of two parts. The first part specifies the component of aggregate final expenditure which is directed onto non-traded goods. The second part is J - the volume of non-traded goods used as intermediate inputs in the farm sector. It is clear that both represent components of the total demand for non-traded goods.

Given Z_{NFT} and Z_{NT}, then Z_F can be obtained from the identity:

(21) $Z_F = Z - Z_{NFT} - (Z_{NT} - J)$

In order to determine the actual level of the demand for labour in the farm sector, the non-farm traded goods sector, and the classical optimum level of the demand for labour in the non-traded goods sector, L_{NT}^*, we need a measure of the real wage, n. Given the composition of a real wage unit, v, namely 'a' units of non-traded goods, 'b' units of non-farm traded goods and 'c' units of farm goods, the real wage can be defined as:

(22) $$n = \frac{w}{ap_{NT} + bp_{NFT} + cp_F}$$

where w is the nominal wage and is common to all sectors of the economy.

Aggregate demand for labour is then defined as the sum of the demands for labour in the three sectors of the economy:

(23) $L = L_{NFT} + L_{NT} + L_F$ where, under most circumstances in the short run, the relevant measure of L_{NT} would be L_{NT}^D.

The supply of labour is assumed to be fixed in the short run:

(24) $L^S = \bar{L}$

It is also assumed that aggregate employment is always equal to the aggregate demand for labour:

(25) $E = L$

This assumption could also be interpreted as an assumption that L is always less than L^S, so that the fixed supply of labour does not represent an effective constraint on the level of employment.

The final two equations in this variant of the model specify the demand for and supply of nominal money balances:

(26) $m^D = m^D(\overset{+}{Y} \text{ or } \overset{+}{Z}, \overset{-}{r})$

The scale argument in the demand for money function is specified to be either Y or Z (which, of course, will differ where an imbalance exists in the current account). There is a lack of consensus in the literature on this point. It is common for Y to be used, in both the theoretical and empirical literature. However, to the extent that money balances, particularly narrowly defined money such as M1, derives much of its utility from its role as a medium of exchange, there would seem to be strong theoretical grounds for supposing that aggregate expenditure, Z, may be a more appropriate scale argument. As we shall see, many of the shocks which affect the farm sector can have quite disparate effects on Y and Z at a macroeconomic level, so this issue could be of some consequence.

Finally, it is assumed that the money market is in equilibrium at all points in time, and that the stock of money, m^S, is fixed.

(27) $m^D = m^S$

The non-farm and macroeconomic aggregates sector of the model thus contains 19 equations and identitites. The 19 variables which are, in that sense, treated as endogenous to this sector of the model are:

(1) Y (2) Y_{NFT} (3) Y_{NT} (4) L_{NFT} (5) L_{NT} (6) L (7) E
(8) C_P^{NF} (9) C_P (10) I_P^{NF} (11) I_P (12) Z (13) Z_{NFT} (14) Z_{NT}
(15) Z_F (16) n (17) L^S (18) m^D (19) r

The variables which are exogenous to the non-farm sector of the model but endogenous to the farm sector are:

(1) Y_F (2) Y_F^{NF} (3) C_P^F (4) I_P^F (5) L_F

The variables which appear in the non-farm sector of the model and which are exogenous to the model as a whole are:

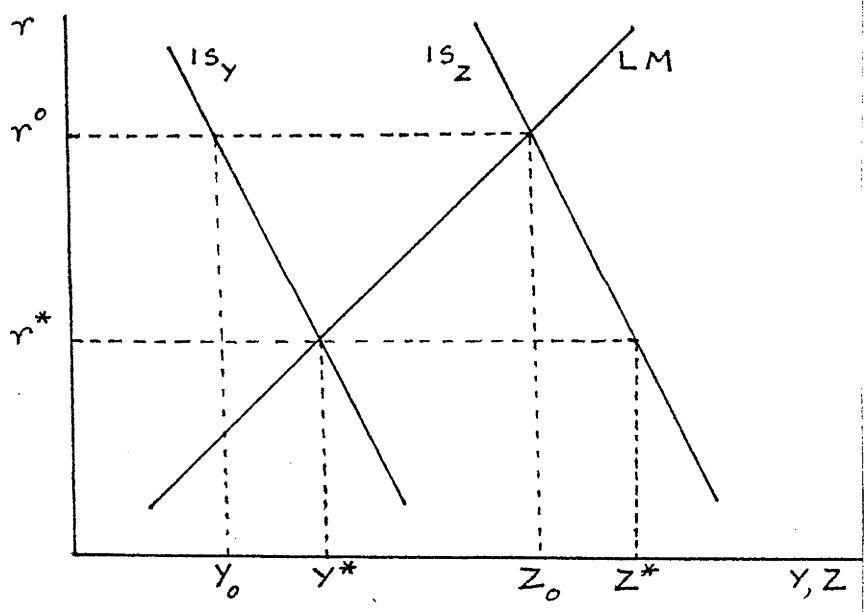
(1) K_{NFT} (2) α_{NFT} (3) p_{NT} (4) p_{NFT} (5) p_F (6) v (7) w
(8) K_{NT} (9) α_{NT} (10) C_G (11) I_G (12) ε (13) J (14) $\bar{L}$
(15) m^S

III (3) An Approximate Geometric Characterisation of the Model

The model can be characterised geometrically in four interrelated sectors - (i) Sector I, which is an income/expenditure sector; (ii) Sector II, which represents a macroeconomic Engel Curve; (iii) Sector III, the production functions; and (iv) Sector IV, the labour market.

Figure III (1)

Sector I



In Sector I, the IS_Z curve indicates the volume of expenditure, Z, that is associated with each level of the interest rate, other factors unchanged. The IS_Z curve summarises equations (6), (8), (14), (15), (16), (17) and (18). The negative slope represents the assumed

negative relationship between final demand (C_P, I_P) and r. A rise in non-farm production would move IS_Z to the right because of the effect of a rise in non-farm income on non-farm consumption expenditure, and because of the accelerator effect on non-farm investment. Similarly, a rise in farm income would move IS_Z to the right because of the consumption response of farm households, and the investment response via a change in farm residual funds - see equations (6), (7) and (8).

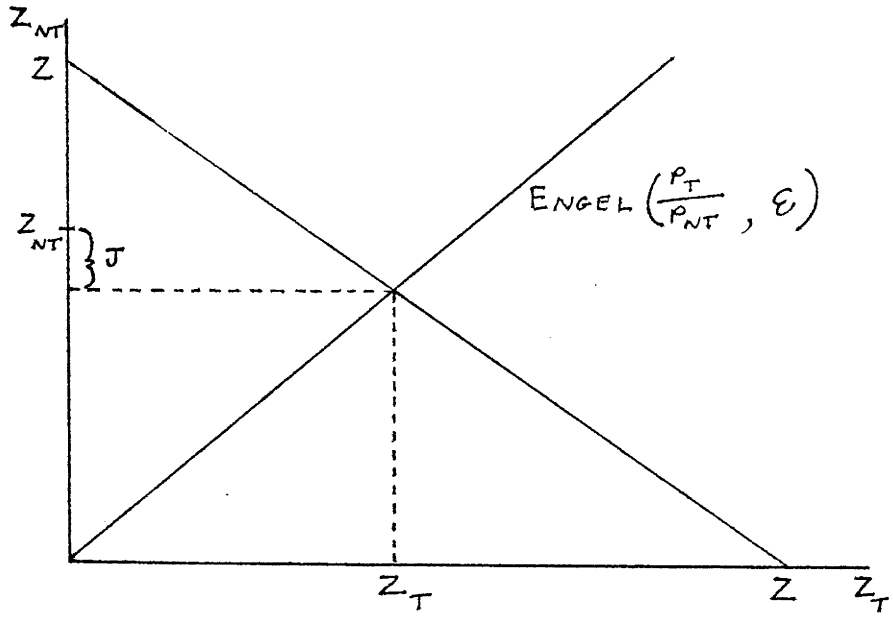
The IS_Y curve indicates the relationship between the aggregate volume of production, Y, and the interest rate. The farm and non-farm traded components of Y are, of course, independent of the level of Z, and hence are independent of r in the short run. However, the non-traded component of Y is negatively related to r because of the assumed negative relationship between Z and r and hence between Z_{NT}=Y_{NT} and r. In general, there is no reason to suppose that the IS_Z and IS_Y curves would be parallel. It is more probable that IS_Y would be steeper than IS_Z because only part of a change in Z, induced by a change in r, would fall onto non-traded goods.

Since $Y_{NT} = Z_{NT}$, it is clear that the horizontal distance between IS_Y and IS_Z is a measure of the balance of trade. In particular, if $Y < Z$, the balance of trade is in deficit, and conversely.

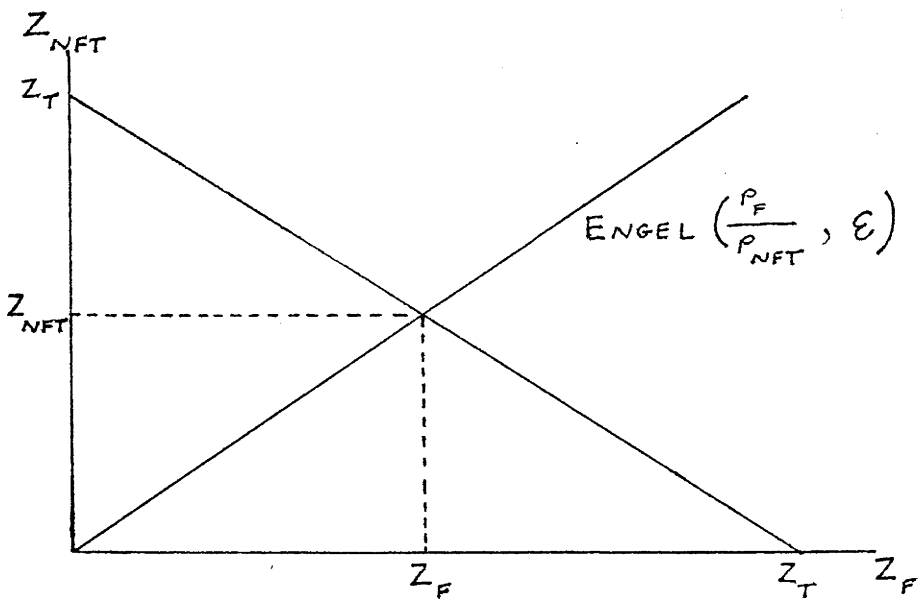
Equations (26) and (27) are incorporated into the familiar LM curve. The potential significance of the ambiguity as to the appropriate scale argument in the demand for money function is immediate in Figure III (1). If Y was the scale argument, then r^*, Y^* and Z^* would be consistent with equilibrium in the money market. However, if Z was the scale argument then, given the same money stock, r^0, Y^0 and Z^0 would be consistent with money market equilibrium.

Figure III (2)

Sector II (1)



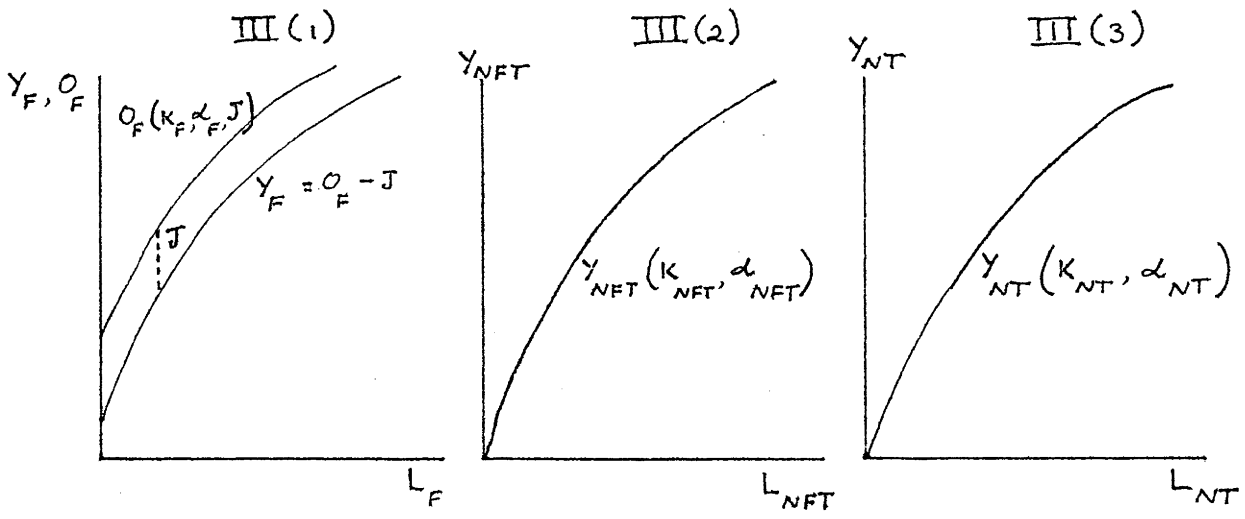
Sector II (2)



Equations (19), (20) and (21) are represented in Sector II. It is assumed that farm and non-farm traded commodities can be combined into a single traded good, given their relative price. Then aggregate expenditure, Z, from Sector I, can be separated into its traded and non-traded components, given the relative price of traded and non-traded goods and the macroeconomic preference mapping, ε. The traded component of Z, Z_T, can then be separated into its farm and non-farm traded components, given the relative price of farm and non-farm traded goods, and the preference mapping. As discussed previously, in order to obtain the level of total demand for non-traded goods, Z_{NT}, J must be added directly to the non-traded component of Z, as is done in Figure III (2).

Figure III (3)

Sector III

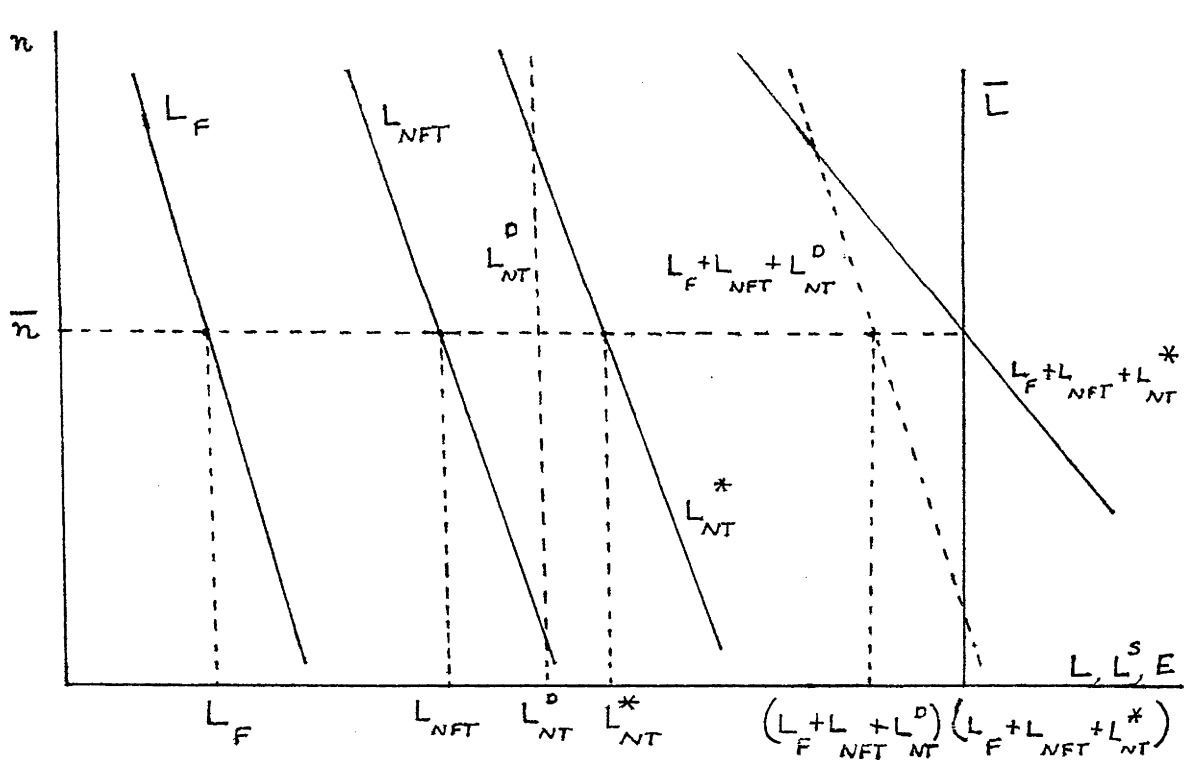


Equations (1), (3), (10) and (12) are captured in Sector III. Given K_F, α_F and J, the gross volume of farm production is a function of farm employment L_F. Farm value added, Y_F is obtained by subtracting non-primary inputs, J, from the gross volume of farm production. Similarly, given K_{NFT} and α_{NFT}, Y_{NFT} can be represented as a function of L_{NFT}, while Y_{NT} can be represented as a function of L_{NT}.

The actual levels of L_F and L_{NFT} can be obtained directly from the labour market, in Sector IV. However, the specification of L_{NT}, in Sector III (3) is a little more complex. In particular, we need to specify an 'optimal' level of L_{NT}, - L_{NT}^* - which can be obtained from Sector IV, and a demand constrained level of L_{NT} - L_{NT}^D, - which can be obtained directly from Sector III (3). Given Z_{NT} from Sector II, then L_{NT}^D can be obtained by finding that level of L_{NT} for which $Y_{NT} = Z_{NT}$.

Figure III (4)

Sector IV



The real wage, measured as the number, n, of real wage units, v, is represented along the vertical axis of Sector IV. It is clear from equation (22) that, given the make-up of v, the prices of farm, non-farm traded and non-traded commodities, and the nominal wage, n can be readily calculated. With each of these variables given in the present analysis, the real wage will be fixed at (say) $\bar{n}$. Equation (2) is represented by schedule L_F. In other words, given p_F, p_{NFT} and

p_{NT}, the marginal physical product of labour in the farm sector can be converted to real wage units, allowing L_F to be represented as a function of n. Similarly, equation (11) is represented by the schedule L_{NFT}, and the L_{NT}^* component of equation (13) is represented by the schedule L_{NT}^*. The L_{NT}^D component of (13) is represented by the vertical line L_{NT}^D, and is obtained by inverting the production function in Sector III (3), given Z_{NT}.

It should be noted that, as drawn, the L_{NT}^D schedule is continued above the point of intersection between L_{NT}^D and L_{NT}^*. Following Barro and Grossman (1976), one might allow L_{NT}^D and L_{NT}^* to be coincident above their point of intersection. This is equivalent to an assumption that some degree of price rigidity in the non-traded goods sector is relevant only in the downward direction (i.e. in the face of deficient demand), but prices are perfectly flexible in the upward direction (i.e. in the face of excess demand). On the other hand, the continuation of L_{NT}^D above the point of intersection implies that there is a degree of price rigidity in both directions. It is clear, however, that this potential ambiguity can be avoided by an assumption that the point of intersection between L_{NT}^D and L_{NT}^* always occurs at a real wage level equal to or above the ruling real wage i.e. $L_{NT}^D \leqslant L_{NT}^*$ or, equivalently, $Z_{NT} \leqslant Y_{NT}(K_{NT}, L_{NT}^*, \alpha_{NT})$. Such an assumption is adopted throughout the analysis in the present chapter, and again in the analyses with Models II, III, IV and V in subsequent chapters. The assumption is relaxed, however, in the analysis with the theoretical simulation variants of Models I and II in Chapter X and O'Mara et al(1985). There, the demand for non-traded commodities may exceed the classical optimum level of output, given the real wage, with a similar degree of rigidity of non-traded goods prices in both an upward and downward direction. As we shall see, these

issues also need to be borne closely in mind when the quantitative results, presented in Chapter IX, are being assessed and interpreted.

The aggregate demand for labour schedule, L, is obtained by horizontally summing the three individual labour demand schedules - which, of course, captures equation (23). The supply of labour is fixed at $\bar{L}$ (equation (24)). It is assumed, for convenience, that, given $\bar{n}$, $L_F + L_{NFT} + L_{NT}^* = \bar{L}$. Recalling that, by assumption, $L_{NT}^D \leqslant L_{NT}^*$, then it follows that $L \leqslant \bar{L}$, which is consistent with equation (25) which states that the actual level of employment is equal to the demand for labour.

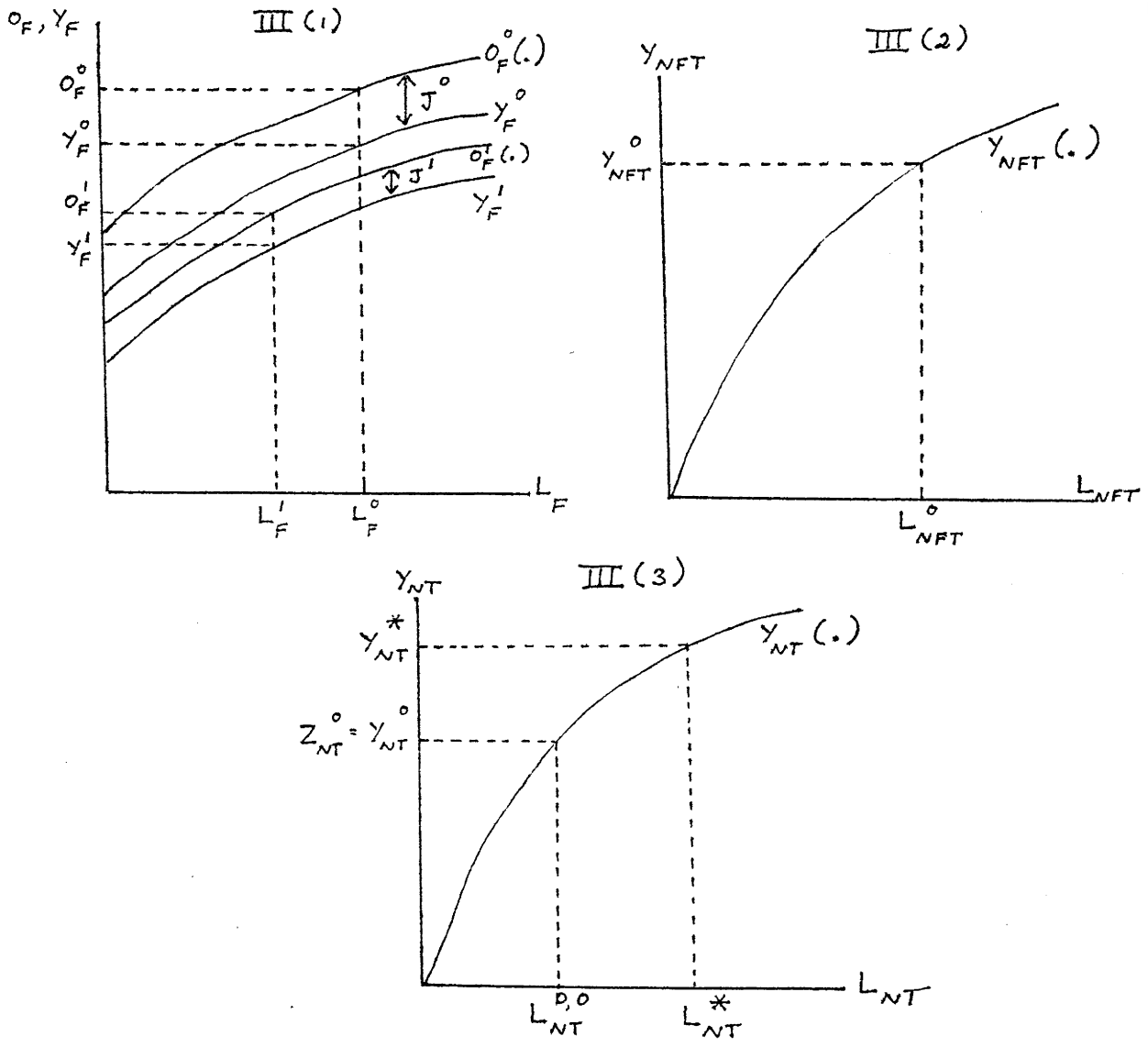
We can now proceed to undertake some analysis of the first paradigm using this geometric characterisation of the model.

III (4) Some Analysis of the First Paradigm

The analysis can commence in Sector III.

Figure III (5)

Sector III



In Sector III (1), the initial positions of the gross and net production functions in the farm sector are $O_F^0(\cdot)$ and Y_F^0, given an initial level of J equal to J^0. With an initial level of farm employment of L_F^0, this implies that gross farm production is initially O_F^0, and farm value added is initially Y_F^0. In the non-farm traded goods sector, output and employment are initially Y_{NFT}^0 and L_{NFT}^0, respectively. In the non-traded goods sector, the

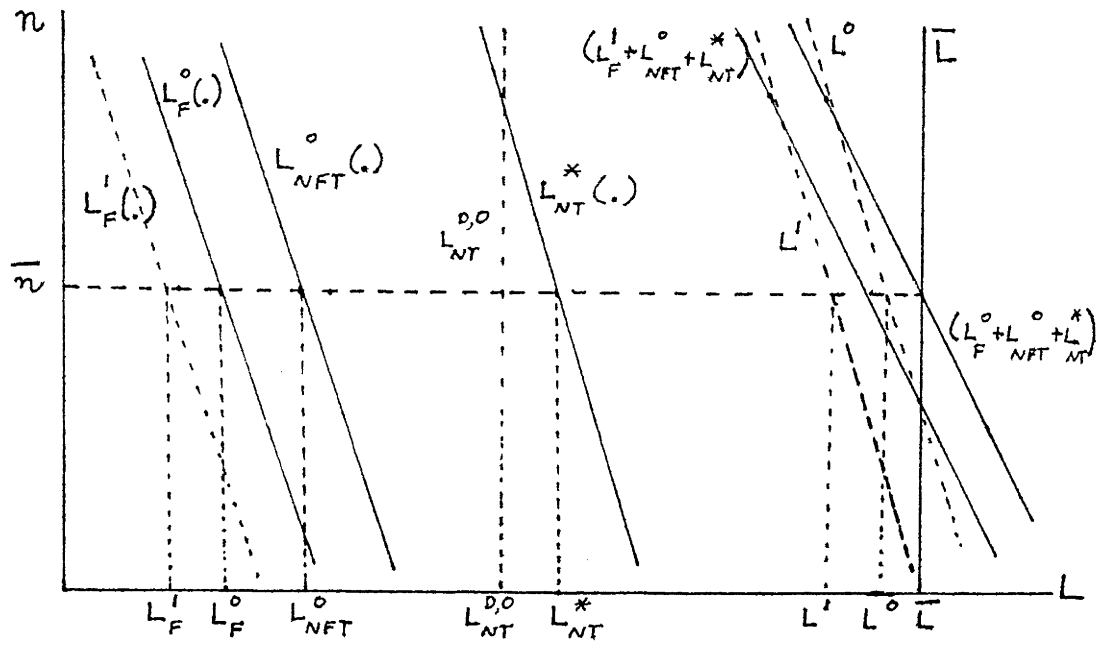
classical optimum levels of output and employment are Y_{NT}^{*} and L_{NT}^{*}. However, the actual, demand constrained, levels of output and employment in that sector are $Y_{NT}^{0} = Z_{NT}^{0}$ and $L_{NT}^{D,0}$.

Now suppose that an adverse weather shock affects the farm sector - typically, the onset of drought conditions (a parallel analysis can, of course, be mounted for a beneficial weather shock, such as above average seasonal conditions, or the return to normal weather following a drought). In the model, the adverse weather shock can be conceptualised as a fall in α_F. The gross production function in the farm sector fallsto $O_F^1(.)$. From equation (1), it can be seen that this would lower the marginal productivity of non-primary inputs used in the farm sector, so that the volume of such inputs used would fall, say, from J^0 to J^1 - the extent of the fall, of course, is not endogenously determined in the model. This would further aggravate the decline in the marginal product of farm labour, so that farm employment would fall from L_F^0 to L_F^1. In consequence, the gross volume of farm production falls to O_F^1, and farm value added falls to Y_F^1.

The fall in employment in the farm sector can be readily represented in the labour market, Sector IV.

Figure III (6)

Sector IV

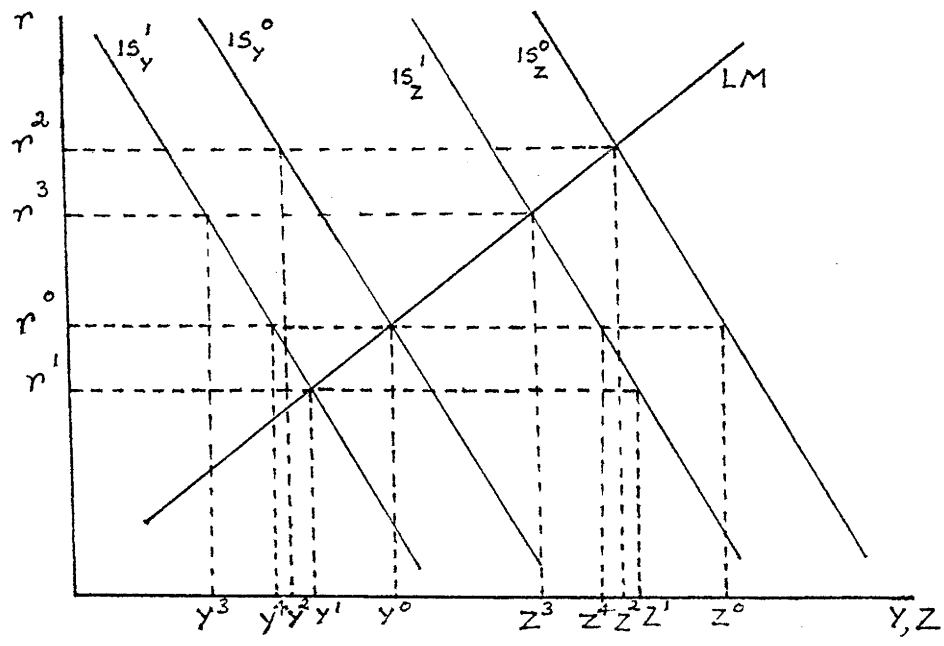


The decline in the marginal productivity of farm labour moves the demand for labour in the farm sector to the left from $L_F^0(.)$ to $L_F^1(.)$, so that, given the real wage, $\bar{n}$, farm employment falls from L_F^0 to L_F^1, as noted previously. Similarly, aggregate employment falls from L^0 to L^1. It is interesting to note also that, given $\bar{n}$, $L_F^1 + L_{NFT}^0 + L_{NT}^* < \bar{L}$ ie. given the drought affected demand for labour in the farm sector, and if it were insisted that the non-traded goods sector operate at a point on its optimum demand for labour schedule, then labour market clearance would require a real wage below $\bar{n}$.

We can now move to Sector I, and consider some of the macroeconomic implications of the drought.

Figure III (7)

Sector I



In Sector I, assume that the initial positions of the IS curves are represented by IS_Y^0 and IS_Z^0. If Z is the scale argument in the demand for money function, the initial level of the interest rate would be r^2, with the initial levels of Z and Y therefore being Z^2 and Y^2. Conversely, if Y was the scale argument, the relevant levels

of these variables would be r^0, Z^0 and Y^0.

For ease of exposition, we will consider, firstly, the impact or first round effect of the drought on the IS curves. The drought induced decline in Y_F would move IS_Y to the left from $IS_Y{}^0$ to $IS_Y{}^1$. It is clear, from equations (6),(7) and (8),that this would induce some decline in the level of consumption and investment expenditure in the farm sector, while the decline in $Y_F{}^{NF}$ would reduce non-farm consumption expenditure - eq. (14) - so that IS_Z would also move to the left, from $IS_Z{}^0$ to $IS_Z{}^1$.

It would be expected that the marginal propensity to consume in the farm sector would be less than unity in the short run - and perhaps much less than unity (the empirical evidence on this point is reviewed in Chapter VIII). It would also be expected that the marginal propensity to consume out of $Y_F{}^{NF}$ would be less than unity. If the marginal propensity to invest out of farm residual funds was also less than unity, and if the drought had no other impact on farm investment decisions, then the horizontal distance between $IS_Z{}^1$ and $IS_Z{}^0$ would, in general, be less than the horizontal distance between $IS_Y{}^0$ and $IS_Y{}^1$. The empirical and theoretical literature on farm investment decisions will be reviewed in Chapter VIII, including existing estimates of the marginal propensity to invest out of residual funds. It will be argued there that, at least on theoretical grounds, the possibility of the marginal propensity to invest exceeding unity should not be discounted.

It follows that there would not seem to be any necessary relationship between the extent of these leftward movements in IS_Y and IS_Z which occur in the first round. Certainly, there is no reason to suppose that the leftward movement of IS_Z and IS_Y would be equivalent in absolute terms. This carries an important implication for the impact effect of the shock on the interest rate. In particular, while the analysis is suggestive of some downward pressure

on the interest rate, regardless of whether Y or Z is chosen as the scale argument, the precise extent of that downward pressure could depend significantly on whether Y or Z is the true underlying scale argument.

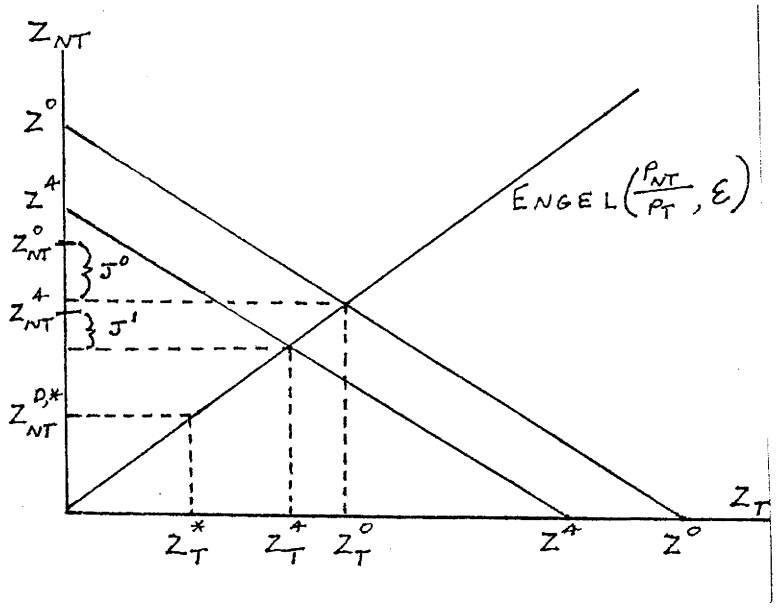
Having noted this potential source of ambiguity, the ensuing analysis will be based largely on the assumption that Y is the scale argument. It is clear that an analysis of the case where the scale argument is Z would follow along very similar lines, the main difference in the two analyses being the level of, and the extent of the movements in, the interest rate.

The next step is to consider the second round of the multiplier process i.e. to assess whether the IS curves, IS_Y^1 and IS_Z^1, are consistent with a Keynesian equilibrium in the non-traded goods sector. In other words, is the aggregate demand for non-traded goods, implied by IS_Z^1 and J^1, equal to the production of non-traded goods implied by IS_Y^1. If not, then further movements in the IS curves will eventuate.

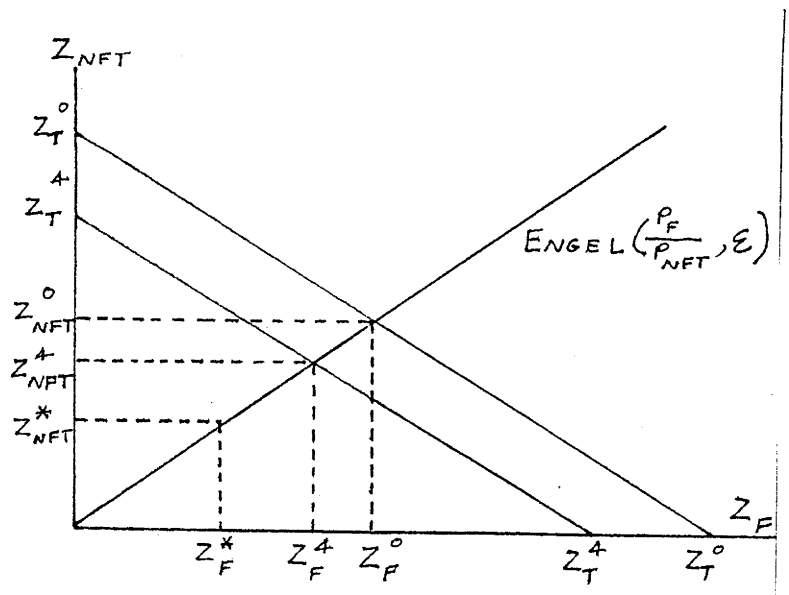
The first point to note is that, if such a disequilibrium exists at any given interest rate, then an equivalent disequilibrium will exist at each interest rate. This is the case because the effect of any change in the demand for non-traded goods as a result of a change in the interest rate (ie. a movement along the IS_Z schedule) is, by construction, captured in the negative slope of the IS_Y schedule. This means that, following the movement in IS_Z from IS_Z^0 to IS_Z^1, and in IS_Y from IS_Y^0 to IS_Y^1, we can assess the state of equilibrium in the non-traded goods sector, for convenience, at interest rate r^0, in the knowledge that such an analysis would be equally as relevant for all other interest rates, including r^1. In terms of Figure III (7), this implies that we can assess the state of the market for non-traded goods implied by Z^4 and Y^4.

Figure III (8)

Sector II (1)



II (2)



In Sector II (1), the initial level of aggregate expenditure, Z^0, implies an initial level of aggregate demand for non-traded goods of $Z_{NT}{}^0$ (given J^0), and an initial level of demand for traded goods of $Z_T{}^0$. $Z_T{}^0$ is in turn, separated into its farm and non-farm traded components in II (2) - $Z_F{}^0$ and $Z_{NFT}{}^0$. The decline in Z, from Z^0 to Z^4, is represented by the leftward movement of the budget line in II (1), so that, given the new lower level of J, - J^1, the aggregate demand for non-traded commodities falls to $Z_{NT}{}^4$. Similarly, the

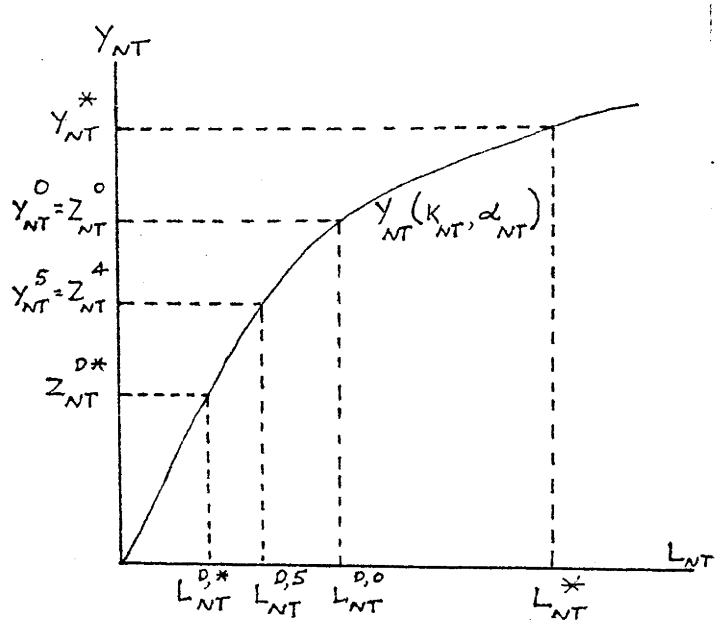
demand for traded commodities falls to Z_T^4, and hence Z_F^4 and Z_{NFT}^4.

By assumption, Z_{NT}^0 is equal to the non-traded component of Y^0 ie. Y_{NT}^0. It is clear that the non-traded component of Y^4 is also equal to Y_{NT}^0. This is the case because the leftward movement of IS_Y, from IS_Y^0 to IS_Y^1, reflects only the drought induced change in Y_F, with no change in either Y_{NT} or Y_{NFT} between the two IS_Y schedules. It follows immediately, therefore, that $Z_{NT}^4 < Z_{NT}^0 = Y_{NT}^4$. As noted above, an equivalent disequilibrium would be evident at all horizontally opposite points on IS_Y^1 and IS_Z^1, including the points associated with Z^1 and Y^1 in Figure III (7).

This excess supply of non-traded goods would induce a decline in the production of non-traded goods, which can be readily represented in Sector III (3).

Figure III (9)

Sector III (3)

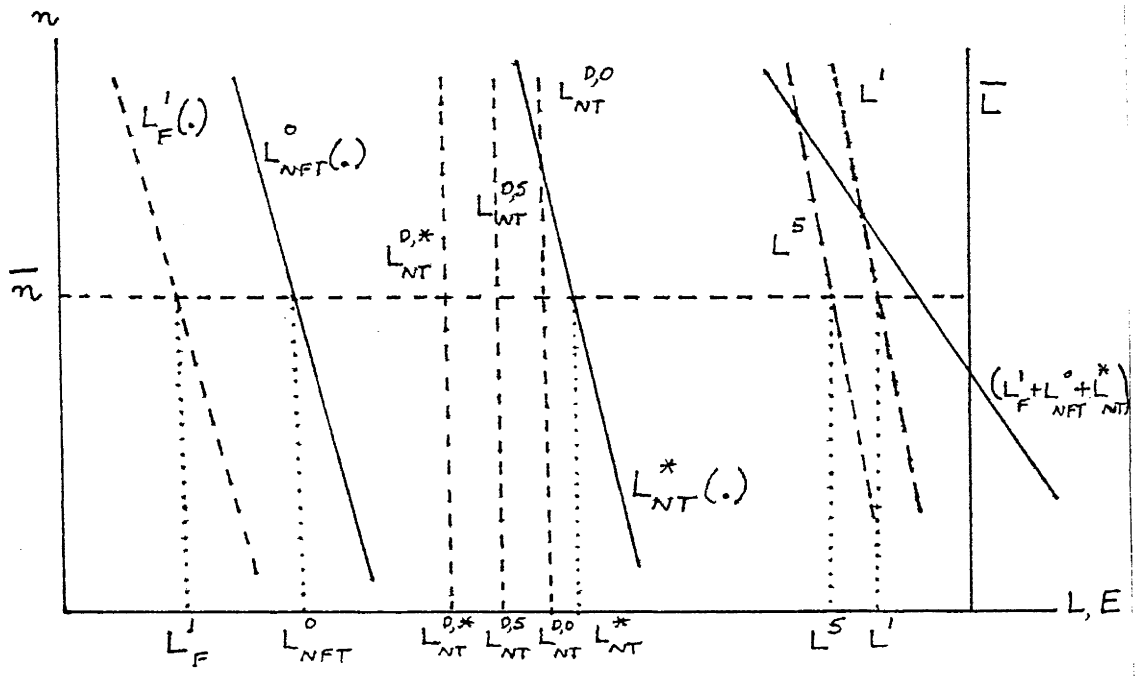


The decline in demand for non-traded goods, from Z_{NT}^0 to Z_{NT}^4, induces an equivalent decline in production, from Y_{NT}^0 to Y_{NT}^5, with a corresponding decline in employment, from $L_{NT}^{D,0}$ to $L_{NT}^{D,5}$.

The decline in employment in the non-traded goods sector can, in turn, be represented in Sector IV.

Figure III (10)

Sector IV

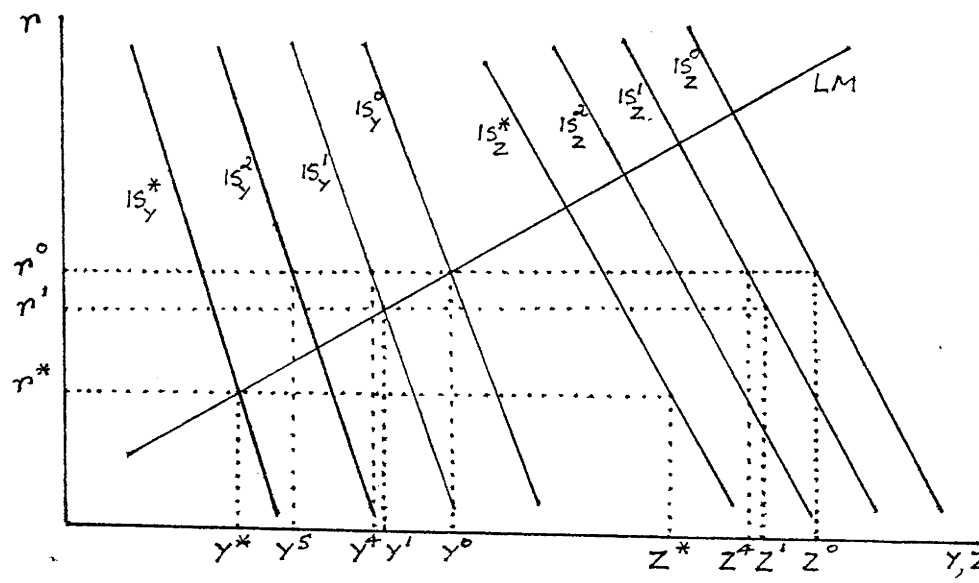


In Figure III (10), the classical optimum level of employment in the non-traded goods sector remains unchanged at L_{NT}^*. However, the demand constrained level of employment in that sector falls from its initial level of $L_{NT}^{D,0}$, to $L_{NT}^{D,5}$. Note that the point of intersection between L_{NT}^* and $L_{NT}^{D,5}$ occurs at a higher real wage than the point of intersection between L_{NT}^* and $L_{NT}^{D,0}$. In other words, not only is the fall in employment in the non-traded goods sector not caused by a rise in the real wage, the existing real wage, $\bar{n}$, becomes even less of a constraint on employment at the margin.

The next step is to assess the impact of the decline in Y_{NT} in terms of Sector I.

Figure III (11)

Sector I



In Figure III (11), the decline in the production of non-traded goods, from Y_{NT}^{0} to Y_{NT}^{5}, produces a leftward movement in the IS_Y curve, from IS_Y^1 to IS_Y^2, where the horizontal distance between IS_Y^1 and IS_Y^2 is equal to the decline in Y_{NT}. Focussing our attention, as before, on r^0, it is clear that, by definition, the non-traded component of Y^5 is equal to the non-traded component of Z^4 plus J^1. In other words, the IS curves, IS_Y^2 and IS_Z^1 are consistent with the non-traded goods market clearing.

This does not mean, however, that the IS curves would be stable at IS_Y^2 and IS_Z^1. Rather, there would be a further leftward movement of IS_Z from IS_Z^1, as the fall in Y_{NT} is reflected in non-farm consumption expenditure (equation (14)), and non-farm investment (equation (16)). It is clear that, following the same procedure as previously, IS_Y^2 and the new IS_Z curve - say IS_Z^2 - would be associated with an excess supply of non-traded goods, leading to a further decline in non-traded goods production, a further leftward movement of the IS_Y curve from IS_Y^2, and so on. This, of course, is simply the working through of the second and subsequent rounds of the

familiar Keynesian demand multiplier process.

There are several points which should be stressed. Firstly, the decline in aggregate expenditure, as the IS_Z curve moves to the left, has no bearing on the volume of production in the farm and non-farm traded goods sectors. In other words, the Keynesian demand multiplier process is restricted to the non-traded goods sector. This is a reflection of the classical specification employed for the farm sector of the model, and the assumption, underlying the first paradigm, that a perfect residual export market exists for farm commodities. A similar, classical specification is employed in the non-farm traded goods sector, with any change in aggregate expenditure on non-farm traded goods being absorbed in an appropriate adjustment of the balance of trade.

Secondly, it seems reasonable to suppose that, if the only direct linkage from the change in Y_{NT} to the change in Z_{NT} was through the non-farm consumption function, equation (14), then this multiplier process would be stable, eventually converging to a full Keynesian equilibrium, such as might be implied by the IS curves IS_Y^* and IS_Z^* in Figure III (11). In other words, provided that the marginal propensity to consume in the non-farm sector was less than unity in the short run, and noting that only part of a change in Z would fall on non-traded goods, then each subsequent round of the multiplier would produce smaller changes in Y and Z. As is well known, however, the presence of an accelerator effect on non-farm investment expenditure would make stability less certain.

Even where the multiplier process was stable, there would clearly be a significant time lag before the full Keynesian equilibrium was established ie. in terms of Figure III (11), the movement of the IS curves to IS_Y^* and IS_Z^* would not occur instantaneously. Such time lags could be of some significance, given that volume shocks in the farm sector rarely persist longer than one season. On the other hand,

it can be readily demonstrated that, in most simple multiplier formulae, the first two or three rounds of the process typically account for most of the total multiplier effect. Therefore, quantitative work, based on the assumption that the full multiplier effect would work through the macroeconomy within (say) one year, may not dramatically overstate the macroeconomic consequences of the shock in the farm sector. This would be particularly the case if such quantitative work ignored any possible investment response in the non-farm sector, even though such an investment response was felt to be probable.

Finally, it is worth noting the essential features of this post-shock Keynesian equilibrium, given that it is, in fact, established. In Figure III(11), the equilibrium IS curves, IS_Y^* and IS_Z^*, would be mutually consistent. In other words, the level of income implied by points on IS_Y^* would be just sufficient to generate the volume of real expenditure implied by the horizontally opposing points on IS_Z^*. <u>At the same time</u>, the level of real expenditure implied by points on IS_Z^* would, in association with the given level of J, generate a level of aggregate demand for non-traded goods exactly equal to the production of non-traded goods implied by the horizontally opposing points on IS_Y^*. In Sector II(1), (Fig. III(8)), the post-shock level of Z_{NT} would be at some point below Z_{NT}^4, such as $Z_{NT}^{D,*}$, with the corresponding level of Z_T represented by Z_T^*. In Sector II(2), Z_T^* implies a level of Z_{NFT} below Z_{NFT}^4 (say Z_{NFT}^*) and Z_F below Z_F^4 (say Z_F^*). In Sector III(3), (Fig. III(9)), $Y_{NT} = Z_{NT}^{D,*} < Y_{NT}^5$, with $L_{NT} = L_{NT}^{D,*} < L_{NT}^{D,5}$. Finally, in Figure III(10), the effective demand for labour schedule in the non-traded goods sector in the new Keynesian equilibrium is $L_{NT}^{D,*}$, lying to the left of $L_{NT}^{D,5}$.

III (5) Concluding Comments on Section III

The version of the model used in Section III is the most simple of the theoretical structures which are considered in the thesis. However, it provides a useful point of departure, and a basis for comparison with later versions and variants of the model. It also provides a feel for the workings of the geometric construct.

The theoretical results obtained from the model support the intuitive notion that volume shocks in the farm sector, under the circumstances postulated in the first paradigm, can affect output and employment in the non-farm sector in general, and in the non-traded goods sector in particular.

The results also suggest that an adverse volume shock in the farm sector can place downward pressure on the interest rate (and, of course, the converse). The model also implies that the extent of the influence on the interest rate (although probably not the direction of the influence) could depend, perhaps substantially, on whether the true, underlying scale argument in the demand for money function is real income or real expenditure, because the effect of the volume shock in the farm sector on these two variables could be very different.

It has been demonstrated, in the analysis, that a 'Popular Keynesian' specification of the non-traded goods sector can operate alongside a more classical specification of the two traded goods sectors. This has clearly illustrated the importance of restricting the demand multiplier process to the non-traded goods sector, and of discounting changes in local expenditure on farm and non-farm traded goods.

It has been shown how, in principle, short run variations in output and employment in the non-traded goods sector may arise in response to the volume shock in the farm sector, even though there is no cyclical movement in the real wage. Indeed, it was shown that the real wage may become less of a constraint on output and employment in the non-traded goods sector, at the margin, as the effects of the shock in the farm sector begin to be absorbed.

At least in this variant of the model, the important linkages from the farm sector to the non-farm sector of the model come through the consumption response of farm households to a change in farm income, the investment response in the farm sector to a change in farm residual funds, the consumption response by non-farm households to a change in that part of farm value added which accrues to them, and the change in the usage of non-primary inputs in the farm sector. Some care was necessary in the treatment of these non-primary inputs to ensure that, firstly, the approach adopted was valid from a macroeconomic viewpoint and, secondly, that it was instructive of the role played by that variable.

Finally, some attempt was made in the analysis to trace through the various rounds of the multiplier process, rather than to simply move from one Keynesian equilibrium to another. While the issues raised were quite conventional, it seemed sensible, nevertheless, to present such an exercise at the outset - it serves as an aid to understanding the model, and will permit the multiplier process to be treated more summarily in subsequent analyses.

Section IV Some Analysis with an Endogenous Balance of Payments

IV (1) Notation

The additional notation used in the present variant of Model I is as follows:

- d - the domestic credit component of the money supply
- BP - the state of the balance of payments
- k - net capital inflow per period
- r^W - the world nominal interest rate
- e^E - the expected exchange rate
- μ - a vector of arguments influencing k, other than r, r^W and $\dot{e}^E$
- $\cdot$ - indicates the per period change in the respective variable

IV (2) Model Specification

The balance of payments is endogenised via the addition of three equations in the non-farm and macroeconomic aggregates sector.

$$(28) \quad \dot{m}^S = \dot{d} + BP$$

This identity simply states that the per period change in the money supply is equal to the per period change in the domestic credit componet of the money supply, plus the balance of payments surplus. It is assumed, for simplicity, that the money supply multiplier is unity.

$$(29) \quad k = k(\overset{+}{r}, \overset{-}{r^W}, \overset{+}{\dot{e}^E}, \overset{?}{\mu})$$

Net capital inflow is assumed to be a function of the nominal interest rate differential adjusted for expected movements in the exchange rate, and various other arguments such as, for example, artificial restrictions on capital flows, risk premia and so on. It is clear that (29) would include perfect interest parity as a special case ie.

(29)[1] $r = r^W - \dot{e}^E$

Finally, the state of the balance of payments is obtained from the identity

(30) $BP = P_{NFT}Y_{NFT} + p_F O_F - p_{NFT}Z_{NFT} - p_F Z_F + k$

The first four terms on the R.H.S. of (30) define the current account balance, to which is added net capital inflow in order to obtain the overall state of the balance of payments.

The three additional endogenous variables in this variant of the model are: (1) m^S (2) k (3) BP.

The additional exogenous variables appearing in equations (28), (29) and (30) are: (1) d (2) r^W (3) $\dot{e}^E$ (4) μ.

IV (3) A Geometric Characterisation of the Model.

Sectors II, III and IV of the model remain as described in Section III. However, the additional elements included in the present variant of Model I require some modification of Sector I.

In Sector I, we need to identify combinations of Z and r which are consistent with balance of payments equilibrium, all other factors given. In this way, combinations of Z and r (and hence Y), which are not consistent with balance of payments equilibrium can be readily identified, and, from (28), the money stock can be adjusted in the appropriate direction.

The first point to note is that, from (29), with r^W, $\dot{e}^E$ and μ given, k is an increasing function of r. In other words, given r^W, $\dot{e}^E$ and μ, it is possible, in general, to find a level of r which will produce some desired rate of net capital inflow or outflow. For our purposes, of course, this desired rate is that which would exactly counteract the deficit or surplus in the current account.

The next step is to examine the current account balance, which,

from (30) is:

$$p_{NFT}Y_{NFT} + p_F O_F - p_{NFT}Z_{NFT} - p_F Z_F$$

The two variables p_F and p_{NFT} are exogenous to the model and fixed throughout the analysis. Further, Y_{NFT} and O_F, while endogenous to the model, are functions of exogenous variables only. Recalling (19)

$$(19) \quad Z_{NFT} = Z_{NFT}(\overset{+}{Z}, \frac{\bar{p}_{NFT}}{p_{NT}}, \frac{\bar{p}_{NFT}}{p_F}, \overset{?}{\varepsilon})$$

and noting that p_{NFT}, p_{NT}, p_F and ε are exogenous and fixed, it is clear that Z_{NFT} can be regarded as an increasing function of Z. Similarly, from (19), (20) and (21), we get

$$(21) \quad Z_F = Z - Z_{NFT} - (Z_{NT-j})$$

$$= Z - Z_{NFT}(\overset{+}{Z}, \frac{\bar{p}_{NFT}}{p_{NT}}, \frac{\bar{p}_{NFT}}{p_F}, \overset{?}{\varepsilon}) - Z_{NT}(\overset{+}{Z}, \frac{\bar{p}_{NT}}{p_{NFT}}, \frac{\bar{p}_{NT}}{p_F}, \overset{?}{\varepsilon}) + J$$

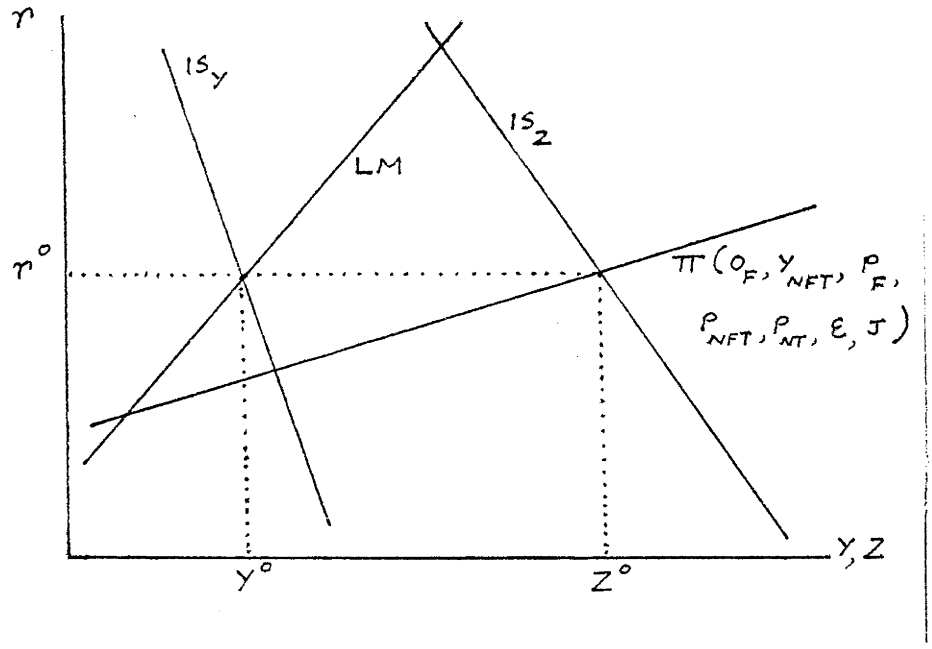
Again, noting that p_{NFT}, p_{NT}, p_F, ε and J are exogenous, then Z_F is a function of Z, and, provided that

$$\frac{\delta Z_{NFT}}{\delta Z} + \frac{\delta Z_{NT}}{\delta Z} < 1, \; Z_F \text{ is an increasing function of } Z.$$

It follows, then, that given p_F, p_{NT}, p_{NFT}, O_F, Y_{NFT}, ε and J, the current account balance is a function of Z. It is also clear that this function is decreasing (in other words, the total partial derivative of the current account with respect to Z is negative). Then, given Z, and hence the state of the current account, it is possible to find a level of the interest rate from (29) which, given r^W, $\dot{e}^E$ and μ would attract a level of k just sufficient to offset that current account balance, thus forcing BP to zero. We will refer to the locus or schedule traced out by these combinations of Z and r as the TT schedule. It is clear that, as the current account is a decreasing function of Z, and as k is an increasing function of r, the TT schedule has a positive slope.

Figure III (12)

Sector I



It will be assumed, throughout the analysis, that the slope of the TT schedule is less than that of the LM curve. This reflects the fact that:

(a) as noted in Section II, the empirical evidence seems to suggest that international capital flows are relatively highly responsive to interest rate differentials - which suggests a relatively flat TT schedule - and, indeed, that many theoretical models assume perfect interest rate parity; and

(b) empirical studies of the demand for money function, of which there are now a vast number in the literature, provide strong evidence that the interest elasticity of the demand for money is relatively small.

It is clear that combinations of r and Z lying above the TT schedule would be associated with balance of payments surpluses ie. given Z, the relatively higher interest rate produces a capital account which is stronger than is necessary in order to offset the

current account balance. The surplus would increase the money supply and hence move the LM curve to the right. Conversely, combinations of Z and r below TT would be associated with balance of payments deficits and leftward movements of the LM curve.

Two final points should be noted. Firstly, the ambiguity as to the true scale argument in the demand for money functions continues to be relevant in Sector I. If Y is the scale argument, as assumed in Section III (5), then balance of payments equilibrium would occur if, given IS_Y and IS_Z, the intersection of IS_Y and LM occurred at the same level of the interest rate as the point of intersection between IS_Z and TT (as drawn, in Figure III (12)). However, if Z is the scale argument, then, given IS_Y and IS_Z, balance of payments equilibrium would require that IS_Z, LM and TT shared a common point of intersection.

Secondly, in the special case where international capital flows are perfectly mobile ie. where perfect interest rate parity holds, the TT schedule would become horizontal at the world interest rate.

IV (4) Some Analysis with the Model

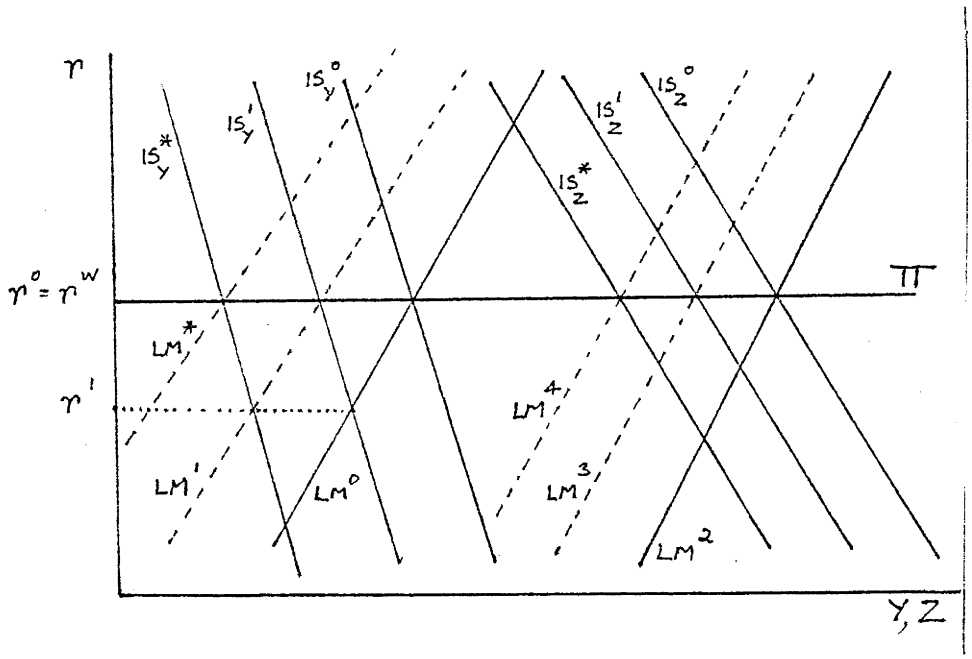
We can now proceed to undertake some analysis of the first paradigm using the present variant of Model I. We will first consider the special case of perfect capital mobility ie. a horizontal TT schedule at the level of the world interest rate, and then move on to consider the (probably more realistic) case of a positively sloped TT schedule.

Much of the analysis undertaken in Section III carries over to the present case. This, of course, greatly simplifies the exposition of the analysis. Indeed, we need only focus on Sector I.

Suppose that an exogenous decline occurs in the gross and net volume of farm production. The developments in Sector III of the

model, as presented in Figure III (5) carry over to the present case, as do the developments in Sector IV, as presented in Figure III (6). Consider, however, the situation in Sector I.

Figure III (13)



Assume that, as in Figure III (7), the initial position of the IS curves and the LM curve are represented by IS_Y^0, IS_Z^0 and LM^0. Also assume, for convenience, that the world interest rate, r^W, is equal to r^0, the initial level of the interest rate in Figure III (7), so that the TT schedule is horizontal at $r^0 = r^W$. Provided that Y is the scale argument in the demand for money function, it is clear that IS_Y^0, IS_Z^0, LM^0 and TT are consistent with an initial balance of payments equilibrium. However, if Z was the scale argument, initial balance of payments equilibrium would have required a different money stock - that associated with LM^2.

The decline in value added in the farm sector, Y_F, shifts the IS_Y curve to the left, from IS_Y^0 to IS_Y^1, which in turn, induces a decline in farm consumption and investment expenditure, shifting IS_Z from IS_Z^0 to IS_Z^1. Given the money stock associated with LM^0,

clearance of the money market would require a lower interest rate, r^1. In this case, however, r^1 is not consistent with the assumption that the world interest rate is higher, at r^W, and that capital is perfectly mobile. Therefore, balance of payments deficits emerge, and persist until the money stock has fallen to a level consistent with the LM curve, LM^1. In other words, in this case, there is no downward movement of the interest rate - rather, the decline in the demand for money is reflected in a balance of payments deficit and hence a decline in the money stock.

As was noted in Section III, $IS_Y{}^1$ and $IS_Z{}^1$ are not consistent with a Keynesian equilibrium in the non-traded goods sector. In particular, the non-traded component of $IS_Y{}^1$ is greater than the aggregate demand for non-traded goods implied by $IS_Z{}^1$ and J^1. As we have seen, this would result in a further cumulative leftward movement of IS_Y and IS_Z until a new Keynesian equilibrium is established at IS_Y^* and IS_Z^* in Figure III (13) (as also in Figure III (11)). This, of course, assumes that this multiplier process is stable, and that the shock in the farm sector persists for long enough to allow IS_Y^* and IS_Z^* to be at least approximately established.

For our present purposes, the important point is that the further leftward movement of the IS curves does not place additional downward pressure on the interest rate - unlike in Section III. Rather, the interest rate remains fixed at r^0, and additional deficits occur in the balance of payments until LM has been shifted to the left from LM^1 to LM^*.

It has been assumed, in the preceding analysis, that the only source of change in the money supply is the balance of payments. This reflects equation (28), where it is specified that the money supply varies in line with domestic credit creation and the state of the balance of payments, with the former variable assumed to be

exogenously determined. The exogeneity assumption for domestic credit could be interpreted as an assumption that the monetary authorities react only passively to shocks in the real sector of the economy. Alternatively, it might be interpreted as an assumption that the monetary authorities see a stable domestic credit policy as making a major contribution to overall stability of the money supply. It is interesting, however, to briefly consider the implications of a policy change in the domestic credit component of the money supply in the presence of the shock in the farm sector.

Suppose, for example, that, in response to the decline in the money supply, the monetary authorities increased the domestic credit component of the money supply. In isolation, this policy would move the LM curve to the right in Figure III (13). However, given that IS_Y^* , IS_Z^* and TT are unaffected, it is clear that LM^* remains consistent with balance of payments equilibrium in the new Keynesian equilibrium. Therefore, the rise in the domestic credit component of the money supply would succeed only in increasing the size of the balance of payments deficits which were required in order to establish a money supply consistent with LM^*. Similarly, if the monetary authorities reacted by reducing the domestic credit component of the money supply, then the size of the balance of payments deficit during the adjustment to LM^* would be reduced.

These results, of course, are a reflection of two well known results established in the literature on the monetary approach to the balance of payments - see, for example, Frenkel and Johnson (1976). The first result is that, under a fixed exchange rate regime, the money stock is determined, not by the domestic monetary authorities, but rather by the demand for money balances in the private sector. The second result is that the main impact of domestic credit policy is felt in the balance of payments.

For present purposes, these results also carry an important corollary. In particular, they suggest that, given a fixed exchange rate, an attempt to quantitatively assess the impact of a shock in the farm sector on non-farm output and employment may not be seriously in error if it fails to take into account any active change in domestic credit policy which the shock may induce.

It is also interesting to briefly consider the case where Z is the scale argument in the demand for money function. As noted above, a different money stock would be required in the initial equilibrium ie. LM^2 rather than LM^0. The leftward movement of IS_Z, from IS_Z^0 to IS_Z^* would be associated with a sufficient balance of payments deficit to shift LM from LM^2 to LM^4. As there is no necessary relationship between the horizontal distance between IS_Z^0 and IS_Z^* on one hand, and between IS_Y^0 and IS_Y^* on the other, it is clear that this balance of payments deficit could be either larger or smaller than the deficit implied by the earlier analysis which was based on the assumption that Y was the scale argument. Also, as before, the extent of the deficit during the adjustment period would be influenced by a change in domestic credit policy in response to the shock in the farm sector.

Before proceeding to consider the case of a positively sloped TT schedule, it is worth briefly reiterating the main implications to emerge for the case where capital is assumed to be perfectly mobile:

(1) the result, obtained in Section III, that the decline in farm production would put downward pressure on the interest rate does not hold in the present case. Rather, the interest rate is invariant to the shock in the farm sector - and hence, the resulting change Y and Z is determined largely by the extent of the horizontal movements in the IS curves, with no significant countervailing interest rate effect.

(2) the level of, and movements in, the interest rate are independent of the scale argument in the demand for money function;

(3) the state of the balance of payments during the adjustment phase may not be invariant to the scale argument;

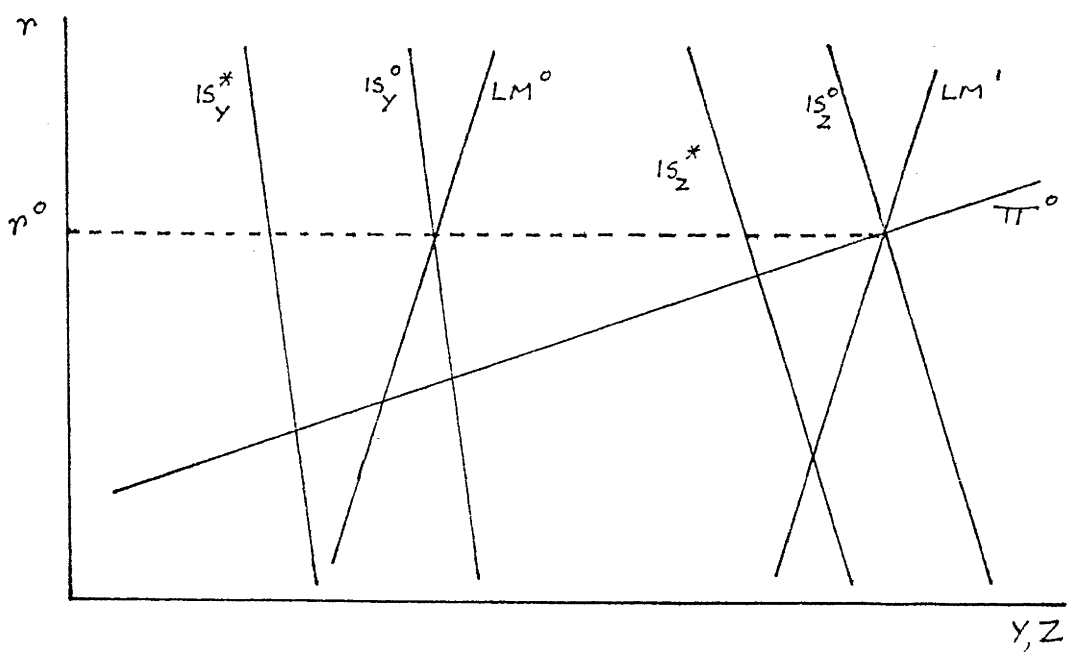
(4) the decline in farm production would be associated with a relatively weak balance of payments - a result which goes further than the intuitively appealing result that a decline in farm production would be associated with a relatively weak current account;

(5) active changes in monetary policy, in response to the farm sector shock, may be of little consequence for an assessment of the impact of the drought on non-farm economic activity.

In considering the case of imperfectly mobile capital, we can, as before, focus our attention on Sector I.

Figure III (14)

Sector I



Assume that, in Figure III (14), the initial positions of the IS curves are represented, as before, by IS_Y^0 and IS_Z^0. Also suppose that the initial position of the TT schedule is represented by TT^0, so that, with Y the scale argument in the demand for money function, the initial position of the LM curve, consistent with balance of payments equilibrium, is LM^0. Once the new Keynesian equilibrium is established following the decline in farm production, the IS curves are represented by IS_Y^* and IS_Z^* (as also in Figure III (13) and Figure III (11). We need to consider the impact of the decline in farm production on the position of the TT schedule.

Recall that the state of the current account of the balance of payments is given by the identity:

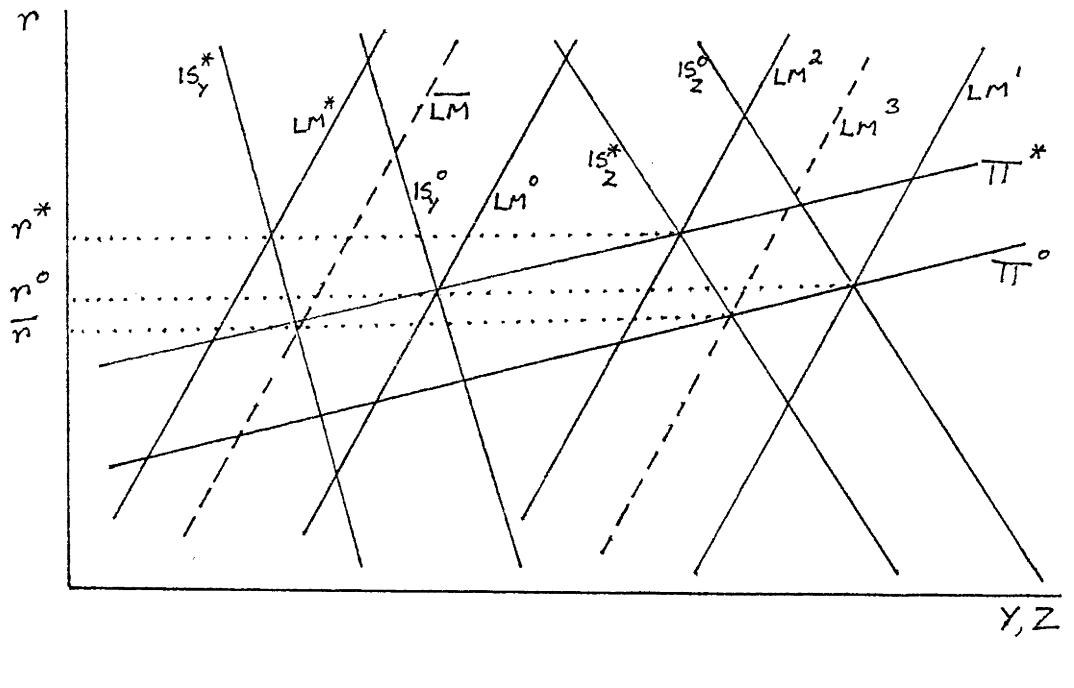
$$p_F O_F + p_{NFT} Y_{NFT} - p_F Z_F - p_{NFT} Z_{NFT}$$

It is immediate that the ordinary partial derivative of the current account with respect to O_F is positive. The remaining elements of the total partial derivative are of no concern in the present context, because $p_{NFT} Y_{NFT}$ is assumed to be exogenously given, while changes in Z_F and Z_{NFT}, induced by a change in O_F via Z, are captured in movements <u>along</u> the TT schedule.

Therefore, the decline in farm production would cause the TT schedule to move to the left. In other words, because the state of the current account is weaker at each level of Z, a higher interest rate and hence a stronger capital account is needed to clear the overall balance of payments.

Figure III (15)

Sector I



In Figure III (15), IS_Y^0, IS_Y^*, IS_Z^0, IS_Z^* and TT^0 are as described in Figure III (14). Suppose that the decline in farm production shifts the TT curve from TT^0 to TT^*. It is immediate that, when a new Keynesian and balance of payments equilibrium are established, the interest rate would be r^*. This raises the theoretical possibility that, as illustrated in Figure III (15), the new equilibrium interest rate <u>could exceed the pre-shock interest rate, r^0</u>. It is clear that such an outcome becomes more likely as the leftward movements of IS_Z from IS_Z^0 becomes smaller i.e. as the impact of the shock on aggregate expenditure becomes smaller.

The outcome for the interest rate is independent of the scale argument in the demand for money function i.e. r^* is determined by the point of intersection between IS_Z^* and TT^*. However, the extent of the balance of payments deficit during the adjustment period is not independent of the scale argument. If Y is the scale argument,

a sufficient balance of payments deficit would be required to shift LM to the left from LM^0 to LM^* - assuming no change in domestic credit. If Z is the scale argument, the required decline in the money stock is that implied by the leftward movement of LM from LM^1 to LM^2.

It is also important to note that the post-shock equilibrium interest rate and the extent of the balance of payments deficit during the adjustment period are not independent of the direct impact of the drought on the current account. In particular, if it was assumed that the drought had no impact on the TT schedule, then the equilibrium interest rate in Figure III (15) would be $\bar{r}$ and the LM curve would move from LM^0 to $\bar{LM}$ in the case of Y as the scale argument, or from LM^1 to LM^3 if Z was the scale argument. This, of course, is in contrast to the outcome just described for the case where TT moves from TT^0 to TT^*, and, in general $\bar{r} < r^*$, $\bar{LM} > LM^*$ and $LM^3 > LM^2$. In other words, once the assumption of perfect mobility of international capital flows is abandoned, the current account can play a direct role in influencing the outcome for the interest rate and the balance of payments. Further, such a result emerges from a model framework which is broadly consistent with the monetary approach to the balance of payments in other respects i.e. balance of payments deficits and surpluses are allowed to influence the money supply and, indeed, are viewed as stock adjustments of the money supply largely in response to changes in the demand for money.

IV (5) Concluding Comments on Section IV

The analysis in Section IV extended that undertaken in Section III by incorporating some explicit balance of payments considerations. Some of the main conclusions are:

(1) with perfectly mobile capital flows:

(a) the decline in farm production has no impact on the interest rate. This implies that the resulting changes in Y and Z could be adequately assessed by considering only the horizontal movements of the IS_Y and IS_Z curves;

(b) in the absence of any change in the domestic credit component of the money supply, the decline in farm production would be associated with a deficit in the balance of payments during the adjustment period. A change in domestic credit would influence the outcome for the balance of payments but have no affect on other variables;

(c) the ambiguity as to the scale argument in the demand for money function is not relevant for the determination of the interest rate, r, but is, in general, relevant for the extent of the balance of payments deficit during the adjustment period;

(2) with imperfectly mobile capital:

(a) the outcome for the interest rate is ambiguous. It is possible that r could either rise or fall relative to its pre-shock equilibrium level. It was possible to identify the broad circumstances under which these various divergent outcomes might arise. An important implication of these results is that an assessment of the impact of a shock in the farm sector on Y or Z, based on the horizontal movements of the IS curves alone, thus ignoring the effects of changes in the interest rate, may either overstate or understate the impact;

(b) the change in the interest rate is independent of the scale argument in the demand for money function;

(c) it remains true that, in the absence of a change in domestic credit, the decline in farm output would be associated with a deficit in the balance of payments during the adjustment period. It also remains true that the extent of that deficit would not, in general, be independent of the scale argument;

(d) the direct effect of the decline in farm production on the current account, via farm exports, influences the interest rate and the extent of the balance of payments deficit during the adjustment period.

Section V Some Preliminary Analysis in the Presence of Partially Flexible Nominal Wages and Non-Traded Goods Prices

V (1) Notation

The additional notation used in the present variant of the model is as follows:

p - an implicit deflator for private farm and non-farm consumption expenditure and farm investment expenditure

y_F - the nominal value of Y_F

y_F^{NF} - the nominal value of Y_F^{NF}

y_F^{F} - the nominal value of Y_F^{F}

y_{NT} - the nominal value of Y_{NT}

y_{NFT} - the nominal value of Y_{NFT}

V (2) Model Specification

The present variant of Model I builds on the variant used in Section IV with the addition of 7 equations, and the slight modification of several others. For convenience, the full speficiation of the model is set out below.

Farm Sector

(1) $$O_F = O_F(\overset{+}{K_F}, \overset{+}{L_F}, \overset{+}{J}, \overset{+}{\alpha_F})$$

(2) $$L_F = L_F(\overset{+}{\frac{\delta O_F}{\delta L_F}}, \overset{+}{\frac{p_F}{p_{NT}}}, \overset{+}{\frac{p_F}{p_{NFT}}}, \overset{-}{n}, \overset{?}{v})$$

(3) $$Y_F = O_F - J$$

(4) $$y_F = p_F O_F - p_{NT} J$$

Equation (4) says that nominal value added in the farm sector is obtained using the double deflation procedure.

(5) $$y_F^F = \beta\, y_F$$

(6) $$y_F = y_F^F + y_F^{NF}$$

Equations (5) and (6) are simply the nominal counterparts of equations (4) and (5) in the two earlier variants of Model I.

$$(7) \quad C_P^F = C_P^F(\overset{+}{\frac{y_F^F}{p}}, \overset{-}{r})$$

$$(8) \quad R = y_F^F - pC_P^F$$

$$(9) \quad I_P^F = I_P^F(\overset{+}{\frac{R}{p}}, \overset{-}{r})$$

Equations (7), (8) and (9) are the counterparts of equations (6), (7) and (8) in the earlier variants of Model I, with explicit allowance made for variations in p. Note that, for simplicity, no distinction is drawn between the real and the nominal interest rate in the present analysis.

The variables which are treated as endogenous to the farm sector of the model are:

(1) O_F (2) L_F (3) Y_F (4) y_F (5) y_F^F (6) y_F^{NF} (7) C_P^F

(8) R (9) I_P^F.

The variables which appear in the farm sector of the model and which are endogenous to the non-farm sector are:

(1) p_{NT} (2) p (3) r (4) n.

Finally, the variables which appear in the farm sector of the model and which are exogenous to the model as a whole are:

(1) K_F (2) J (3) α_F (4) p_F (5) p_{NFT} (6) v.

Non-Farm Sector and Macroeconomic Aggregates

$$(10) \quad Y = Y_{NT} + Y_{NFT} + Y_F$$

$$(11) \quad Y_{NFT} = (\overset{+}{K_{NFT}}, \overset{+}{L_{NFT}}, \overset{+}{\alpha_{NFT}})$$

$$(12) \quad y_{NFT} = p_{NFT}\, Y_{NFT}$$

$$(13) \quad L_{NFT} = L_{NFT}(\overset{+}{\frac{\delta Y_{NFT}}{\delta L_{NFT}}}, \overset{+}{\frac{p_{NFT}}{p_{NT}}}, \overset{+}{\frac{p_{NFT}}{p_F}}, \overset{-}{n}, \overset{?}{v})$$

$$(14)\quad Y_{NT} = Y_{NT}(\overset{+}{K_{NT}}, \overset{+}{L_{NT}}, \overset{+}{\alpha_{NT}})$$

$$(15)\quad y_{NT} = p_{NT}\, Y_{NT}$$

$$(16)\quad L_{NT} = \begin{cases} L_{NT}^{*}(\overset{+}{\frac{\delta Y_{NT}}{\delta L_{NT}}}, \overset{+}{\frac{p_{NT}}{p_{NFT}}}, \overset{+}{\frac{p_{NT}}{p_F}}, \overset{-}{n}, \overset{?}{v}) & \text{for } Z_{NT} = Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) = Y_{NT}^{*} \\ L_{NT}^{D}(\overset{-}{K_{NT}}, \overset{-}{\alpha_{NT}}, \overset{+}{Z_{NT}}) & \text{for } Z_{NT} \neq Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) \end{cases}$$

$$(17)\quad C_P^{NF} = C_P^{NF}(\overset{+}{\frac{y_{NT}}{p}}, \overset{+}{\frac{y_F^{NF}}{p}}, \overset{+}{\frac{y_{NFT}}{p}}, \overset{-}{r})$$

$$(18)\quad C_P = C_P^{NF} + C_P^{F}$$

$$(19)\quad I_P^{NF} = I_P^{NF}(\overset{+}{\Delta Y_{NT}}, \overset{-}{r})$$

$$(20)\quad I_P = I_P^{NF} + I_P^{F}$$

$$(21)\quad Z = C_P + C_G + I_P + I_G$$

$$(22)\quad Z_{NFT} = Z_{NFT}(\overset{+}{Z}, \overset{-}{\frac{p_{NFT}}{p_{NT}}}, \overset{-}{\frac{p_{NFT}}{p_F}}, \overset{?}{\varepsilon})$$

$$(23)\quad Z_{NT} = Z_{NT-J}(\overset{+}{Z}, \overset{-}{\frac{p_{NT}}{p_{NFT}}}, \overset{-}{\frac{p_{NT}}{p_F}}, \overset{?}{\varepsilon}) + J$$

$$(24)\quad Z_F = Z - Z_{NFT} - (Z_{NT} - J)$$

$$(25)\quad n = \frac{w}{ap_{NT} + bp_{NFT} + cp_F}$$

While changes in p_{NT} would vary the relative prices of non-traded, non-farm traded and farm commodities and hence would be expected to vary consumption patterns, it will be assumed that the make-up of the real wage unit, v, is unchanged. This avoids some unnecessary complexity, and could be assumed to reflect the observation that the composition of consumer price indices, against which real wages are typically measured, are not adjusted continuously.

(26) $L = L_{NFT} + L_{NT} + L_F$

(27) $L^S = \bar{L}$

(28) $E = L$

(29) $m^D = m^D(\overset{+}{p}, \overset{+}{Y \text{ or } Z}, \overset{-}{r})$

(30) $m^D = m^S$

(31) $\dot{m}^S = \dot{d} + BP$

(32) $k = k(\overset{+}{r}, \overset{-}{r^W}, \overset{+}{\dot{e}^E}, \overset{?}{\mu})$

(33) $BP = p_{NFT}Y_{NFT} + p_F O_F - p_{NFT}Z_{NFT} - p_F Z_F + k$

Finally, we need to endogenise the movements in nominal wages, non-traded goods prices and price expectations. It is assumed that:

(34) $p = \lambda_1 p_{NT} + \lambda_2 p_{NFT} + \lambda_3 p_F \qquad \sum_{i=1}^{3} \lambda_i = 1$

As p is to be used as an implicit deflator and as relative prices will vary, it is clear that, in principle, λ_1, λ_2 and λ_3 should be endogenous and flexible. Because of the complexity involved, such endogeneity will not be set out explicitly in this algebraic version of the model. However, it will be catered for in the subsequent geometric manipulation of the model.

(35) $\dot{w} = \dot{w}((a\dot{p}_{NT} + \overset{+}{bp_{NFT}} + cp_F)^E, \overset{+}{L - \bar{L}})$

Movements in nominal wages are assumed to be a function of the expected movement in consumer prices, as used to assess the real wage, and the gap between the actual level and the 'natural' level of employment. The 'natural' level of employment could be interpreted as that level which encourages trade unions to seek only to maintain existing real wages (or, in a growth environment, to seek rises in real wages in line with trend growth in labour productivity). For

simplicity, it is assumed that the natural level of employment is equivalent to $\bar{L}$. However, in principle, the natural level of employment could be less than $\bar{L}$ in a highly unionised labour market - if, for example, unions were prepared to trade-off some degree of unemployment in return for a higher real wage. Such a gap between the natural level of employment and $\bar{L}$ could be viewed in terms of Corden's (1979) distinction between 'union voluntary' and 'private involuntary' unemployment. It should also be noted that the assumption of fixed nominal wages, as used in Sections III and IV, could be interpreted as a special case of (35), where expected changes in consumer prices were zero, and any gap between L and $\bar{L}$ had a negligible impact on nominal wage demands.

It is assumed that movements in non-traded goods prices are a function of the change in nominal wages, and the gap between the actual level and the optimal level of non-traded goods production:

$$(36) \qquad \dot{p}_{NT} = \dot{p}_{NT}(\overset{+}{\dot{w}}, \overset{+}{Y_{NT} - Y^{*}_{NT}})$$

The assumption of imperfectly flexible non-traded goods prices clearly implies that, while prices are influenced by the gap between Y_{NT} and Y^{*}_{NT}, the price response is insufficient to ensure that $Y_{NT} = Y^{*}_{NT}$ in the short run. Again, the assumption of perfectly rigid non-traded goods prices in Sections III and IV can be viewed as a special case of (36), where $\dot{w} = 0$ and the influence of $Y_{NT} - Y^{*}_{NT}$ is negligible in the short run.

Finally, the expected change in consumer prices is assumed to be a function of the observed changes in previous periods - which might be be interpreted as either an extrapolative or adaptive process.

$$(37) \qquad \dot{p}^{E} = \dot{p}^{E}((a\dot{p}_{NT} + bp_{NFT} + cp_{F})_{t-i}) \qquad i = 1...n$$

The variables which are treated as endogenous to the non-farm sector of the model are:

(1) Y (2) Y_{NT} (3) Y_{NFT} (4) L_{NFT} (5) y_{NFT} (6) n (7) L_{NT}

(8) y_{NT} (9) C_P^{NF} (10) r (11) C_P (12) I_P^{NF} (13) I_P (14) Z

(15) Z_{NFT} (16) Z_{NT} (17) Z_F (18) L (19) L^S (20) E (21) m^D

(22) m^S (23) k (24) BP (25) p (26) $\dot{w}$ (27) $\dot{p}_{NT}$ (28) $\dot{p}^E$

The variables which enter the non-farm sector of the model and which are endogenous to the farm sector are:

(1) Y_F (2) C_P^F (3) I_P^F (4) L_F (5) O_F

The variables which are exogenous to the model as a whole are:

(1) K_{NFT} (2) α_{NFT} (3) p_{NFT} (4) p_F (5) v (6) K_{NT} (7) α_{NT}

(8) C_G (9) I_G (10) ε (11) J (12) $\bar{L}$ (13) $\dot{d}$ (14) r^W (15) $\dot{e}^E$

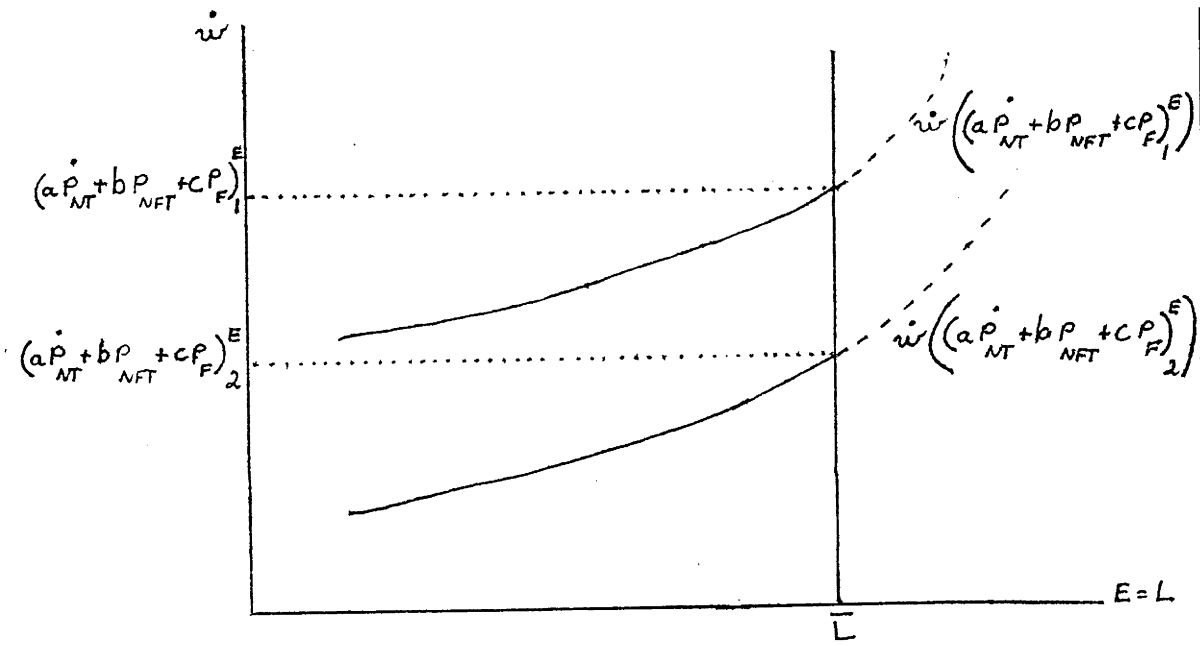
(16) μ.

V (3) A Geometric Characterisation of the Model

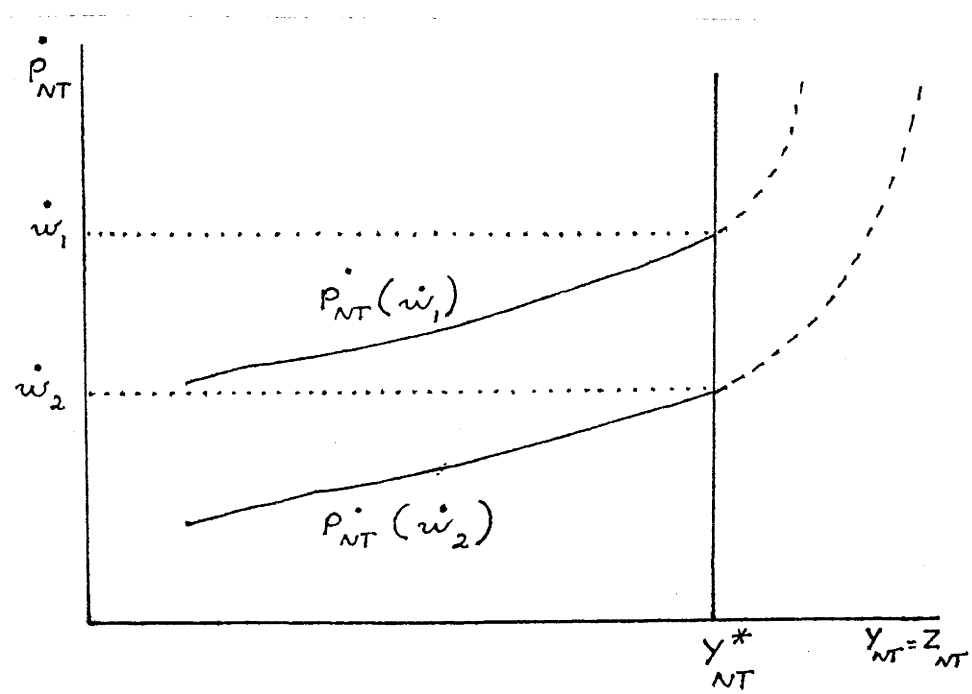
The geometric characterisation of the model builds on that used in Section IV, with the addition of an extra sector, Sector V, which serves to endogenise movements in nominal wages and non-traded goods prices.

Figure III (16)

Sector V (1)



Sector V (2)



In Sector V (1), for a given expected change in consumer prices, the change in nominal wages can be expressed as a function of the level of employment. Where $E = \bar{L}$, the change in nominal wages is equal to the expected change in consumer prices, and where $E < \bar{L}$, $\dot{w}$ is less than the expected change in consumer prices.

Similarly, in Sector V (2), for a given change in nominal wages, the change in non-traded goods prices can be expressed as a function of the level of non-traded goods production. For $Z_{NT} = Y_{NT} = Y_{NT}^{*}$, the change in non-traded goods prices is equal to the change in nominal wages, while, if $Z_{NT} = Y_{NT} < Y_{NT}^{*}$, the change in non-traded goods prices is less than the change in nominal wages.

Finally, note that, for our purposes, only those parts of the Phillips Curves lying to the left of $\bar{L}$ in Sector V (1), and to the left of Y_{NT}^{*} in Sector V (2) are relevant ie. we have assumed that $E < \bar{L}$ throughout, and that $Z_{NT} = Y_{NT} < Y_{NT}^{*}$.

V (4) Some Preliminary Analysis

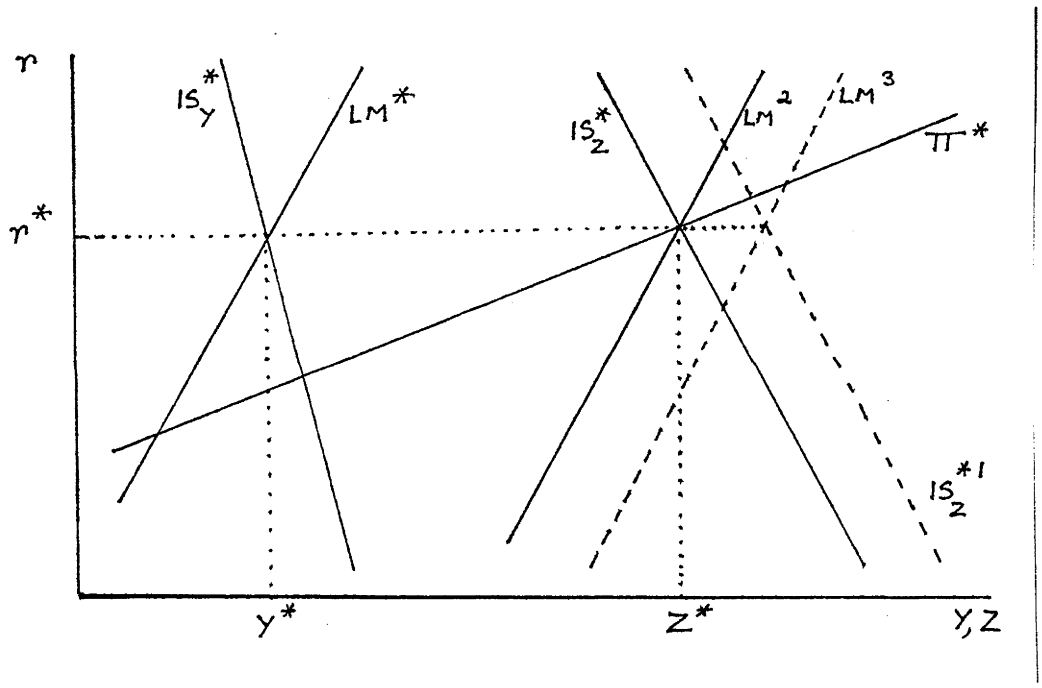
It is clear that the present variant of Model I is substantially more complex than the two earlier variants. The effects of movements in nominal wages and non-traded goods prices, in Sector V, permeate each of the other four sectors, over and above the various linkages captured in the earlier variants.

Because of this additional complexity, it is not feasible to attempt so complete an analysis in the present case, using the geometric construct, as was possible in Sections III and IV. Nevertheless, it is possible to gain some feel for the nature of the impact of variable non-traded goods prices and nominal wages in the model, and this should prove valuable as an aid to the interpretation of the results obtained from the theoretical simulation variant of Model I (which closely resembles the present variant of the model in structure) in Chapter X. This, of course, also serves to further highlight the strong complimentarity which exists between the various approaches to analysing a theoretical model - as discussed in Chapter I.

It will be assumed, for simplicity and ease of exposition, that no change occurs in nominal wages and non-traded goods prices until the new Keynesian and balance of payments equilibrium, as discussed in Section IV, is established. While this is clearly an over-simplification, it allows us to use the equilibrium established in Section IV as a starting point for the present analysis.

Figure III (17)

Sector I



In Figure III (17), IS_Y^*, IS_Z^*, TT^*, LM^* and LM^2 are equivalent to the corresponding schedules in Figure III (15) - in other words, they represent the position of the schedules in the Keynesian and balance of payments equilibrium <u>following</u> the decline in farm production, but in the absence of any change in nominal wages and non-traded goods prices.

It will be recalled, from the analysis in Sections III and IV, that the non-traded component of Y^* - say Y_{NT}^B - is less than the optimal

level of Y_{NT}, ie. Y_{NT}^*. Similarly, the level of employment implied by Y^* is less than $\bar{L}$. It is clear, from Sector V in Figure III (16), that the gap between the actual level and the natural level of employment will, in the present context, place downward pressure on nominal wages. Also, the gap between the actual level and the optimal level of non-traded goods production will place downward pressure on non-traded goods prices. Further, the decline in nominal wages would put additional downward pressure on non-traded goods prices in Sector V (2) while, to the extent that the decline in non-traded goods prices created an expectation of further declines, there would also be additional downward pressure on nominal wages.

It is important to note that this gradual downward adjustment of p_{NT} and w does not carry any necessary implications for the real wage, n (equation (25)). In other words, n may rise, fall or remain unchanged, depending on the timing of the changes in w and p_{NT}, and hence on the sensitivity of w to $(E - \bar{L})$ and of p_{NT} to $(Y_{NT} - Y_{NT}^*)$.

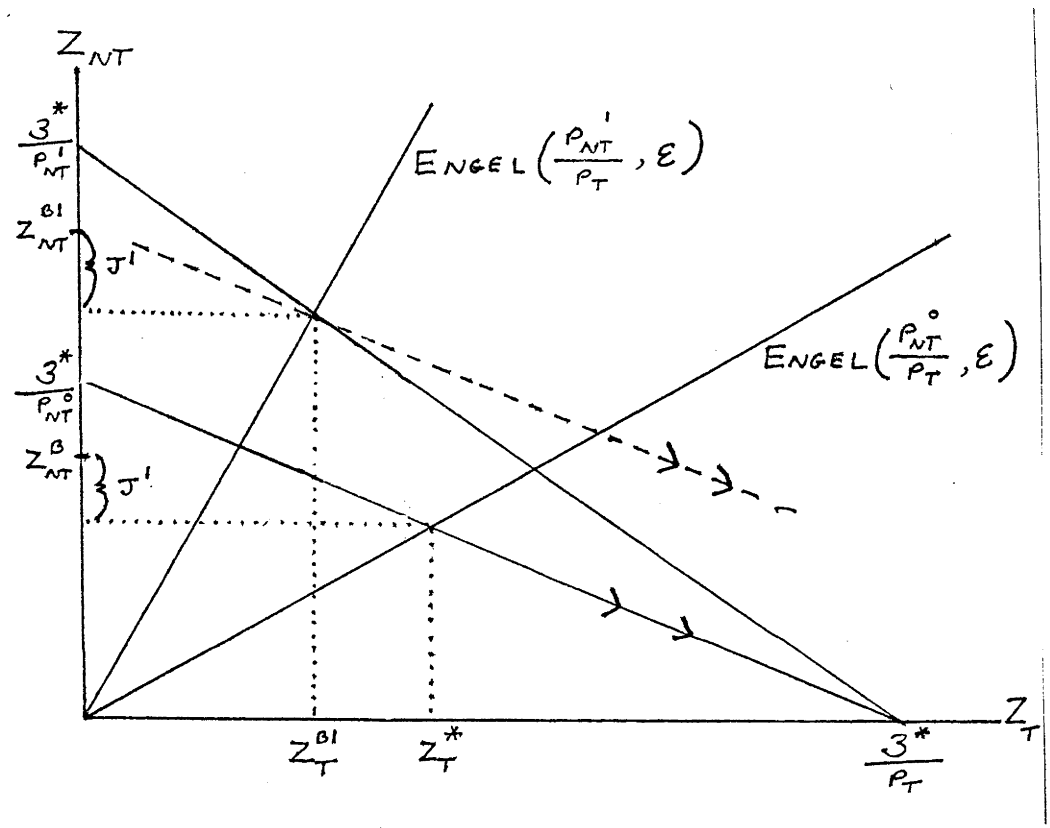
The next step is to assess the impact of the decline in non-traded goods prices and nominal wages on the various schedules in Sector I of the model. It is clear that the LM curve would move to the right, from either LM^* in Figure III (17), or from LM^2, depending on the scale argument in the demand for money function. In other words, if Y is the real scale argument, the decline in p_{NT} means that the nominal value of any given Y is lower, thus being associated with a lower demand for nominal balances. Similarly, if Z is the scale argument, the lower p_{NT} means that the nominal value of a given volume of expenditure is lower, implying a lower demand for nominal balances.

Given p_F, p_{NFT} and the original level of p_{NT}, it is clear that each volume of expenditure along IS_Z^* can be converted to nominal terms. For example, Z^* can be converted to nominal terms - say 3^*.

Then, given 3^*, we can assess the impact of the decline in p_{NT}, in the context of Sector II.

Figure III (18)

Sector II (1)



In Figure III (18), the budget line implied by 3^*, p_{NFT}, p_F and the original level of p_{NT}, say p_{NT}^0, is that given by the intercepts $\frac{3^*}{p_{NT}^0}$ $\frac{3^*}{p_T}$. Then, given the Engel Curve relevant to the original relative prices, and given the post-shock level of J, ie. J^1, the level of real aggregate expenditure on traded goods is Z_T^*, and real aggregate demand for non-traded goods is Z_{NT}^B. After the fall in p_{NT} from p_{NT}^0 to p_{NT}^1, the budget line implied by 3^* rotates to that given by the intercepts $\frac{3^*}{p_{NT}^1}$ $\frac{3^*}{p_T}$. Using the Engel Curve relevant to the new relative price of traded and non-traded goods, it is clear that 3^* is now associated with a volume of expenditure on traded

goods of Z_T^{B1}, and a real aggregate demand for non-traded goods of Z_{NT}^{B1}, again given J^1.

Several points should be noted from this analysis:

(1) firstly, the volume of final expenditure now associated with 3^* is greater than Z^*, when measured at the original relative prices. It follows that, given the levels of nominal expenditure implied by various points along IS_Z^*, the IS_Z curve would move to the right from IS_Z^* to IS_Z^{*1} in Fig. III (17).[1]

(2) It will be recalled that, from equation (29)

$$m^d = m^d(\overset{+}{p}, \overset{+}{Y \text{ or } Z}, \bar{r})$$

Suppose that Z is the real scale argument, and that, as is conventionally assumed, the demand for nominal money balances is homogeneous of degree one in price. Under such circumstances, (29) would become:

$$\frac{m^d}{p} = m^d(\overset{+}{Z}, \bar{r}).$$

Also suppose that the real expenditure elasticity of demand for money was unity. It follows that the rightward movement of LM from LM^2, following the fall in p_{NT}, as noted above, would be just sufficient to ensure that LM intersects IS_Z^{*1} at interest rate r^*, the same interest rate as the point of intersection between IS_Z^* and LM^2. Such an LM curve is represented by LM^3 in Figure III (17).

(3) Thirdly, the volume of expenditure on non-traded goods is higher in the presence of the lower level of p_{NT}. As drawn in Figure III (18), it is assumed that, following the fall in p_{NT},

---

[1] In other words, a line drawn through the point of intersection between the new budget line $\frac{3^*}{p_{NT}^1}$ $\frac{3^*}{p_T}$ and the new Engel Curve, Engel $(\frac{p_{NT}^1}{p_T}, \varepsilon)$, and parallel to the original budget line, lies entirely outside the original budget line. As a similar exercise could be undertaken for each point along IS_Z^*, it follows that the IS_Z curve would move to the right from IS_Z^* to IS_Z^{*1}.

given 3^*, the volume of expenditure on traded goods falls, and as p_T is given, nominal expenditure on traded goods also falls. In other words, the demand for non-traded goods is assumed to be price elastic, so that the fall in p_{NT} results in a rise in the level of nominal expenditure on non-traded goods.[2]

The multiplier effects of these adjustments to the IS_Z curve are quite clear. In particular, as the rightward movement of IS_Z from IS_Z^* to IS_Z^{*1} is associated with an increase in the volume and nominal value of demand for non-traded goods, this would stimulate an increase in the volume of production of non-traded goods, causing the IS_Y curve to move to the right from IS_Y^*. This increase in real income in the non-traded goods sector would then produce a further increase in real expenditure, moving the IS_Z curve further to the right from IS_Z^{*1}, and so on. In other words, a Keynesian demand multiplier process would occur, as described in Section III, but, on this occasion, in a positive direction.

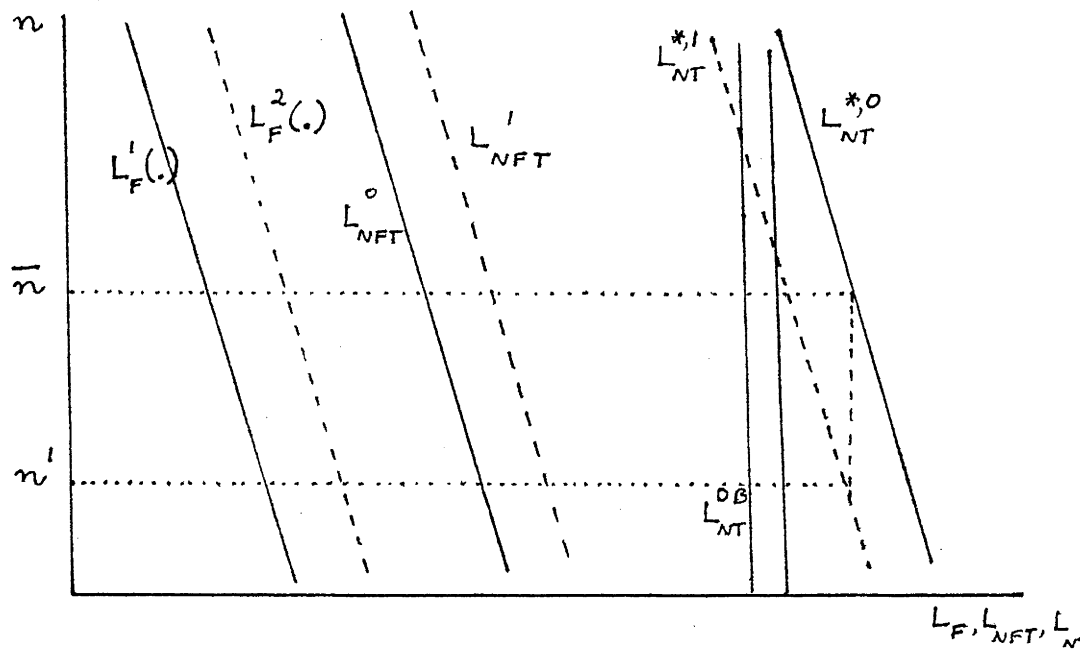
In the presence of downward adjustment of nominal wages and non-traded goods prices, it would also be expected that the position of the IS_Y and IS_Z curves would be influenced by developments in the farm and the non-farm traded goods sectors. This can be illustrated conveniently in Sector IV of the model.

---

[2]The assumption that the demand for non-traded goods is price elastic would seem sensible if the non-traded goods sector is conceptualised as the aggregate of a group of producers possessing at least some price searching ability i.e. downward adjustment of prices would occur only if marginal revenue was positive (and, indeed, if the marginal revenue product exceeded the nominal wage rate).

Figure III (19)

Sector IV



In Sector IV, in Figure III (19), $L_F^1(.)$ is the position of the demand for labour schedule in the farm sector, following the decline in farm production, but prior to the fall in p_{NT} - as also in Figure III (10). Similarly, L_{NFT}^0 is the original position of the demand for labour schedule in the non-traded goods sector. It will be recalled that these schedules are constructed for a given v, and given relative prices of farm, non-farm traded and non-traded goods. It is clear that, as the relative price of non-traded goods falls, each level of the real wage would represent a smaller burden to employers in the farm and non-farm traded goods sectors. Therefore, the demand for labour schedules in those sectors would move to the right - say from $L_F^1(.)$ to $L_F^2(.)$, and from L_{NFT}^0 to L_{NFT}^1. Similarly, the optimal demand for labour in the non-traded goods sector would move to the left, from L_{NT}^{*0} to L_{NT}^{*1}.

It was noted above that the actual level of the real wage, n, may rise, fall or remain unchanged at $\bar{n}$, in the presence of variable nominal wages and non-traded goods prices. If n falls below $\bar{n}$, then the effect of the rightward movement of $L_F(.)$ and $L_{NFT}(.)$ on employment in the farm and non-farm traded goods sectors would be further reinforced. Even if n rose above $\bar{n}$, it would be expected that some increase in employment in those sectors would occur provided that there was at least some fall in the nominal wage level. On the other hand, the optimal level of output in the non-traded goods sector would fall unless n fell to at least n^1.

In general then, the falling level of nominal wages and non-traded goods prices would have a beneficial effect on output and employment in the farm and non-farm traded goods sectors. This would produce a further rightward movement of the IS_Y curve in Sector I, and hence induce a further rightward movement of the IS_Z curve. It should also be noted that, to the extent that the optimal level of non-traded goods production falls, this will serve to further narrow the gap which exists between the actual level and the optimal level of non-traded goods production. In other words, not only will the fall in p_{NT} and w serve to raise the actual level of production of non-traded goods as IS_Y and IS_Z move to the right from IS_Y^* and IS_Z^* in Figure III (17), but Y_{NT}^* will also tend to fall.

The final schedule to be considered in Sector I is the TT schedule. In particular, we need to assess whether, for a given level of Z, the position of the TT schedule in Figure III (17) will shift from TT^*, given the fall in non-traded goods prices and nominal wages. The current account balance is given by the identity:

$$p_F O_F + p_{NFT} Y_{NFT} - p_F Z_F - p_{NFT} Z_{NFT}$$

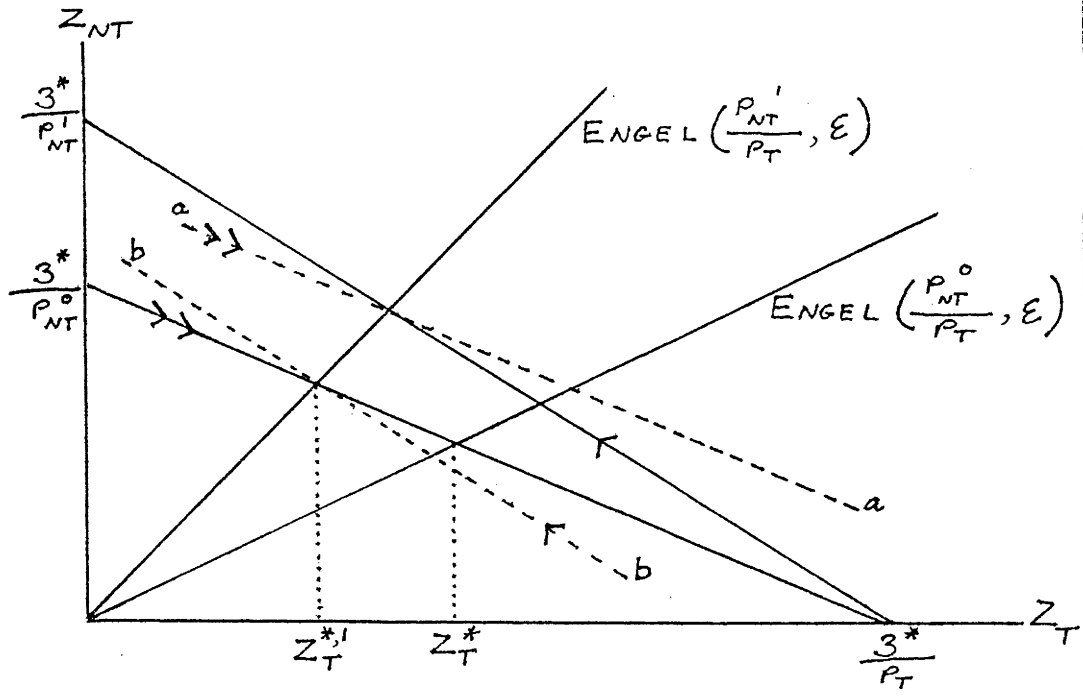
As we have seen, the fall in p_{NT} and w would, in general, lead to an

increase in O_F and Y_{NFT} which would, in turn, improve the current account balance for given Z. In other words, the rise in O_F and Y_{NFT} would tend to move TT to the right from TT^* in Figure III (17).

The two remaining endogenous variables in the current account identity are Z_F and Z_{NFT}. Both of these variables are functions of Z, relative prices and the indifference mapping ε. A change in p_{NT} and w obviously influences Z, but we can ignore that in the present context because we are assessing the impact on the current account for given Z. As ε is given, we need only consider the impact of a change in p_{NT} on Z_F and Z_{NFT} as it operates through the relative price term. This can be done readily in Sector II (1).

Figure III (20)

Sector II (1)



For purposes of illustration, we can again focus on Z^*, the volume of final expenditure in the new Keynesian equilibrium established prior to the commencement of any decline in p_{NT} and w - as in Figure III (17). Given p_F, p_{NFT} and the original level of p_{NT}

ie. p_{NT}^{0}, Z^{*} can be converted to nominal terms, 3^{*}. Given 3^{*}, we have seen previously that the fall in p_{NT} from p_{NT}^{0} to p_{NT}^{1} has the effect of rotating the budget line in Figure III (20) to that given by the intercepts $\frac{3^{*}}{p_{NT}^{1}}$ $\frac{3^{*}}{p_{T}}$. It is clear that, in general, $Z_{T}^{*1} < Z_{T}^{*}$ ie. for a given volume of expenditure, the decline in the relative price of non-traded goods would reduce the volume of expenditure on traded goods. Further, as p_{F} and p_{NFT} are given, this would also imply a decline in the nominal value of expenditure on traded goods.[3]

There would seem, therefore, to be two influences affecting the movement of the TT schedule, both of which are suggestive of a rightward movement of TT from TT^{*} in Figure III (17) in the face of a decline in p_{NT} and w. Firstly, the value and volume of farm and non-farm traded goods production would increase, serving to improve the current account at each given level of Z. Secondly, a pure substitution effect in expenditure would reduce the proportion of any given volume of expenditure which is directed onto traded goods.

---

[3]The new volume of expenditure is given by the point of intersection between $\frac{3^{*}}{p_{NT}^{1}}$ $\frac{3^{*}}{P_{T}}$ and Engel $\frac{p_{NT}^{1}}{p_{T}}$, ε). The problem is that this new volume of expenditure, when valued at the original prices, is greater that Z^{*} - clearly, the line aa, passing through that point of intersection and parallel to the original budget line, lies outside the original budget line. Suppose, however, that nominal expenditure is reduced from 3^{*}, so that the budget line drawn for the new relative prices moves inwards to the position indicated by the line bb. It is clear that the chosen point on that budget line would also be on the original budget line i.e. when measured at the original relative prices, it would represent a volume of expenditure equal to Z^{*}.

It should also be recalled, from the discussion of Figure III (18), that, given 3^*, p_{NT}^1 and p_T, the volume and value of expenditure on traded goods is less than for 3^*, p_{NT}^* and p_T. This implies that, not only will TT move to the right from TT^*, but also that the new TT schedule would intersect IS_Z^{*1} at a level of the interest rate below r^*.

We are now in a position to draw together the various strands of the present analysis. It has been argued that, taking as a starting point the Keynesian and balance of payments equilibrium established in Section IV - as replicated in Figure III (17) - a downward adjustment of nominal wages and non-traded goods prices would:

(1) move the LM curve to the right, regardless of whether the scale argument in the demand for money function was Y or Z;

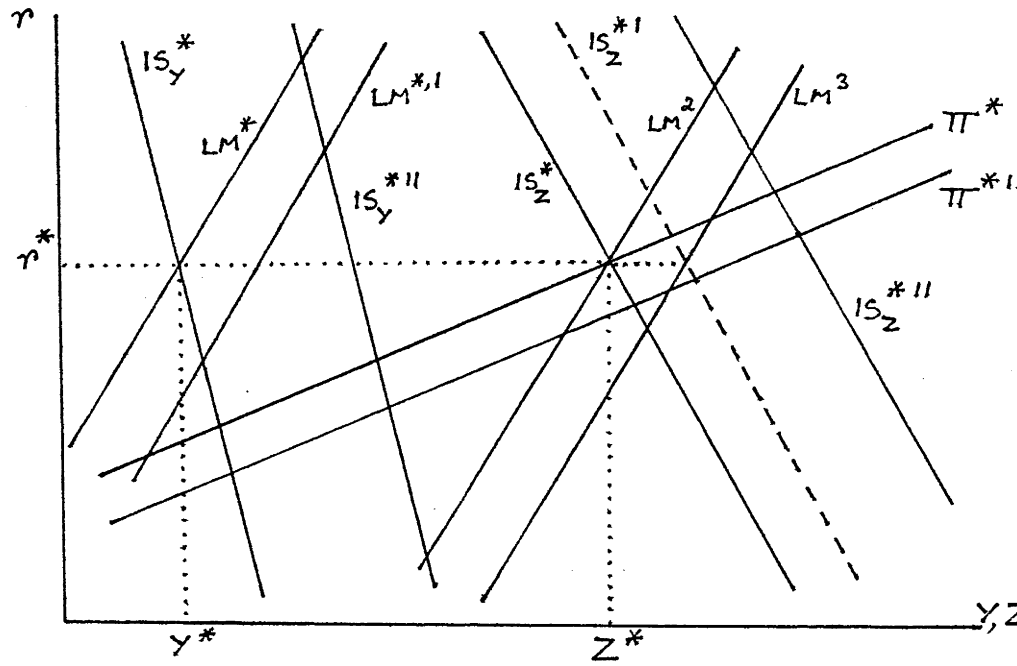
(2) move the IS_Y and IS_Z curves to the right. In general, it would be expected that the horizontal movement of the IS curves would exceed that of the LM curve ;

(3) move the TT curve to the right, with certain restrictions, as noted above.

In Figure III (21), IS_Y^*, IS_Z^*, LM^*, LM^2 and TT^* are the positions of the respective curves in the Keynesian and balance of payments equilibrium, as established in Section IV, prior to the downward adjustment of p_{NT} and w. After the effects of the downward adjustment of p_{NT} and w have been absorbed, IS_Y moves from IS_Y^* to IS_Y^{*11}, IS_Z from IS_Z^* to IS_Z^{*11} and TT from TT^* to TT^{*11}. The direct effect of the change in p_{NT} on the price level has the effect of moving LM from LM^* to LM^{*1}, or from LM^2 to LM^3, depending on the relevant scale argument. The IS_Z curve, IS_Z^{*1}, is as described previously, in the context of Figure III (17). Note that IS_Z^{*1} and LM^3 intersect at interest rate r^*, and that TT^{*11} intersects IS_Z^{*1} at a level of the interest rate below r^*.

Figure III (21)

Sector I



Several conclusions follow immediately:

(1) with IS_Y, IS_Z and TT moving to the right from IS_Y^*, IS_Z^* and TT^* respectively, then, when a Keynesian and balance of payments equilibrium are re-established, in the presence of the lower level of w and p_{NT}, Y should lie somewhere to the right of Y^*, and Z to the right of Z^*. In other words, the decline in p_{NT} and w serves to at least partly mitigate the effect of the decline in farm production on Y and Z, relative to that suggested by the analysis in Section IV. Such a result, of course, is intuitively appealing;

(2) the rightward movement of IS_Y and IS_Z seems likely to exceed the <u>initial</u> rightward movement of the LM curve which occurs as a reflection of the fall in p_{NT} with a given nominal money stock. As TT will also move to the right, it follows that, in general, balance of payments equilibrium would require a larger nominal

money stock than implied by LM^*, LM^{*1}, LM^2 or LM^3. In other words, the adjustment period would be characterised by balance of payments surpluses. Such surpluses would at least partly offset the balance of payments deficits which were indicated during the adjustment period in the analysis in Section IV;

(3) it is unclear whether the decline in p_{NT} and w would place upward or downward pressure on the interest rate, relative to r^*. As drawn, TT^{*11} and IS_Z^{*11} intersect at an interest rate in excess of r^*, suggesting upward pressure on r. However, the converse outcome would also seem to be theoretically possible. It will be recalled that the analysis in Section IV suggested that the outcome for r was uncertain. The present analysis would seem to reinforce that uncertainty.

V (5) Concluding Comments on Section V

Because of the complexity of the present variant of Model I, our geometric analysis was necessarily rather sketchy and imcomplete. Amongst other things, this complexity highlights the need to move to a theoretical simulation approach in order to undertake a more complete analysis. Nevertheless, some useful insights were gained which should prove to be of value in interpreting and assessing the results obtained from the theoretical simulation variant of Model I, in Chapter X. The theoretical simulation variant endogenises both the balance of payments and movements in non-traded goods prices and nominal wages. In that sense, its general structure is very similar to the present variant of the model.

For analytical convenience, it was assumed that the post shock Keynesian and balance of payments equilibrium, identified in Section IV, was established prior to the commencement of any downward adjustment of non-traded goods prices and nominal wages. In reality, of course, these various adjustments could be expected to occur simultaneously.

There is a strong suggestion that, when non-traded goods prices and nominal wages are made more flexible, the impact of the decline in farm production on overall output and employment should be reduced. This result is quite conventional, and, of course, lies at the heart of the debate between the 'Popular Keynesian' and 'Classical' schools of thought. It would also suggest that quantitative assessments of the impact of shocks in the farm sector on non-farm output, based on 'Popular Keynesian' assumptions, may overstate the true impact.

The results also suggest that the interest rate and the state of the balance of payments during the adjustment period may depend significantly on the degree of flexibility of nominal wages and non-traded goods prices. There is some suggestion that, as the influence of a lower level of p_{NT} and w begins to be felt, the balance of payments could be stronger than otherwise. Finally, it would seem to remain true that movements in the interest rate could either reinforce or partly counteract the horizontal movements of the IS curves.

Section VI: Concluding Comments on Chapter III

In Chapter III:

(a) the basic philosophy underlying Models I, II, III, IV and V has been set out;

(b) Model I has been specified, characterised geometrically and then used to analyse the implications of a shock in the farm sector under the circumstances postulated in the first paradigm i.e. a shock to the volume of farm production in the presence of a perfect residual export market for farm commodities. It was assumed that the shock to farm production was adverse, but a largely parallel analysis could be undertaken for a beneficial shock;

(c) in the first instance, the analysis abstracted from explicit balance of payments considerations, and it was assumed that the price of non-traded goods and nominal wages were fixed. The state of the balance of payments was subsequently incorporated into the analysis and, ultimately, a degree of flexibility of non-traded goods prices and nominal wages was also introduced;

(d) for purposes of illustration, a sequential approach to the Keynesian dynamics was adopted in the earlier parts of the analysis i.e. the various rounds of the demand multiplier process were followed through in the model. This permitted the multiplier process to be treated more summarily in the latter parts of the analysis - and indeed, also in later chapters;

(e) the main results and conclusions obtained from these analyses have been summaried in Sections III (5), IV (5) and V (5). Little would be gained by repeating that material here. However, in broad terms:

- the exogenous decline in farm production set in train a negative Keynesian demand multiplier process in the non-traded goods sector of the economy;
- it was shown how, in principle, variations in output and employment in the non-traded goods sector could arise in response to the shock to the volume of farm production, even in the absence of a counter-cyclical movement in the real wage;
- the adjustment to the new, post-shock Keynesian equilibrium was associated with temporary deficits in the overall balance of payments, in the absence of any change in the domestic credit policy of the monetary authorities;
- the extent of the decline in economic activity and the size of the temporary balance of payments deficit was reduced once some flexibility of non-traded goods prices and nominal wages was permitted;
- in the largely closed economy analysis, the decline in farm production was associated with downward pressure on the interest rate, which may accord with intuition or conventional wisdom. However, once explicit balance of payments considerations were introduced, the outcome of the interest rate became uncertain i.e. it is possible that an exogenous decline in farm production could place upward pressure on the interest rate. This uncertainty with respect to the impact on the interest rate remained present following the introduction of some flexibility in non-traded goods prices and nominal wages. While this result may appear counterintuitive, it can be explained readily. Implicit behind the intuitive expectation that the interest rate would fall is the recognition that the decline in farm production and the resulting decline

in overall economic activity would reduce the demand for money and hence would place downward pressure on the interest rate. However, once explicit balance of payments considerations are introduced, it is recognised that the decline in farm production has a direct adverse effect on the current account, so that a relatively stronger capital account is required in order to clear the overall balance of payments. An increase in the interest rate may be required to generate this relative strengthening of the capital account. In such a case, equilibrium in the money market is re-established not via a fall in the interest rate, but rather via a fall in the money supply, in the form of balance of payments deficits.

This analysis should prove valuable as a complement to the more complete and rigorous analysis of the first paradigm undertaken within the context of the theoretical simulation variant of Model I, in Chapter X. A number of the results also prove useful in developing the simple quantitative model in Chapter IX.

Before we can proceed to these theoretical simulation and quantitative analyses, however, we need to undertake some analysis of the four remaining paradigms within the context of Models II, III, IV and V. This is the subject of the next four chapters.

CHAPTER IV

MODEL II: SOME ANALYSIS OF THE SECOND PARADIGM

Introduction

In Chapter III we examined some macroeconomic consequences of a shock in the farm sector of the economy, where the nature of that shock was consistent with the first paradigm. In particular, it was assumed that an exogenous change in the volume of farm production occurred, in the presence of a perfect residual export market for farm commodities. That analysis was undertaken using Model I. Now, in Chapter IV, we will direct our attention to the second paradigm and undertake some analysis using a slightly different version of the model, Model II.

It will be recalled, from Chapter II, that the second paradigm is defined as the case where an exogenous shock to the volume of farm production occurs in the absence of either an export outlet or buffer stockholding. This implies that the production shock must be absorbed via an appropriate change in the price paid by domestic consumers of the product, and received by producers. It was argued that this paradigm is relevant for the largely non-traded farm commodities - for example, a wide range of horticultural commodities and several intensive livestock industries - and is of some relevance for the beef, mutton and lamb industries.

The philosophy underlying Model II is largely identical to that described at length for Model I, in Chapter III. The only substantive difference between Model I and Model II lies in the marketing environment in which the farm sector is assumed to operate, as dictated by paradigms one and two.

In Chapter III, a variant of Model I was developed which catered for a degree of flexibility of non-traded goods prices and nominal wages. We will not, however, consider such a variant of Model II. There are several reasons for this decision. Firstly, it was clear from the analysis undertaken with Model I that the inclusion of some degree of flexibility of non-traded goods prices and nominal wages adds substantially to the complexity of the analysis, making heavy demands on the geometric approach. Further, that earlier analysis with Model I has already served to provide some feel for the impact of movements in the price of non-traded goods, and in nominal wages, within the general model framework. In view of that, it was felt that the inclusion of flexible non-traded goods prices and nominal wages in Model II could be best undertaken in the theoretical simulation variant of Model II - as presented in O'Mara et al (1985) and discussed very briefly in Chapter X.

In Section II below, the algebraic structure of Model II is set out, a geometric characterisation of the model is presented and this geometric structure is then used to undertake some analysis of the second paradigm. In Section III, explicit balance of payments considerations are incorporated into the analysis. Finally, some concluding comments are contained in Section IV.

Section II. Model II - Specification and Some Analysis

II(1). Notation

The notation used in Model II is identical to that used for Model I as described in Chapter III, with the addition of two terms:

p_F^W - the local equivalent of the world price of those farm commodities which are subject to an effective export contraint,

$\bar{O}_F$ - the constrained volume of farm exports.

II(2). Model Specification

Farm Sector

(1) $O_F = O_F(\overset{+}{K_F}, \overset{+}{L_F}, \overset{+}{J}, \overset{+}{\alpha_F})$

(2) $L_F = L_F(\overset{+}{\frac{\delta O_F}{\delta L_F}}, \overset{+}{\frac{p_F}{p_{NT}}}, \overset{+}{\frac{p_F}{p_{NFT}}}, \bar{n}, \overset{?}{\dot{v}})$

(3) $Y_F = O_F - J$

(4) $y_F = p_F O_F - p_{NT} J$

In Model I, there was no requirement to distinguish between real and nominal value added in the farm sector until p_{NT} was allowed to vary, in Section V. In the present case, however, as p_F is determined endogenously, the distinction is relevant immediately.

(5) $y_F^F = \beta y_F$

(6) $y_F = y_F^F + y_F^{NF}$

(7) $C_P^F = C_P^F(\overset{+}{\frac{y_F^F}{p}}, \bar{r})$

(8) $R = y_F^F - pC_P^F$

(9) $I_P^F = I_P^F(\overset{+}{\frac{R}{p}}, \bar{r})$

(10) $Z_F = O_F - \bar{O}_F$

Equation (10) says that the volume of domestic expenditure on farm commodities must be sufficient to absorb all farm output in excess of the constrained volume of farm exports, $\bar{O}_F$. This equation serves to endogenise p_F.

It is clear that the specification of the farm sector in Model II is identical to that in Model I except that, in the present case, explicit allowance has been made for variations in p_F (and hence in p).

The variables which are treated as endogenous to the farm sector are:

(1) O_F (2) L_F (3) Y_F (4) y_F (5) y_F^F (6) y_F^{NF} (7) C_P^F
(8) R (9) I_P^F (10) p_F

The variables which appear in the farm sector of the model and which are endogenous to the non-farm and macroeconomic aggregates sector of the model are:

(1) n (2) p (3) r.

The variables which are exogenous to the model as a whole are:

(1) K_F (2) J (3) α_F (4) p_{NT} (5) p_{NFT} (6) v.

<u>Non-Farm Sector and Macroeconomic Aggregates</u>

$$(11)\quad Y = Y_{NT} + Y_{NFT} + Y_F$$

$$(12)\quad Y_{NFT} = Y_{NFT}\,(\overset{+}{K}_{NFT}, \overset{+}{L}_{NFT}, \overset{+}{\alpha}_{NFT})$$

$$(13)\quad L_{NFT} = L_{NFT}\left(\frac{\delta \overset{+}{Y}_{NFT}}{\delta L_{NFT}}, \frac{\overset{+}{p}_{NFT}}{p_{NT}}, \frac{\overset{+}{p}_{NFT}}{p_F}, \bar{n}, \overset{?}{v}\right)$$

$$(14)\quad Y_{NT} = Y_{NT}\,(\overset{+}{K}_{NT}, \overset{+}{L}_{NT}, \overset{+}{\alpha}_{NT})$$

$$(15)\quad L_{NT} = \begin{cases} L^*_{NT}\left(\frac{\delta \overset{+}{Y}_{NT}}{\delta L_{NT}}, \frac{\overset{+}{p}_{NT}}{p_{NFT}}, \frac{\overset{+}{p}_{NT}}{p_F}, \bar{n}, \overset{?}{v}\right) \text{ for } Z_{NT} = Y_{NT}\,(K_{NT}, L^*_{NT}, \alpha_{NT}) \\ L_{NT}^{D}\,(\bar{K}_{NT}, \bar{\alpha}_{NT}, \overset{+}{Z}_{NT}) \text{ for } Z_{NT} \neq Y_{NT}\,(K_{NT}, L^*_{NT}, \alpha_{NT}) \end{cases}$$

Up to this point, the specification of the non-farm sector of Model II is identical to that for Model I . Some modification is required, however, in the non-farm consumption function.

$$(16)\quad C_P^{NF} = C_P^{NF}\left(\frac{p_{NT}\overset{+}{Y}_{NT}}{p}, \frac{p_{NFT}\overset{+}{Y}_{NFT}}{p}, \frac{\overset{+}{y}_F^{NF}}{p}, \frac{(p_F^W \overset{+}{-} p_F(\bar{O}_F))}{p}, \bar{r}\right)$$

In (16), explicit allowance is made for variations in p_F, acting through the consumption deflator, p, to influence the volume of non-farm consumption expenditure. In addition, it is assumed that quotas for the export of farm commodities are held by non-farm households, and that quota profits, as defined by the term

$$p_F^W - p_F\ (\bar{O}_F)$$

influence non-farm consumption expenditure.

$$(17)\quad C_P = C_P^F + C_P^{NF}$$

$$(18)\quad I_P^{NF} = I_P^{NF}\ (\overset{+}{\Delta Y}_{NT}, \bar{r})$$

$$(19)\quad I_P = I_P^F + I_P^{NF}$$

$$(20)\quad Z = C_P + C_G + I_P + I_G$$

$$(21)\quad Z_{NFT} = Z_{NFT}\left(\overset{+}{Z}, \frac{\overset{-}{p}_{NFT}}{p_{NT}}, \frac{\overset{-}{p}_{NFT}}{p_F}, \overset{?}{\dot{\varepsilon}}\right)$$

$$(22)\quad Z_{NT} = Z_{NT-J}\left(\overset{+}{Z}, \frac{\overset{-}{p}_{NT}}{p_{NFT}}, \frac{\overset{-}{p}_{NT}}{p_F}, \overset{?}{\dot{\varepsilon}}\right) + J$$

$$(23)\quad Z_F = Z - Z_{NFT} - (Z_{NT} - J)$$

$$(24)\quad n = \frac{w}{ap_{NT} + bp_{NFT} + cp_F}$$

$$(25)\quad L = L_{NFT} + L_{NT} + L_F$$

$$(26)\quad L^S = \bar{L}$$

$$(27)\quad E = L$$

(28) $m^D = m^D (Y \overset{+}{\text{or}} Z, \overset{+}{p}, \overset{-}{r})$

(29) $m^D = m^S$

(30) $p = \lambda_1 \; p_{NT} + \lambda_2 \; p_{NFT} + \lambda_3 p_F \qquad \sum_{i-1}^{3} \lambda_i = 1$

Given that p is used as an implicit deflator, and that p_F is endogenous, it is clear that, in principle, λ_1, λ_2 and λ_3 should be flexible and endogenous. However, because of the complexity involved, such endogeneity will not be set out explicitly in the algebraic version of Model II. The weights will, however, be endogenous in the subsequent manipulation of the geometric characterisation of the model.

The variables which are treated as endogenous to the non-farm and macroeconomic aggregates sector of the model are:

(1) Y (2) Y_{NT} (3) Y_{NFT} (4) L_{NFT} (5) L_{NT} (6) C_P^{NF} (7) C_P

(8) I_P^{NF} (9) I_P (10) Z (11) Z_{NFT} (12) Z_{NFT} (13) Z_F (14) n

(15) L (16) L^S (17) E (18) m^D (19) r (20) p

The variables which appear in this sector of the model and which are endogenous to the farm sector are:

(1) Y_F (2) p_F (3) y_F^{NF} (4) C_P^F (5) I_P^F (6) L_F

The variables which are exogenous to the model as a whole are:

(1) K_{NFT} (2) α_{NFT} (3) p_{NFT} (4) p_{NT} (5) v (6) K_{NT} (7) α_{NT}

(8) p_F^W (9) $\bar{O}_F$ (10) C_G (11) I_G (12) ε (13) J (14) w

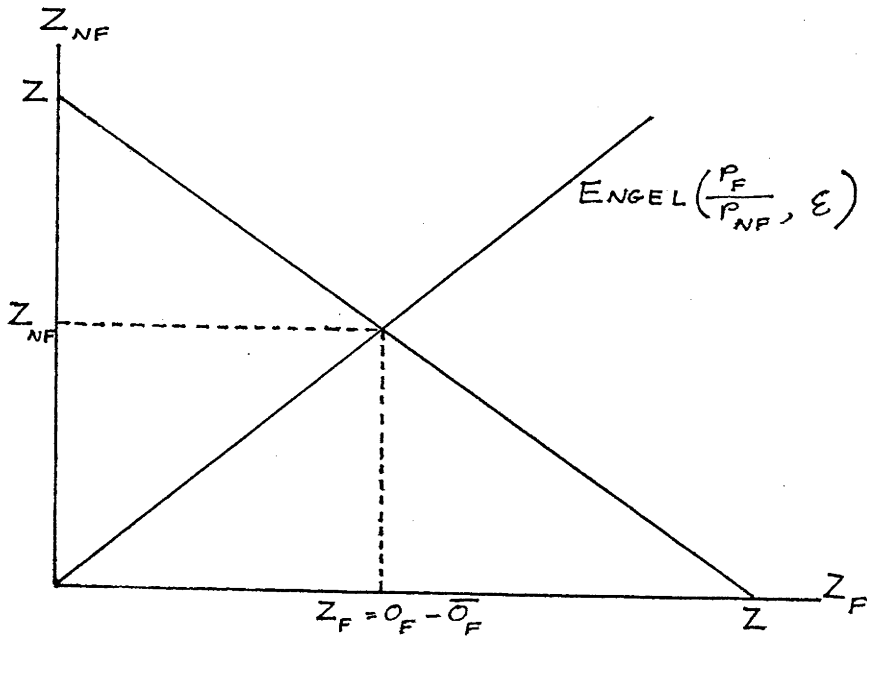
(15) $\bar{L}$

II(3) Geometric Characterisation of the Model

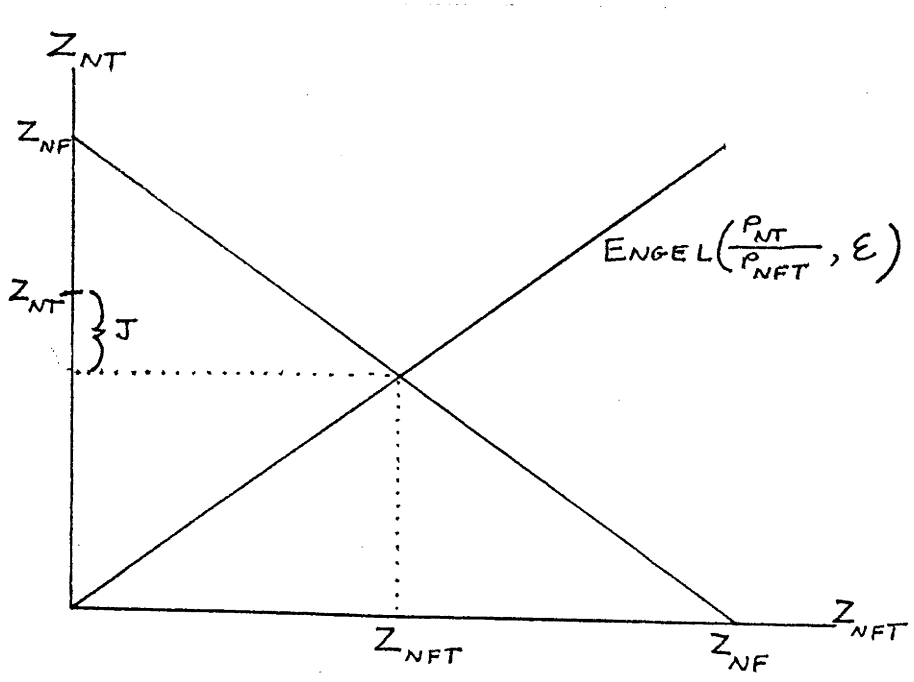
In the geometric characterisation of Model II, Sectors I and III are identical to those described for Model I in Section III of Chapter III. Some slight modification is necessary, however, to Sector II.

FIGURE IV(1)

SECTOR II(1)



SECTOR II(2)

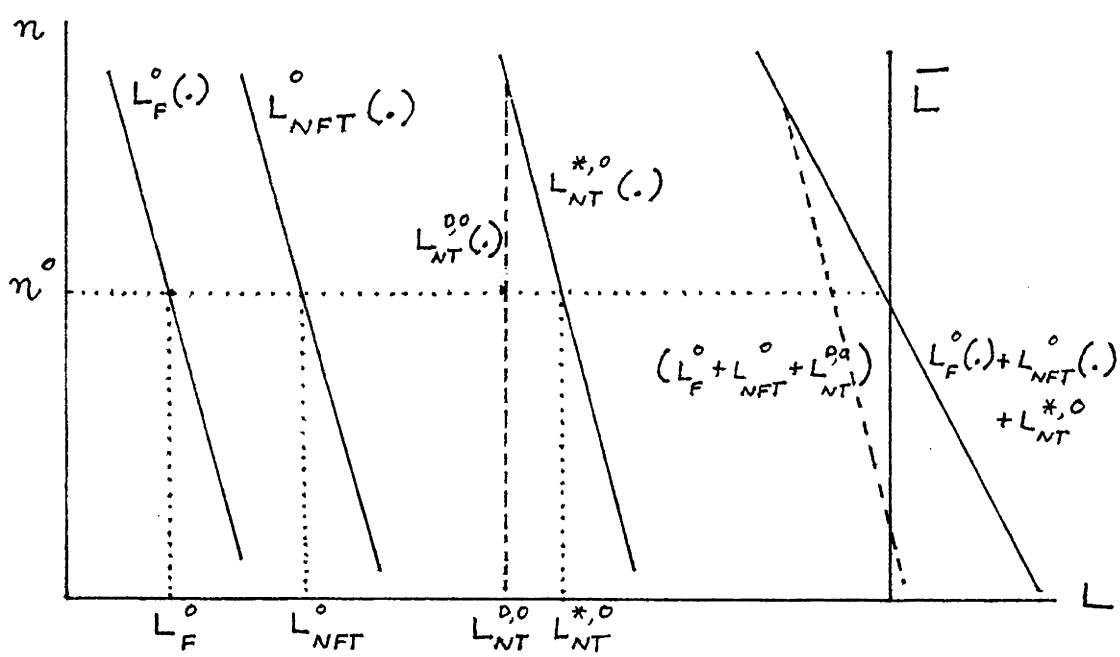


It will be recalled that, in Sector II of Model I, aggregate expenditure, Z, was separated first into its non-traded and traded components (in Sector II(1)), and then the traded component was further separated, in Sector II(2), into its farm and non-farm components. In Model II, however, it is convenient to adopt a different break-up, separating aggregate expenditure firstly into its farm and non-farm components in Sector II(1) and then separating non-farm expenditure into its non-traded and traded components. Note that, in Sector II(1), Z_F is constrained to absorb the balance of farm output remaining after the constrained volume of farm exports has been met. Also note that, as before, total demand for non-traded goods is obtained by adding J directly onto the non-traded component of final expenditure.

Sector IV of Model II is also identical to Sector IV of Model I. However, it is useful to briefly re-examine Sector IV in the present context because it helps to illustrate some simplifying assumptions which will be made in the present analysis.

FIGURE IV(2)

SECTOR IV



Suppose that, given the levels of p_{NT} and p_{NFT}, and some initial level of p_F, p_F^o, the demand for labour in the farm sector is given by $L_F^o(.)$, in the non-farm traded goods sector by $L_{NFT}^o(.)$, and the optimal demand for labour in the non-traded goods sector is given by $L_{NT}^{*,o}(.)$. Then, if, given the level of the nominal wage, w, the real wage is n^o, the level of employment in the farm sector is L_F^o, in the non-farm traded goods sector is L_{NFT}^o, and the optimal level of employment in the non-traded goods sector is $L_{NT}^{*,o}$.

In the present analysis, nominal wages and the prices of non-traded and non-farm traded goods are assumed to be fixed throughout. The price of farm commodities will, however, vary in response to changes in farm production. It is useful, therefore, to consider the implications of movements in p_F in terms of Sector IV. Suppose, for example, that p_F rose above its original level. It follows immediately that the real wage, n, would fall from n^o in Figure IV(2). It is also clear that the demand for labour schedule in the farm sector, would move to the right from $L_F^o(.)$ - because the real wage unit, v, would now convert into fewer physical units of farm commodities, so that any given real wage, n, becomes less burdensome on the farm sector. It follows that output and employment in the farm sector would increase. Following an analagous line of reasoning, the demand for labour schedule in the non-farm traded goods sector would move to the left from $L_{NFT}^o(.)$, and the optimal demand for labour schedule in the non-traded goods sector would move to the left from $L_{NT}^{*,o}(.)$. However, these leftward movements of the latter schedules would be exactly offset by the decline in n from n^o, leaving the level of output and employment in the non-farm traded goods sector, and the optimal level of output and employment in the non-traded goods sector, unaffected - in other words, as p_{NFT}, p_{NT} and w are unchanged, equation of the nominal wage with the value of the marginal product in those two

sectors will continue to occur at the same levels of output and employment.

In view of the above discussion, it is clear that:

(1) to the extent that an exogenous change in farm production results in a change in the relative price of farm and non-farm commodities, that price change would, in general, be expected to induce a further change in farm output. However, as this induced change in farm output is not crucial to the analysis, it will be ignored in what follows.

(2) provided that p_{NFT}, p_{NT} and w are given, changes in p_F will have no impact on output and employment in the non-farm traded goods sector, or on optimal output and employment in the non-traded goods sector. In the ensuing analysis, therefore, these variables will be assumed to be fixed.

This serves to simplify the analysis, because we can largely ignore Sector IV of the model.

II(4). Some Analysis of the Second Paradigm

The analysis can commence in Sector III(1).

FIGURE IV(3)

SECTOR III(1)

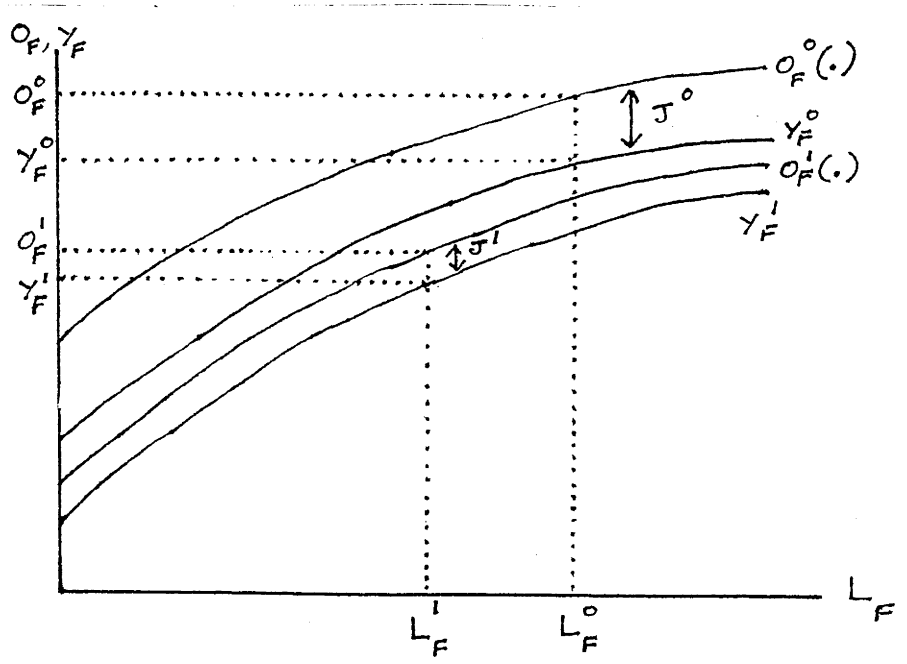
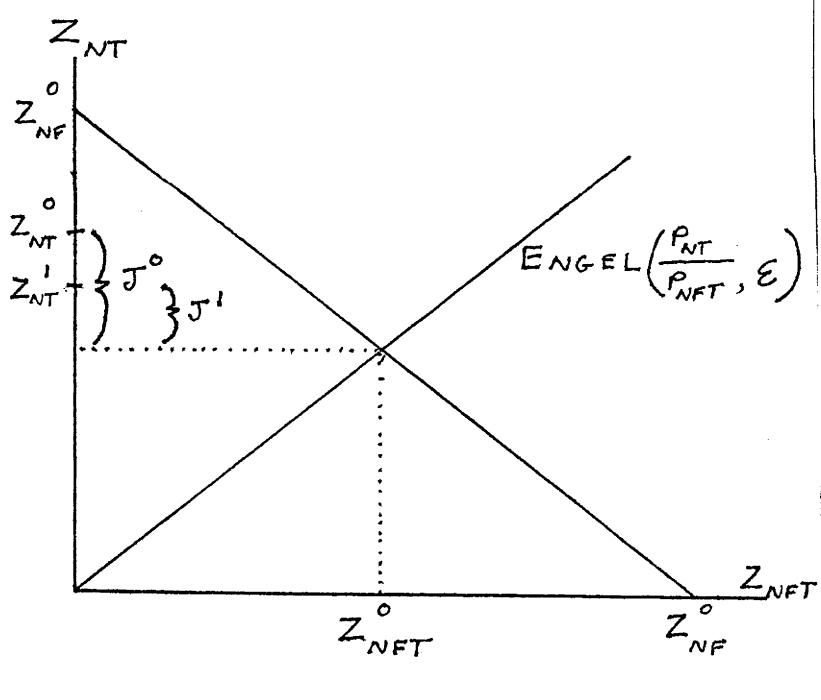


Figure IV(3) above is identical to Sector III(1) in Figure III(5), which formed part of the analysis undertaken with Model I . The original levels of output and employment in the farm sector are given by O_F^0, Y_F^0 and L_F^0, given J^0. Following, for example, an adverse weather shock, output and employment decline to O_F^1, Y_F^1 and L_F^1, given an assumed exogenous decline in the usage of non-primary inputs, from J^0 to J^1.

For simplicity, we will assess firstly the macroeconomic implications of the decline in J, from J^0 to J^1, and then consider the implications of the decline in O_F.

FIGURE IV(4)

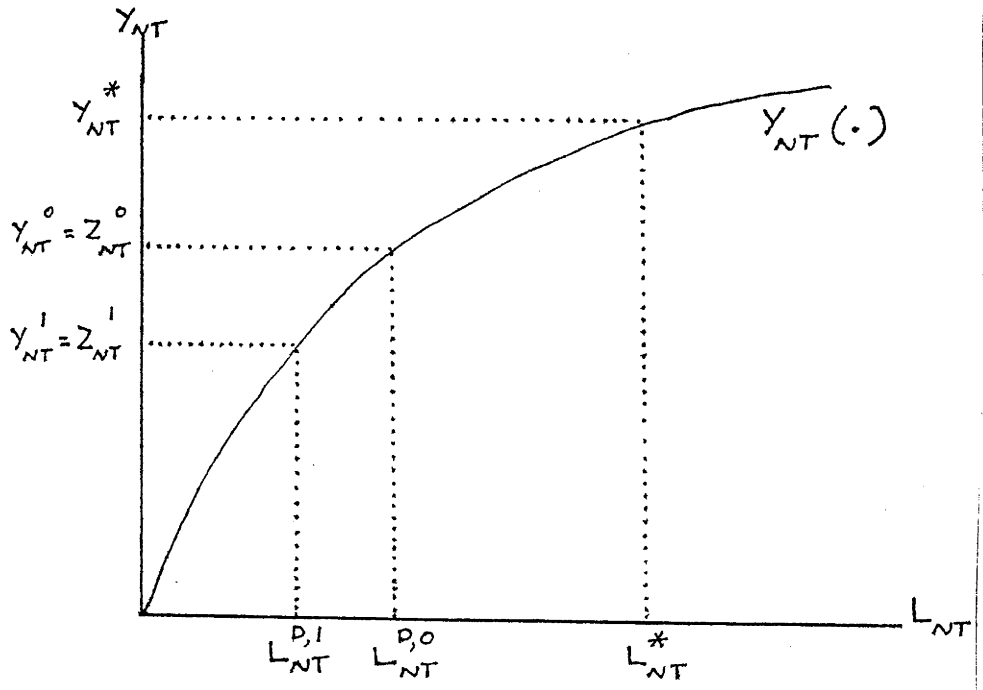
SECTOR II(2)



In Sector II(2), given the initial level of real final expenditure on non-farm commodities, Z_{NF}^0, and the initial level of J, J^0, then the initial level of total demand for non-traded goods is Z_{NT}^0. The decline in the usage of non-primary inputs in the farm sector, from J^0 to J^1, reduces total demand for non-traded goods from Z_{NT}^0 to Z_{NT}^1.

FIGURE IV(5)

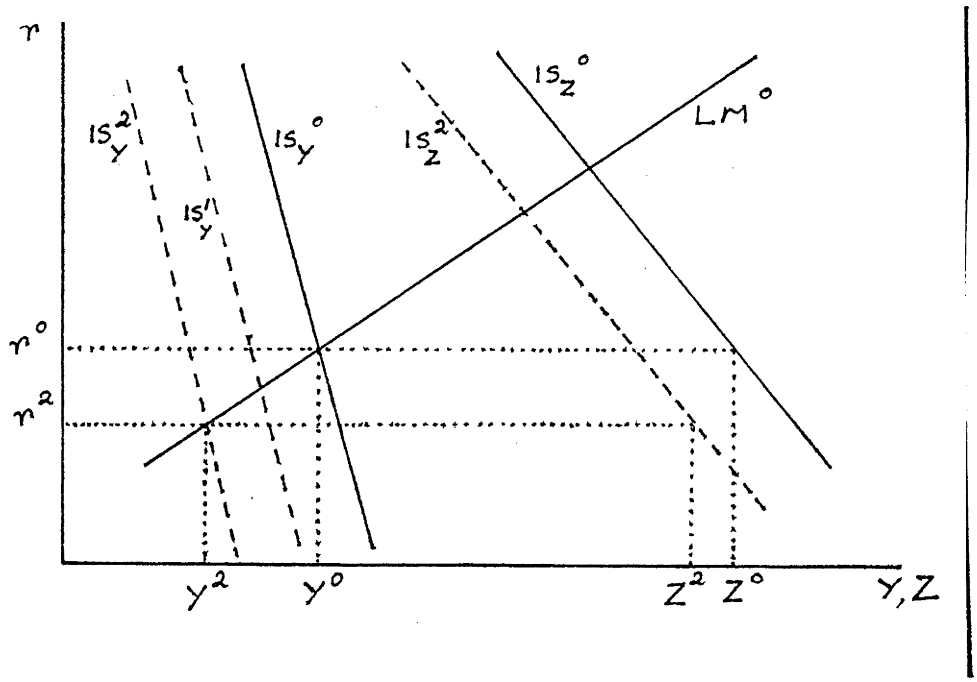
SECTOR III(3)



In Sector III(3), the initial demand constrained levels of output and employment in the non-traded goods sector are $Y_{NT}^0 = Z_{NT}^0$ and $L_{NT}^{D,0}$. Following the fall in the usage of non-primary inputs in the farm sector, so that Z_{NT} falls to Z_{NT}^1, output and employment in the non-traded goods sector fall to $Y_{NT}^1 = Z_{NT}^1$ and $L_{NT}^{D,1}$. Note that both Y_{NT}^0 and Y_{NT}^1 are, by assumption, less than Y_{NT}^*.

FIGURE IV (6)

SECTOR I

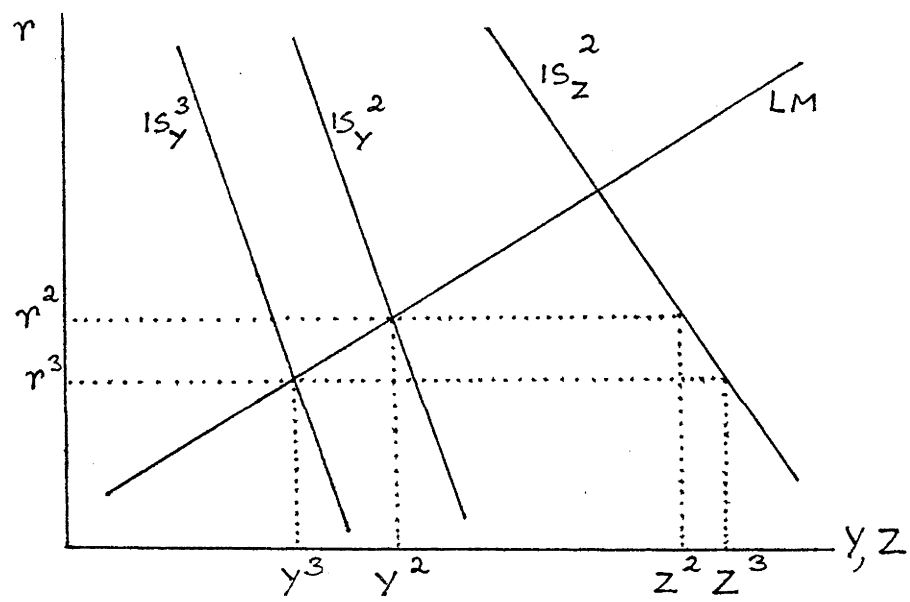


In Sector I, suppose that the initial positions of the curves are represented by $IS_Y{}^0$, $IS_Z{}^0$ and LM^0, so that, if Y is the scale argument in the demand for money function, the initial levels of Y, Z and r are given by Y^0, Z^0 and r^0. The decline in the demand for, and hence production of, non-traded goods in response to the decline in the usage of non-primary inputs in the farm sector causes the IS_Y curve to move to the left, to $IS_Y{}^1$ - the horizontal distance between $IS_Y{}^0$ and $IS_Y{}^1$ being equal to the decline in J. It would be expected that this leftward movement of IS_Y would induce a decline in non-farm consumption and investment expenditure, thus pushing IS_Z to the left from $IS_Z{}^0$. In other words, a Keynesian demand multiplier process is set in train within the non-traded goods sector, as has been described at some length in the context of Model I. Suppose, for simplicity, that sufficient time is available for a new Keynesian equilibrium to be established in the non-traded goods sector, following the decline in J, and that the IS curves in that new Keynesian equilibrium are represented by $IS_Y{}^2$ and $IS_Z{}^2$.

We can now proceed to consider the implications of the decline in Y_F itself. The first point to note is that any rise in farm prices which might occur is irrelevant for the determination of the change in Y_F, i.e. Y_F is valued using some given base period prices. Therefore, it is unambiguous that Y_F falls, and this causes IS_Y, in Figure IV(7), to move to the left from IS_Y^2 to IS_Y^3.

FIGURE IV(7)

SECTOR I



The next point to note is that, had we been using Model I at this point, it would have been unambiguous that the decline in Y_F would have set in train a negative Keynesian demand multiplier process, leading to a cumulative leftward movement of IS_Y and IS_Z from IS_Y^3 and IS_Z^2 respectively. In other words, with p_F unchanged, the decline in the volume of farm production would have unambiguously lowered farm incomes, leading to a decline in farm consumption and investment expenditure, and in consumption expenditure by non-farm households in receipt of y_F^{NF}. This would have shifted IS_Z to the left from IS_Z^2, resulting in a fall in the demand for, and hence production of, non-traded goods, pushing IS_Y to the left from IS_Y^3, and so on. Further,

(focusing om those parts of the analysis with Model I in which p_{NT} and w were fixed), there would be no changes in the relative price of farn and nom-farm commodities to contend with, and no changes in the real money stock.

As will become evident, this unambiguous leftward movement of IS_Y from IS_Y^3, which would have occurred in the Model I framework, provides us with an important focal point for the present analysis.

Returning to Model II, it is clear, from Figure IV(7), that, assuming Y to be the scale argument, the leftward movement of IS_Y from IS_Y^2 to IS_Y^3 would reduce r from r^2 to r^3, so that Y falls from Y^2 to Y^3 and Z moves from Z^2 to Z^3.

We now need to solve three problems:

(1) we need to find a new market clearing price for farm output in the presence of the lower level of O_F;

(2) we need to assess the net impact of the change in O_F, p_F and J on farm income, and hence on expenditure originating from the farm sector;

(3) we need to assess the impact of the change in p_F, and the change in expenditure originating from the farm sector, on the state of the Keynesian equilibrium in the non-traded goods sector.

Problem 1.

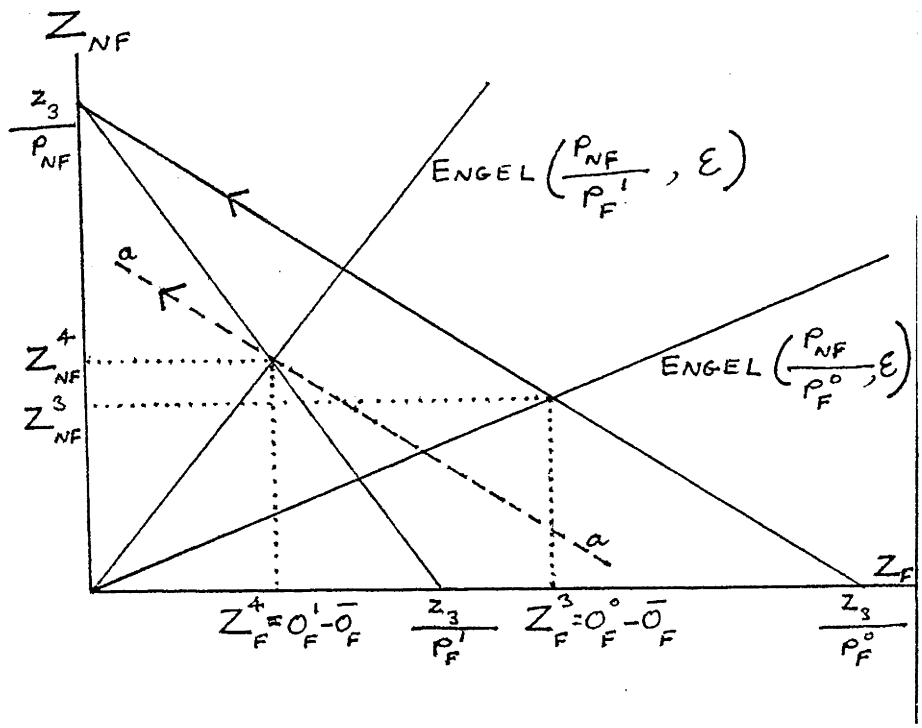
Suppose that the decline in the volume of farm production (ie. the leftward movement of IS_Y from IS_Y^2 to IS_Y^3) does mot induce any change in expenditure originating in the farm sector. [This assumption can be relaxed after problem (2) above is solved.] In other words, we will assume that, despite the leftward movement of IS_Y from IS_Y^2 to IS_Y^3, IS_Z remains at IS_Z^2.

It is clear that, given p_{NT}, p_{NFT} and the original level of p_F, say p_F^0, each volume of expenditure along IS_Z^2 can be converted to nominal terms. Let z_3 be the nominal equivalent of Z_3. Problem 1

is then simply the problem of finding a level of p_F such that the farm commodity market clears, in the presence of a given level of nominal expenditure, z_3.

Figure IV(8)

Sector II(1)



In Sector II(1), the budget line implied by z_3 and p_F^0 is represented by the line with intercepts

$$\frac{z_3}{p_{NF}} \quad \frac{z_3}{p_F^0}$$

The implied volume of expenditure on farm commodities is $Z_3 = O_F^0 - \bar{O}_F$ i.e. just sufficient to clear the farm commodity market. Maintaining the level of nominal expenditure at z_3, it is clear that, following the fall in farm output from O_F^0 to O_F^1, a rise in the price of farm commodities, from p_F^0 to p_F^1 would result in a fall in the volume of expenditure on farm commodities from Z_F^3 to Z_F^4. Hence, p_F^1 is consistent with clearance of the farm commodity market as O_F falls.

Two points should be noted. Firstly, the new expenditure point,

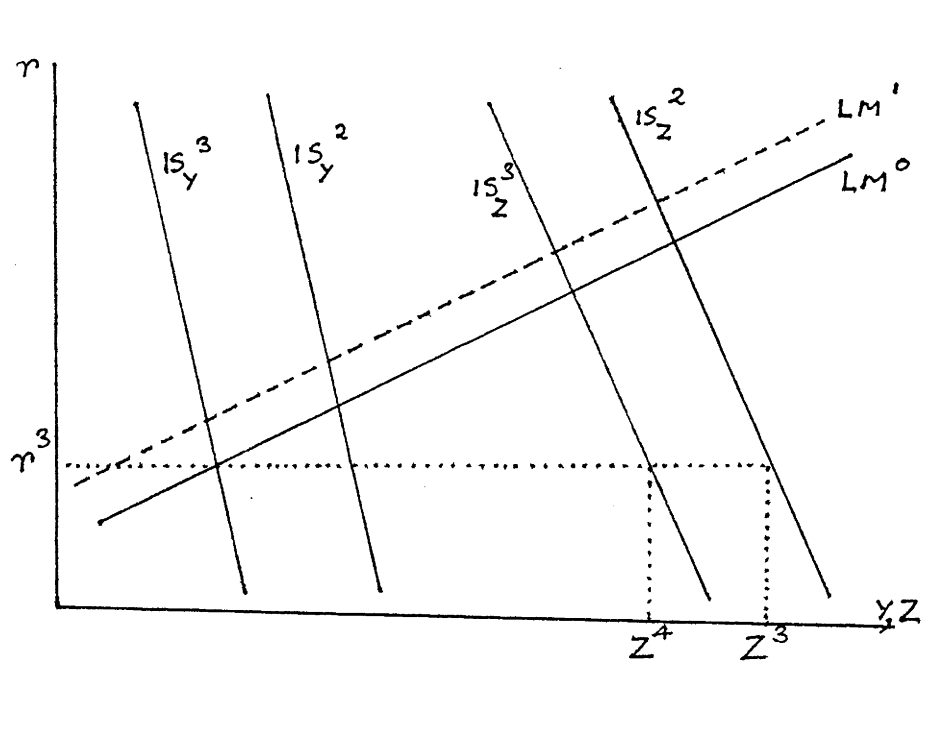
Z_F^4 Z_{NF}^4, when valued at the original prices, p_{NF} and p_F^0, is less than the original volume of expenditure Z_F^3 Z_{NF}^3. In other words, a line drawn through the new expenditure point, and running parallel to the original budget line - line aa in Figure IV(8) - lies entirely inside the original budget line. It is also clear that, using p_F^1, we could calculate a new volume of expenditure associated with each other level of nominal expenditure along IS_Z^2 in Figure IV(7), and, in each case, the new volume of expenditure would be less than that implied by IS_Z^2. In other words, on the assumption that nominal expenditure remains at the levels implied by points along IS_Z^2, the IS_Z curve would move to the left from IS_Z^2 as p_F rises.

The second point to note is that the impact of the rise in p_F from p_F^0 to p_F^1 on Z_{NF} is ambiguous. As drawn in Figure IV(8), $Z_{NF}^4 > Z_{NF}^3$. In other words, the demand for farm commodites is price elastic, so that the fall in the volume of farm production is associated with a reduced level of nominal expenditure on farm commodities, and increased nominal (and hence real) expenditure on non-farm commodities. However, if the demand for farm commodities was price inelastic, the converse conclusion would hold, i.e. nominal expenditure on farm commodities would rise, and nominal (and hence real) expenditure on non-farm commodities would fall.

Before proceeding to examine problems (2) and (3), it is useful to briefly review our analysis of problem (1) in terms of Sector 1.

Figure IV(9)

Sector I



It will be recalled that IS_Y^2 and IS_Z^2 represent the positions of the IS curves in the new Keynesian equilibrium following the fall in J. The horizontal distance between IS_Y^2 and IS_Y^3 is the decline in the volume of farm output, measured at given prices. On the assumption that nominal expenditure originating from farm households was unchanged in the face of the decline in farm output, IS_Z would remain at IS_Z^2, given p_F^0. However, the rise in p_F from p_F^0 to p_F^1 reduced the volume of expenditure associated with any given level of nominal expenditure, so that IS_Z moved from IS_Z^2 to IS_Z^3.

The rise in p_F would also clearly shift the LM curve to the left from LM^0. However, the ambiguity surrounding the scale argument in the demand for money function leads to some ambiguity as to the extent of that leftward movement. Suppose that Z was the real scale argument and that (not implausibly) the price and real expenditure elasticities of the demand for nominal money balances were both unity. In that case, the LM curve would move to the left from LM^0 by an equivalent

horizontal distance as the distance between IS_Z^3 and IS_Z^2 - because, by definition, horizontally opposing points on IS_Z^3 and IS_Z^2 are associated with the same level of nominal expenditure. However, there is no necessary presumption that horizontally opposing points on IS_Y^3 and IS_Y^2 would be associated with the same nominal value of income and hence with the same demand for nominal money balances in the case where Y was the real scale argument.

In general then, we can conclude that LM would move to the left from LM^0, but the extent of that movement is unclear. Suppose that the LM curve moved from LM^0 to LM^1, with Y the real scale argument. It is clear that some upward pressure would be placed on the interest rate relative to r^3, with a consequent lowering of Z below Z^4. It will be assumed for simplicity, however, that this has only a negligible impact on the market clearing price for farm commodities, i.e. p_F remains at p_F^1.

Problems 2 and 3.

The next step is to assess whether there would be any further movement in the IS curves from their positions at IS_Y^3 and IS_Z^3. For our purposes, there are two potential sources of such a movement, as intimated by problems (2) and (3):

- a change in the level of expenditure originating from farm households, or from non-farm households in receipt of y_F^{NF} or quota profits. This would violate the assumption of a given level of nominal expenditure, on which IS_Z^2 and IS_Z^3 are based;
- while IS_Y^2 and IS_Z^2 are consistent with Keynesian equilibrium in the non-traded goods sector (by assumption, as noted above), IS_Y^3 and IS_Z^3 may not be. It will be recalled that the levels of production of non-traded goods at horizontally opposing points on IS_Y^2 and IS_Y^3 are

equivalent - in other words $IS_Y^2 - IS_Y^3 = \Delta Y_F$. Therefore, if the demand for non-traded goods, at horizontally opposing points on IS_Z^2 and IS_Z^3 are not equivalent, then IS_Y^3 and IS_Z^3 would not be consistent with a Keynesian equilibrium in the non-traded goods sector.

It is evident that the resolution of both issues lies in the own price elasticity of demand for farm commodities on the domestic market. Suppose that, in Figure IV(8), the own price elasticity of demand for farm commodities, across the arc between p_F^0 and p_F^1 had been unity. It would follow that:

(a) the nominal value of farm sales on the domestic market would be unchanged, and farm receipts from a constrained volume of export sales (if any) would increase. As J has declined, it follows that y_F and hence y_F^F and y_F^{NF} have incresed. However, with a higher level of p_F, profits accruing to holders of farm export quotas would be lower. Therefore, the net impact of the change in farm output and farm prices on aggregate nominal expenditure is ambiguous. If the net effect was an increase, there would be a tendency for IS_Z to move to the right from IS_Z^3, and conversely- in each case, setting in train a demand multiplier process in the non-traded goods sector ;

(b) at horizontally opposing points on IS_Z^2 and IS_Z^3, the demand for non-farm, and hence non-traded goods, would be equivalent. Therefore, IS_Y would remain at IS_Y^3 whilever IS_Z remained at IS_Z^3.

Combining (a) and (b) above, therefore, we can conclude that, following the change in farm prices from p_F^0 to p_F^1, the IS curves may move either to the left or to the right of their positions at IS_Y^3 and IS_Z^3. This, of course, is in contrast to the implication which

emerged from Model 1 where it was unambiguous that IS_Y and IS_Z would move to the left from IS_Y^3 and IS_Z^2.

Next, consider the case where the demand for farm commodities is price elastic across the arc between p_F^0 and p_F^1. In particular, suppose that the price elasticity is $-(1 + \lambda)$ such that the gross value of farm production falls sufficiently to offset the decline in the usage of J, so that y_F, and hence y_F^F and y_F^{NF} remain unchanged. Then,

(a) our assumption that farm consumption and investment expenditure, and consumption expenditure by non-farm households in receipt of y_F^{NF}, remain unchanged would be valid. However, the rise in p_F would reduce the level of profits accruing to holders of farm export quotas so that, on balance, aggregate expenditure would decline relative to the level assumed in the location of IS_Z^2 and hence IS_Z^3. In other words, there would be a tendency for IS_Z to move to the left from IS_Z^3, thus reducing aggregate demand for non-farm and hence non-traded goods;

(b) At each point on IS_Z^3, the demand for non-farm, and hence non-traded, goods is greater than at the horizontally opposing point on IS_Z^2. In other words, IS_Z^3 and IS_Y^3 would be associated with excess demand for non-traded goods. With other factors unchanged, production of non-traded goods would increase, pushing IS_Y to the right from IS_Y^3, and setting in train a positive demand multiplier process in the non-traded goods sector.

Combining points (a) and (b) above, it follows that the direction of movement of IS_Y from IS_Y^3 is ambiguous. If the leftward movement of IS_Z from IS_Z^3 is insufficient to eliminate the excess demand for non-traded goods which exists at IS_Y^3 and IS_Z^3, then IS_Y would move to the right from IS_Y^3 as production of non-traded goods increases. This would, in turn, set in train a positive demand multiplier process in

the non-traded goods sector, pushing IS_Y further to the right, and instigating a rightward movement of IS_Z. Conversely, if the leftward movement of IZ_Z from IS_Z^3 is sufficient to more than eliminate the excess demand for non-traded goods evident at IS_Y^3 and IS_Z^3, then production of non-traded goods will fall, pushing IS_Y to the left from IS_Y^3. A negative Keynesian demand process would then push both IS_Z and IS_Y further to the left.

As might be anticipated, the case where the own price elasticity of demand for farm commodities lies between -1 and $-(1 + \lambda)$ shares elements in common with the two preceding cases, ie. where the elasticity was -1, and where it was $-(1 + \lambda)$. In this case, the gross value of farm production either rises, or falls insufficiently to offset the decline in J, so that y_F, and hence y_F^F and y_F^{NF} rise. However, quota profits fall. Therefore:

(a) as was the case with a unit elasticity, aggregate expenditure may rise or fall relative to the level on which IS_Z^2 and IS_Z^3 are based, i.e. the IS_Z curve may move to the right or to the left from IS_Z^3;

(b) as was the case with an elasticity of $-(1 + \lambda)$, IS_Y^3 and IS_Z^3 would be associated with an excess demand for non-traded goods and hence, with other factors unchanged, there would be a tendency for IS_Y and IS_Z to move to the right from IS_Z^3 and IS_Y^3 in a positive Keynesian demand multiplier process.

Therefore, there is again a substantial degree of ambiguity as to the direction of movement of IS_Y from IS_Y^3. If, in (a) above, the IS_Z curve moved to the right from IS_Z^3, that would reinforce the excess demand for non-traded goods evident at IS_Y^3 and IS_Z^3, leading to a cumulative rightward movement of IS_Y and IS_Z from IS_Y^3 and IS_Z^3. However, if in (a), IS_Z moved to the left from IS_Z^3, then the nature of the ambiguity would be largely the same as that described for the

case where the own price elasticity of demand was assumed to be $-(1 + \lambda)$. In other words, if some excess demand for non-traded goods remained, following the leftward movement of IS_Z from IS_Z^3, then IS_Y would move to the right from IS_Y^3, and the leftward movement of IS_Z would be reversed. Alternatively, if a situation of excess supply had been created in the non-traded goods sector, then IS_Y would have moved to the left from IS_Y^3, and the leftward movement of IS_Z would have been reinforced.

Next, we can consider the case where the own price elasticity of demand for farm commodities is greater than (ie. more elastic than) $-(1 + \lambda)$. In this case, the decline in the gross value of farm production is more than sufficient to offset the decline in the usage of J, so that y_F, and hence y_F and y_F^{NF} fall. There is also, of course, a decline in quota profits. It follows that:

(a) consumption and investment expenditure by farm households, and consumption expenditure by non-farm households in receipt of y_F^{NF} and quota profits, would fall. In this case, therefore, it is unambiguous that, <u>with other factors unchanged</u>, IS_Z would move to the left from IS_Z^3;

(b) with the own price elasticity of demand being in excess of unity, it follows that IS_Y^3 and IS_Z^3 would be associated with excess demand for non-traded goods.

Therefore, if the leftward movement of IS_Z from IS_Z^3, in (a) above, is more than sufficient to eliminate the excess demand for non-traded goods implied by IS_Y^3 and IS_Z^3, then IS_Y would move to the left from IS_Y^3, and the leftward movement of IS_Z would be reinforced. Alternatively, if the leftward movement of IS_Z from IS_Z^3, in (a) above, had not been sufficient to eliminate the excess demand for non-traded goods evident at IS_Y^3 and IS_Z^3, then IS_Y would move to the right from IS_Y^3, and the leftward movement of IS_Z would be reversed.

The final case to consider is that where the demand for farm commodities is own price inelastic across the arc between p_F^0 and p_F^1. In this case, the fall in the volume of farm production is associated with an increase in the gross value of farm production. Further, as J has declined, it is clear from equation (4) that the rise in y_F would be greater than the rise in the gross value of farm production, $p_F o_F$. There would also be a decline in the level of profits accruing to holders of farm export quotas. Therefore:

(a) aggregate expenditure may either rise or fall relative to the level implied by IS_Z^2 and IS_Z^3. In other words, with other factors unchanged, IS_Z may move either to the right or to the left from IS_Z^3;

(b) IS_Y^3 and IS_Z^3 would necessarily be associated with an excess supply of non-traded goods, ie. the rise in nominal expenditure on farm commodities necessarily implies a fall in nominal (and hence real) expenditure on non-farm commodities, including the output of the non-traded goods sector.

If, in (a) above, the IS_Z curve moved to the left from IS_Z^3, then the decline in aggregate expenditure would reinforce the excess supply of non-traded goods evident at IS_Y^3 and IS_Z^3, thus leading to a leftward movement of IS_Y, from IS_Y^3, which would, in turn, induce further leftward movements of IS_Z. Alternatively, if, in (a), IS_Z moved to the right from IS_Z^3 but insufficiently so to eliminate the excess supply of non-traded goods implied by IS_Z^3 and IS_Y^3, then IS_Y would move to the left from IS_Y^3, and the rightward movement of IS_Z would be reversed. Finally, if a rightward movement of IS_Z occurred, and was sufficient to more than eliminate the excess supply of non-traded goods at IS_Y^3 and IS_Z^3, then IS_Y would move to the right from IS_Y^3, inducing a further rightward movement of IS_Z, and so on.

In general, then, there would seem to be a substantial degree of ambiguity as to the location of the IS_Y curve in Model II after a new Keynesian equilibrium is established in the non-traded goods sector of the model. In particular, under a wide range of circumstances that IS_Y curve may lie to the left of IS_Y^3. However, there are also a wide range of circumstances under which the new equilibrium IS_Y curve may lie to the right of IS_Y^3. IS_Y^3 has proved to be an important focal point in the analysis because, under the circumstances postulated in the first paradigm, as examined in the context of Model I (with p_{NT} and w fixed), it was unambiguous that the new equilibrium IS_Y curve would have been located to the left of IS_Y^3. It follows that, under the circumstances postulated by the second paradigm, a given change in the volume of farm production, and in the usage of non-primary inputs in the farm sector, J, may plausibly have a significantly smaller impact on non-farm and total G.D.P. than under the first paradigm.

It is possible to reduce this ambiguity to some limited extent if the changes in profits accruing to holders of farm export quotas are ignored. It might be assumed, for example, that the change in farm production is limited entirely to non-traded farm commodities, so that export quotas are irrelevant, or that quotas are held by overseas residents so that any change in quota profits does not accrue to local households. Then:

(1) if the demand for farm commodities is unit elastic, it is unambiguous that IS_Y would move to the right from IS_Y^3 — y_F would increase, pushing IS_Z to the right from IS_Z^3, while IS_Z^3 and IS_Y^3 were consistent with a Keynesian equilibrium in the non-traded goods sector;

(2) if the own price elasticity of demand for farm commodities is equal to $-(1 + \lambda)$, it is again unambiguous that IS_Y would move to the right from IS_Y^3. In this case, y_F is unchanged following

the change in farm production and prices but IS_Y^3 and IS_Z^3 are associated with excess demand for non-traded goods;

(3) it is trivial that, for all elasticities within the range -1 to $-(1 + \lambda)$, IS_Y would move to the right from IS_Y^3 — y_F would increase, leading to an increase in the level of expenditure relative to that implied by IS_Z^3, while IS_Y^3 and IS_Z^3 would already be associated with excess demand for non-traded goods;

(4) the case where the elasticity exceeds (ie. is more elastic than) $-(1 + \lambda)$ is more complicated. Consider Sector II(1) in Figure IV(10).

Figure IV(10)

Sector II(1)

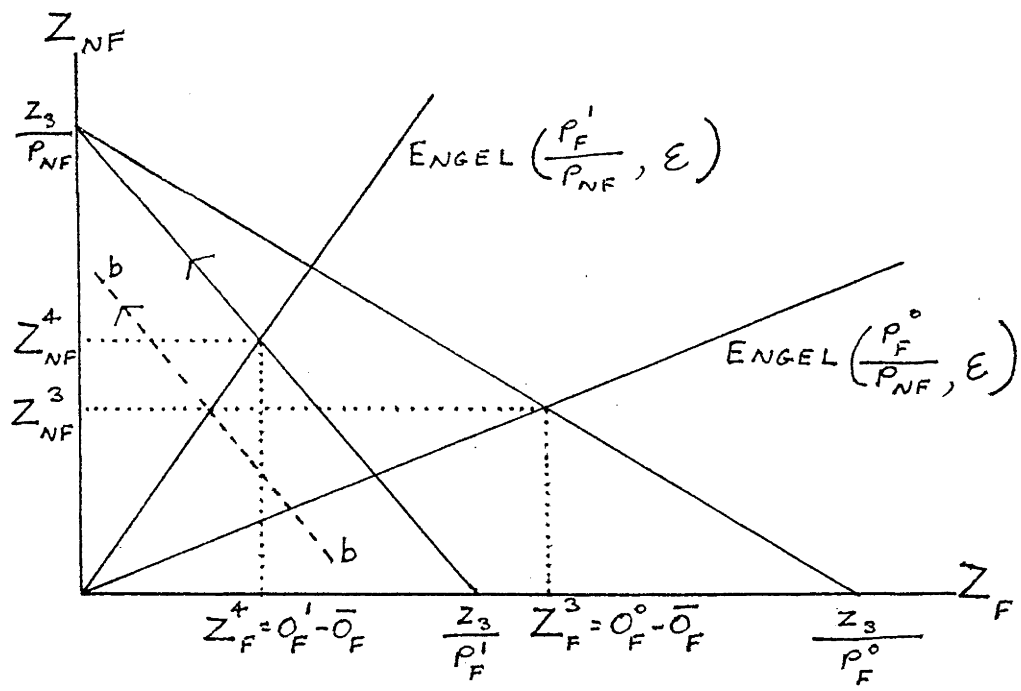


Fig. IV(10) largely corresponds to Fig. IV(8). Given z_3 and the original level of farm prices, p_F^0, the volume of expenditure on farm commodities is Z_F^3, and the volume of expenditure on non-farm commodities is Z_{NF}^3. After the rise in p_F from p_F^0 to p_F^1 and with aggregate nominal expenditure unchanged at z_3, the volume of farm expenditure contracts to Z_F^4, which is consistent

with clearance of the farm commodity market. As demand for farm commodities is own price elastic in this case, it is clear that the volume of expenditure on non-farm commodities would increase from Z_{NF}^{3} to Z_{NF}^{4}. The higher level of $Z_{NF} - Z_{NF}^{4}$ would then be converted into higher levels of Z_{NT} and Z_{NFT} in Sector II(2), provided of course, that both non-traded and non-farm traded commodities are superior.

It is clear that, if the increase in demand for non-traded goods implied by Z_{NF}^{4} relative to Z_{NF}^{3}, is to be eliminated (ie. if IS_Y is not to move to the right from IS_Y^{3}), then the budget line would need to move inwards from $\frac{z_3}{p_{NF}} \frac{z_3}{p_F^{1}}$ to at least bb, and the vertical distance between $\frac{z_3}{p_{NF}} \frac{z_3}{p_F^{1}}$ and bb must be greater than $Z_{NF}^{4} - Z_{NF}^{3}$. As p_{NF} is given, we know that $Z_{NF}^{4} - Z_{NF}^{3}$ is a measure of the increase in nominal expenditure on non-farm commodities, and hence is also a measure of the decline in nominal expenditure on farm commodities. We also know that, if $\bar{O}_F$ is zero, the decline in $p_F o_F$ would be equal to the decline in nominal expenditure on farm commodities and if $\bar{o}_F$ is positive, the decline in $p_F o_F$ would be less than the decline in nominal expenditure on farm commodities. Further, y_F falls by less than the decline in $p_F o_F$, because of the decline in J.

We can conclude, therefore, that the decline in y_F is less than $Z_{NF}^{4} - Z_{NF}^{3}$. Therefore, if the marginal propensity to consume (m.p.c.) out of y_F^{F} was less than unity and/or the marginal propensity to invest out of farm residual funds was less than unity and/or the m.p.c. out of y_F^{NF} was less than unity, then the budget line would move inwards from $\frac{z_3}{p_{NF}} \frac{z_3}{p_F^{1}}$ by a vertical distance less than $Z_{NF}^{4} - Z_{NF}^{3}$, so that some excess

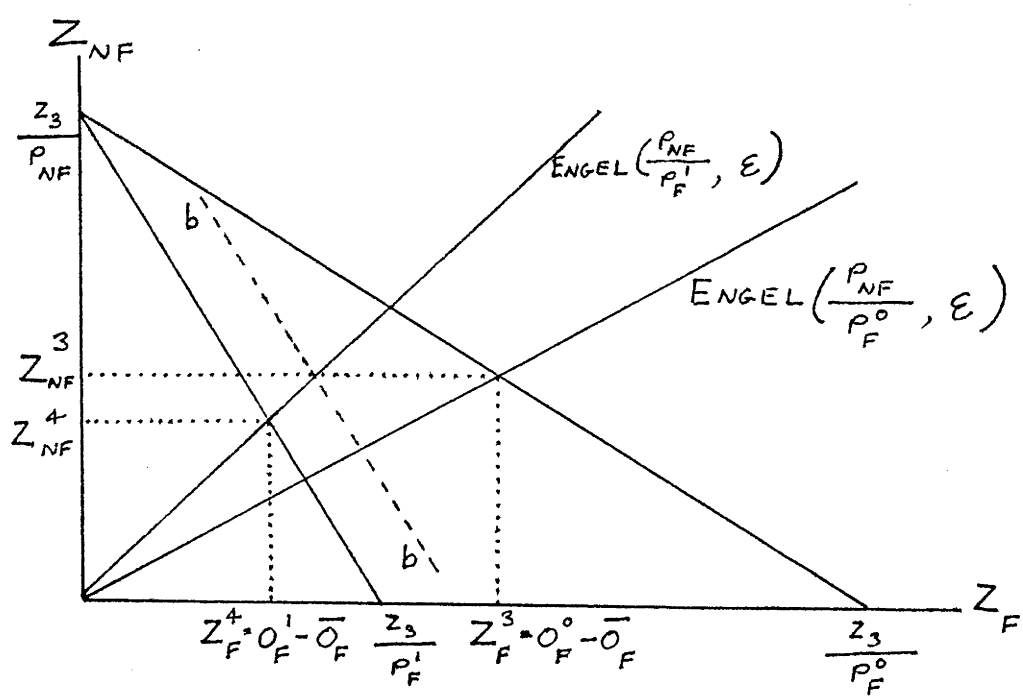
demand for non-traded goods would remain, and IS_Y would move to the right from IS_Y^3.

It would seem, therefore, that when the own price elasticity of demand exceeds $-(1 + \lambda)$, and where changes in quota profits are ignored, the conditions under which IS_Y would move to the right from IS_Y^3 are relatively favourable. Marginal propensities to consume of less than unity in the farm and non-farm sectors should be relatively uncontroversial, and, as suggested in Chapter VIII, there is also substantial empirical evidence in support of values for the marginal propensity to invest out of farm residual funds of less than unity. However, it will also be demonstrated in Chapter VIII that marginal propensities to invest in excess of unity are theoretically plausible;

(5) finally, consider the case where the demand for farm commodities is own price inelastic. Again, consider Sector II(1), in Fig. IV(11).

Figure IV(11)

Sector II(1)



In this case, given z_3, the rise in p_F from p_F^0 to p_F^1 produces clearance of the farm commodity market, but the price inelasticity of demand for farm commodities results in a decline in the volume of expenditure on non-farm commodities, from Z_{NF}^3 to Z_{NF}^4. It is clear that, provided that non-traded goods are not inferior, this decline in Z_{NF} would imply a decline in the demand for non-traded goods, in Sector II(2). If the decline in the demand for, and hence production of, non-traded goods is to be avoided, the budget line in Sector II(1) must move outwards from $\frac{z_3}{p_{NF}}$ $\frac{z_3}{p_F^1}$ to at least bb.

We can now follow a similar line of reasoning as adopted in (4) above. It is clear that the vertical distance between $\frac{z_3}{p_{NF}}$ $\frac{z_3}{p_F^1}$ and bb is greater than the vertical distance between Z_{NF}^3 and Z_{NF}^4. We also know that $Z_{NF}^3 - Z_{NF}^4$ is a measure of the increase in the nominal value of sales of farm commodities on the local market. Then

- if $\bar{O}_F = 0$ (i.e. the relevant farm commodities are non-traded), and recalling that J has declined, it follows that

$$Z_{NF}^3 - Z_{NF}^4 = \Delta p_F O_F < \Delta y_F$$

- if $\bar{O}_F > 0$ (i.e. exports are positive but effectively constrained in volume), it follows that

$$Z_{NF}^3 - Z_{NF}^4 < \Delta p_F O_F < \Delta y^F \quad .$$

In both cases, therefore, $Z_{NF}^3 - Z_{NF}^4 < \Delta y^F$. Hence, even if the m.p.c's out of y_F^F and y_F^{NF} were both less than unity, and the marginal propensity to invest out of farm residual funds was less than unity, it would still be possible that the budget line could move outwards from $\frac{z_3}{p_{NF}}$ $\frac{z_3}{p_F^1}$ by a greater vertical distance than the vertical

distance $Z_{NF}^{3} - Z_{NF}^{4}$. Therefore, the possibility that the budget line could move out to, or beyond, bb could not be ruled out, even for a marginal propensity to invest of less than unity. If it fell short of bb, then some excess supply of non-traded goods would remain, and IS_Y would move to the left from IS_Y^{3}. Alternatively, if the budget line moved out beyond bb, then excess demand for non-traded goods would be generated, and IS_Y would move to the right from IS_Y^{3}.

In general then, in this case of an inelastic demand for farm commodities, we have been unable to significantly reduce the uncertainty surrounding the direction of movement of IS_Y from IS_Y^{3}, even after discounting changes in quota profits and appealing to 'reasonable' values for the relevant marginal propensities.

II(5) Concluding Comments on Section II

We have used Model II to examine some aspects of the second paradigm - the case of a shock to the volume of farm production, in the presence of an effective export constraint and in the absence of buffer stockholding, so that the volume shock needed to be absorbed on the domestic market via an appropriate change in the farm price. This paradigm is of relevance to the various largely non-traded agricultural industries, as well as to those operating in the presence of, for example, quota restrictions on imports imposed by overseas markets.

Model II is largely equivalent to Model I - differing only in that the former incorporates a restriction on the volume of farm exports, and hence endogenises the local (as distinct from the overseas) price of farm commodities. In consequence, much of the analysis undertaken with Model I carried over to the present case. This greatly simplified our task, because it permitted us to concentrate primarily on those aspects of the analysis with Model II which differed from the earlier analysis with Model I - those differences, of course, being attributable to the alternative assumptions underlying the first and second paradigms.

We were able to identify a particular IS_Y curve. - $IS_Y{}^3$ - which we used as a pivotal point in the analysis. Following a given decline in the volume of farm production, and in the usage of non-primary inputs in the farm sector, it was noted that, in Model I (with p_{NT} and w fixed) a new IS_Y curve consistent with a Keynesian equilibrium in the non-traded goods sector would have been established to the left of IS_Y . However, in Model II, it was argued that the same decline in farm output, and in the usage of non-primary inputs, could result in the new Keynesian equilibrium IS_Y curve lying either to the left or to the right of IS_Y . It follows that, under the

circumstances postulated by the second paradigm, a given change in O_F and in J may plausibly have a significantly smaller impact on non-farm and total G.D.P. than under the first paradigm.

Where the demand for farm commodities is at least unit own price elastic and where quota profits are ignored, it was demonstrated that, under a wide range of circumstances, the new Keynesian equilibrium IS_Y curve would lie to the right if IS_Y^3. However, under all other circumstances, we were able to do little to clarify the direction of movement of IS_Y from IS_Y^3.

Finally, it should be noted that the analysis has focussed on the more general issue of the direction of movement of IS_Y from IS_Y^3. Because of the complexity of the issues involved, no attempt has been made to assess, in detail, the magnitude of these movements. Therefore, in those cases where IS_Y does, in fact, move to the left from IS_Y^3, it remains an open question whether that movement would be greater than, or less than, the corresponding movement which would have occurred in Model I . Similarly, the fact that IS_Y could move to the right of IS_Y^3 raises the question of whether that rightward movement could carry IS_Y to the right of the initial IS_Y curve, IS_Y^0 - in other words, it raises the question of whether the decline in farm output could result in an overall <u>increase</u> in total G.D.P. It is felt that an exploration of such issues, while obviously important, could be more satisfactorily undertaken in the theoretical simulation variant of Model II, as presented in O'Mara et al (1985) and discussed briefly in Chapter X.

Section III Some Analysis with an Endogenous Balance of Payments

III(1) Model Specification

To endogenise the balance of payments, three equations are added to the original specification of Model II.

$$(31) \quad \dot{m}^S = \dot{d} + BP$$

$$(32) \quad k = k(\overset{+}{r}, \overset{-}{r}^W, \overset{+}{\dot{e}}^E, \overset{?}{\dot{\mu}})$$

Equations (31) and (32) correspond exactly with equations (28) and (29) respectively, in Model I.

$$(33) \quad BP = p_{NFT}Y_{NFT} - p_{NFT}Z_{NFT} + p_F^W \bar{O}_F + k$$

Equation (33) is the balance of payments identity. It is clear, however, that the specification differs significantly to that employed earlier, in Model I. In particular, the contribution of the farm sector to the current account is fixed, given the exogenously determined levels of p_F^W and $\bar{O}_F$ (the latter, of course, being zero in the case of a non-traded agricultural commodity). In other words, the value of farm exports is invariant to changes in the volume of farm production, or in the volume of local expenditure on farm commodities, or in the local price of farm commodities, p_F - provided that export restraints remain effective, and that quota profits accrue to local residents.

Section III(2) Geometric Characterisation of the Model

The geometric characterisation of the model is identical to that used in Section II, with the inclusion in Sector I of a TT schedule which traces out combinations of Z and r which are consistent with balance of payments equilibrium.

As we have seen in our analysis with Model I, in locating the position of the TT schedule in Sector I, only the direct partial effect of Z on the balance of payments via the current account is considered along the horizontal axis, and the direct, partial effect of r on net capital inflow along the vertical axis. In other words, with all other factors which affect the current account given, the state of the current account can be assessed for each level of Z. Similarly, with all other factors which affect net capital inflow given, a level of the interest rate can be found which would produce a rate of net capital inflow or outflow just sufficient to counteract the current account balance, thus producing an overall zero balance of payments.

From (33) the current account elements of the balance of payments are

$$p_{NFT}Y_{NFT} - p_{NFT}Z_{NFT} + p_F^W \bar{O}_F$$

It will be recalled that p_{NFT} is given exogenously, and that, as noted in Section II(3), Y_{NFT} is assumed to be fixed. Therefore, changes in Z have no bearing on the term $p_{NFT}Y_{NFT}$.

Next, consider the term $p_{NFT}Z_{NFT}$. From (21), Z_{NFT} is a function of Z, $\frac{p_{NFT}}{p_{NT}}$, $\frac{p_{NFT}}{p_F}$ and ε. The ordinary partial derivative of Z_{NFT} with respect to Z is assumed to be positive, while p_{NFT}, p_{NT} and ε are exogenously given. A problem emerges, however, in assessing the impact of a change in Z on Z_{NFT} via p_F. It is clear that, as

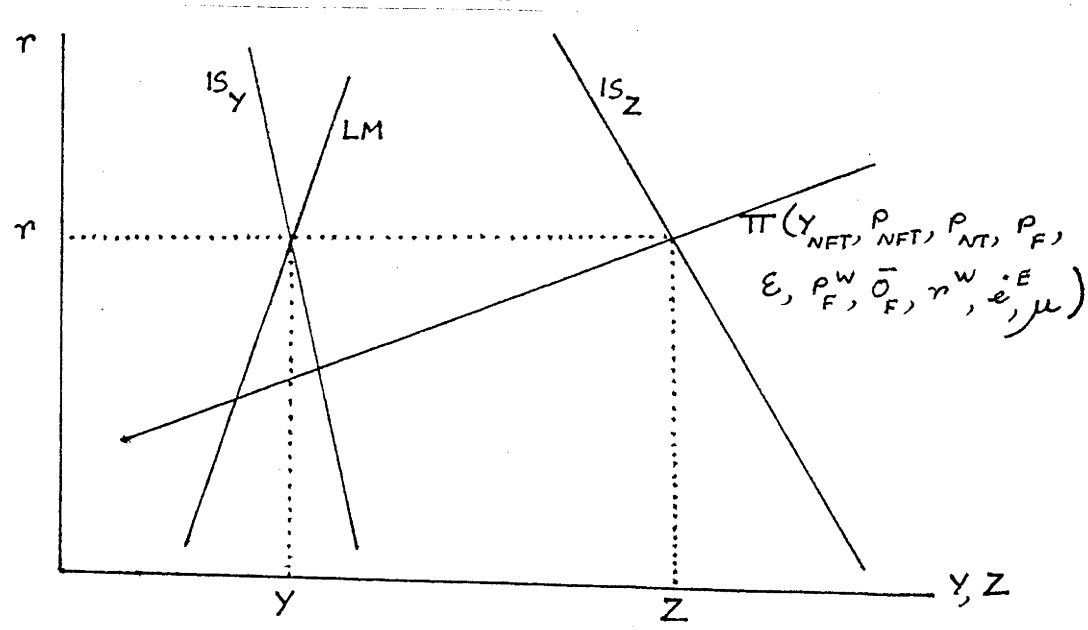
p_F is endogenous in Model II, then, in principle, changes in Z would be expected to influence p_F. For simplicity, however, it will be assumed that the impact of changes in Z on p_F are negligible. In other words, it will be assumed that such domestic demand induced changes in farm prices are negligible relative to the price changes which are required in order to absorb changes in the volume of farm production on the domestic market - the latter, of course, being the focus of attention in the present analysis. This, of course, is also consistent with the approach adopted in Section II, where the only change in p_F considered was that caused directly by the change in O_F.

Finally, of course, changes in Z have no impact on either p_F^W or $\bar{O}_F$ because both are assumed to be given exogenously.

It is clear then, that, given Y_{NFT}, p_{NFT}, p_{NT}, p_F, ε, p_F^W and $\bar{O}_F$, the state of the current account is a decreasing function of Z. From (32), net capital inflow, k, is an increasing function of r, given r^W, $\dot{e}^E$ and μ. Therefore, the TT schedule in Sector I will be positively sloped, and drawn for given levels of Y_{NFT}, p_{NFT}, p_{NT}, p_F, ε, p_F^W, $\bar{O}_F$, r^W, $\dot{e}^E$ and μ, as in Figure IV(12).

Figure IV(12)

Sector I



Several further points should be noted. Firstly, as was the case with Model I, it will be assumed that the slope of the TT schedule is everywhere flatter than that of LM. Secondly, if Y is the scale argument in the demand for money function, then balance of payments equilibrium would require that the IS_Y and LM curves intersect at the same level of the interest rate as the point of intersection between IS_Z and TT (as drawn in Figure IV(12)). Alternatively, if Z is the true scale argument, then balance of payments equilibrium would require IS_Z, TT and LM to share a common point of intersection. Finally, it will be recalled that, in Model I , the TT schedule was drawn on the assumption of given values for, amongst other variables, p_F and O_F. That contrasts with the present case, where a distinction has been drawn between p_F and p_F^W - both of which influence the position of TT - and where O_F has been replaced by $\bar{O}_F$.

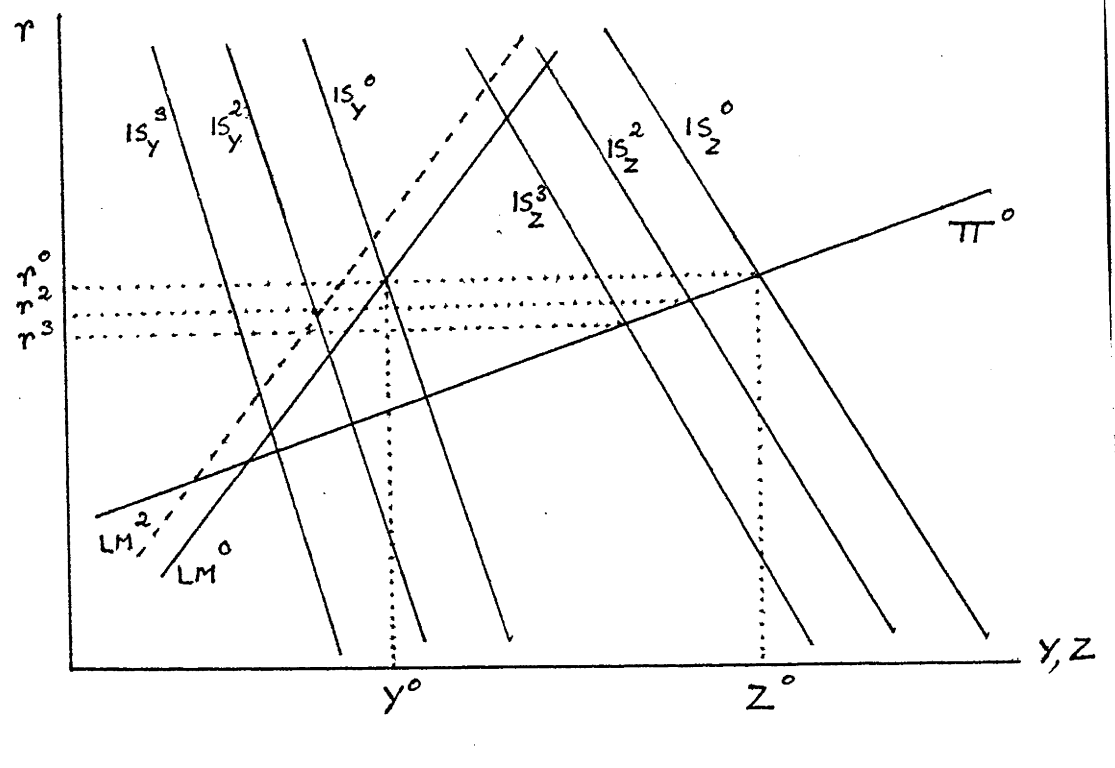
III(3) Some Analysis of the Second Paradigm

Because the two variants of Model II are very similar, much of the analysis undertaken in Section II carries over to the present case. We will focus our attention, therefore, only on some of the issues raised by the endogeneity of the balance of payments in Model II.

Suppose that, prior to the shock in the farm sector, the positions of the IS curves and the LM curve are represented, as usual, by IS_Y^0, IS_Z^0 and LM^0 in Figure IV(13). Also suppose that the initial position of the TT curve is represented by TT^0, so that, given that Y is the scale argument in the demand for money function, the balance of payments is initially in equilibrium at Y^0, Z^0 and r^0.

Figure IV(13)

Sector I



As was the case in Section II, it will be assumed that the shock in the farm sector occurs in two stages. Firstly, it will be assumed that the usage of non-primary inputs in the farm sector declines, and that sufficient time then elapses for a new Keynesian equilibrium to be established in the non-farm sector. Then, in the second stage, the actual volume of farm output declines.

In Figure IV(13), after a new Keynesian equilibrium is established in the non-farm sector following the decline in the usage of non-primary inputs in the farm sector, the IS curves are represented by IS_Y^2 and IS_Z^2, as in Section II. As the decline in J has no impact on the current account, other than via the induced change in Z, the TT schedule remains at TT^0. It is clear, therefore, that given IS_Y^2, IS_Z^2 and TT^0, balance of payments equilibrium would require an interest rate of r^2. To the extent that IS_Y^2 intersects LM^0 at an interest rate below r^2, then balance of payments deficits would occur until the money stock had been reduced sufficiently to shift the LM

curve to the left from LM^0 to LM^2. (Of course, had the horizontal distance $IS_Z^0 - IS_Z^2$ been sufficiently greater than the horizontal distance $IS_Y^0 - IS_Y^2$, then it is possible that the intersection of IS_Y^2 and LM^0 may have occurred at an interest rate above r^2, so that a temporary balance of payments surplus may have been required).

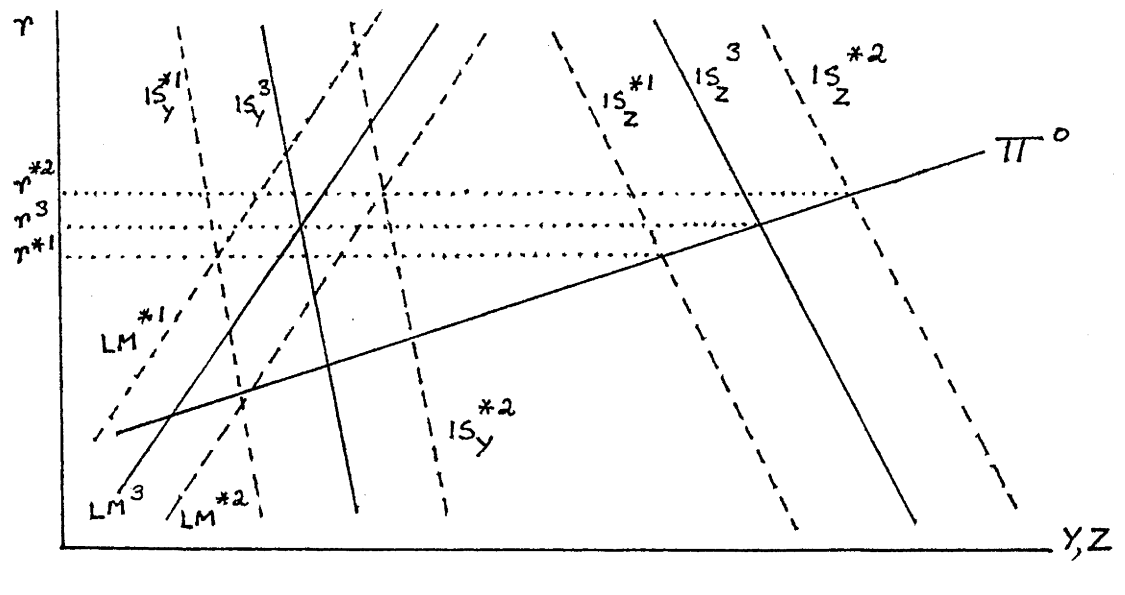
As we saw in Section II, the decline in farm output is reflected in a leftward movement of IS_Y from IS_Y^2 to IS_Y^3, and on the assumption that aggregate nominal expenditure is unchanged in the face of the lower volume of farm production and higher farm prices, the IS_Z curve moves to the left from IS_Z^2 to IS_Z^3. We noted, in Section III (2), that a change in p_F would require a shift in the position of the TT schedule from TT^0. However, we will proceed, for the moment, on the assumption that TT remains at TT^0. Then, given IS_Y^3, IS_Z^3 and TT^0, it is clear that balance of payments equilibrium would require the interest rate to fall from r^2 to r^3. However, the rise in the farm price would also result in a leftward movement of LM from LM^2. Therefore, the net effect of the rise in farm prices and the fall in farm output on the balance of payments is ambiguous. For example, if IS_Y^3 and the new LM curve intersected at an interest rate below r^3, then temporary balance ofpayments deficits would occur, and conversely, until IS_Y^3 and LM intersected at interest rate r^3.

In our analysis in Section II, the emphasis was on the direction of movement of IS_Z, and more particularly, IS_Y, from IS_Z^3 and IS_Y^3. It was argued that, under a wide range of circumstances, Keynesian equilibrium in the non-traded goods sector would require a cumulative leftward movement of the IS curves from IS_Y^3 and IS_Z^3. It was noted that such an outcome would be qualitatively (although not necessarily quantitatively) the same as would be expected in Model I. However, it was also noted that, under a wide range of circumstances,

the IS curves would move to the right from IS_Y^3 and IS_Z^3 as the economy adjusted towards a new Keynesian equilibrium.

Figure IV(14)

Sector I



In Figure IV(14), IS_Y^3, IS_Z^3 and TT^0 are as described in Figure IV(14). In addition, suppose that the nominal money stock is consistent with LM^3, and hence with balance of payments equilibrium, given IS_Y^3, IS_Z^3 and TT^0. Now consider the case where the new Keynesian equilibrium IS curves lie to the left of IS_Y^3 and IS_Z^3 - say at IS_Y^{*1} and IS_Z^{*1}. It is clear that balance of payments equilibrium would require the interest rate to decline from r^3 to r^{*1}. As TT^0 is flatter than LM^3, it follows that, unless the horizontal distance between IS_Z^3 and IS_Z^{*1} substantially exceeds the horizontal distance between IS_Y^3 and IS_Y^{*1}, the leftward movement of the IS curves would be associated with balance of payments deficits. For example, in Figure IV(14), balance of payments deficits would occur until the LM curve had been moved to the left from LM^3 to LM^{*1}. Then, given TT^0, it is clear that IS_Y^{*1}, IS_Z^{*1} and LM^{*1} are consistent with Keynesian equilibrium in the non-

traded goods sector, and with balance of payments equilibrium.

Now consider the case where the IS curves move to the right from IS_Y^3 and IS_Z^3 - for example, suppose that the new IS curves, consistent with Keynesian equilibrium in the non-traded goods sector, were represented by IS_Y^{*2} and IS_Z^{*2}. In this case, balance of payments equilibrium would require a higher interest rate, r^{*2}. As TT^0 is flatter than LM^3, it follows that, unless the horizontal distance between IS_Z^{*2} and IS_Z^3 is substantially greater than the horizontal distance between IS_Y^{*2} and IS_Y^3, the rightward movement of the IS curves would be associated with balance of payments surpluses. For example, in Figure IV(14), balance of payments surpluses would occur until the LM curve had been moved to the right from LM^3 to LM^{*2}.

The analysis to date might be summarised as follows:

- the leftward movement of IS_Y from IS_Y^0 to IS_Y^2, and of IS_Z from IS_Z^0 to IS_Z^2 would, under a wide range of circumstances, be associated with balance of payments deficits;
- the subsequent movement of IS_Y from IS_Y^2 to IS_Y^3, and of IS_Z from IS_Z^2 to IS_Z^3 - as farm output falls and farm prices increase - could be associated with either a balance of payments deficit or a surplus;
- on the assumption that the position of the TT schedule is unaffected by the change in p_F, then, if IS_Y and IS_Z move further to the left from IS_Y^3 and IS_Z^3, such movements would, under a wide range of circumstances, be associated with further balance of payments deficits. As we have already seen, such leftward movements of the IS curves are consistent, at least qualitatively, with the movements which would be expected to occur in Model I (with p_{NT} and w fixed).

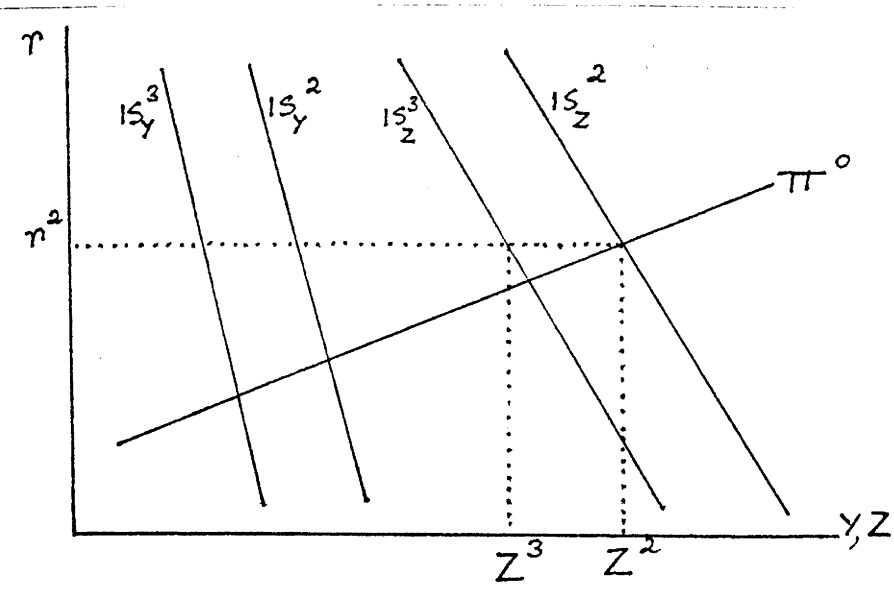
Further, the general tendency for such movements of the IS curves to be associated with balance of payments deficits is consistent with the conclusions which emerged from Model I;

- however, in the present case, unlike in Model I, the IS curves may also move to the right from IS_Y^3 and IS_Z^3. As we noted in Section II, the possibility of such rightward movements of the IS curves indicates that, under the second paradigm, a given decline in O_F and J may have a significantly smaller impact on non-farm and total G.D.P. than under the **first paradigm. Our present analysis has indicated that the rightward movement of the IS curves from** IS_Y^3 and IS_Z^3 is also likely to be associated with balance of payments surpluses - in other words, in the second paradigm, a given decline in O_F and J may also have a **smaller adverse impact on the balance of payments during the adjustment period than under the first paradigm.**

The next step is to relax our simplifying assumption that the change in p_F has no impact on the TT schedule. Consider Sector I.

Figure IV(15)

Sector I

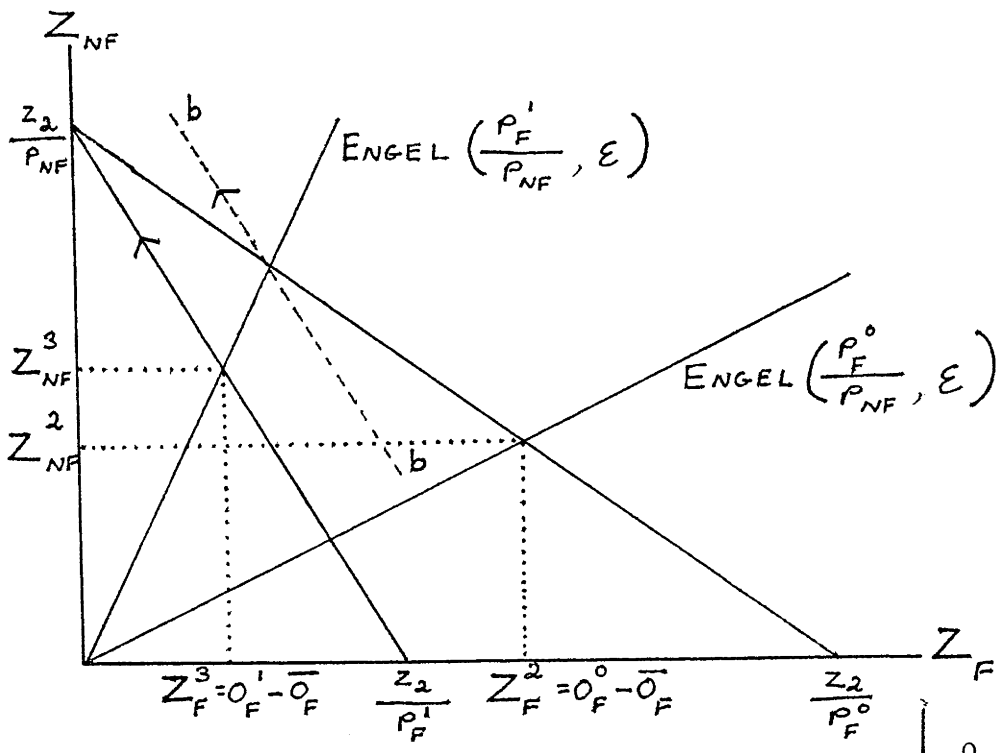


In Figure IV(15), IS_Y^2, IS_Y^3, IS_Z^2, IS_Z^3 and TT^0 are as described above in Figure IV(13). In particular, IS_Y^2 and IS_Z^2 represent the positions of the IS curves after a new Keynesian equilibrium has been established following the decline in J. As TT is unaffected by a change in J, ceteris paribus, TT remains at TT^0 up until this point, and an interest rate of r^2 is required to clear the balance of payments. Then, the fall in farm production shifts IS_Y from IS_Y^2 to IS_Y^3, and given the levels of aggregate nominal expenditure implied by each point on IS_Z^2, the rise in p_F causes the IS_Z curve to shift from IS_Z^2 to IS_Z^3. Our task is to assess the impact of the rise in p_F from p_F^0 to p_F^1, and the fall in Z from Z^2 to Z^3, on the state of the current account. This will allow us to draw some conclusions about the position of the new TT schedule relative to TT^0.

The analysis can be undertaken in Sector II, using a procedure similar to that which was employed in Section II in order to assess the implications of a relative price change. In particular, given p_{NT}, p_{NFT} and the original level of p_F - p_F^0 - Z^2 can be converted to nominal terms - say z_2. By construction, Z^3, when converted to nominal terms using p_{NT}, p_{NFT} and the <u>new</u> farm price - p_F^1 - will also equal z_2.

Figure IV(16)

Sector II(1)



In Figure IV(16), given z_2 and the original farm price, p_F^0, the budget line is represented by the line with intercepts

$$\frac{z_2}{p_{NF}} \quad \frac{z_2}{p_F^0} \quad .$$

The resulting volume of expenditure on farm commodities, Z_F^2, is just sufficient to clear the farm commodity prior to the decline in farm output ie.

$$Z_F^2 = O_F^0 - \bar{O}_F \quad .$$

Following the decline in farm output and the resulting rise in p_F from p_F^0 to p_F^1, the budget line rotates to

$$\frac{z_2}{p_{NF}} \quad \frac{z_2}{p_F^1}$$

and the volume of expenditure on farm commodities falls from Z_F^2 to $Z_F^3 = O_F^1 - \bar{O}_F$.

Suppose that the demand for farm commodities was own price elastic across the arc between p_F^0 and p_F^1. It would follow that, given z_2, nominal expenditure on farm commodities would fall, and hence nominal (and real) expenditure on non-farm commodities would rise. Such a case is represented in Figure IV(16), where the rise in p_F results in the volume of expenditure on non-farm commodities increasing from Z_{NF}^2 to Z_{NF}^3. It is clear that, provided non-farm traded commodities are superior, the higher level of Z_{NF} would imply, in Sector II(2), a higher volume of expenditure, not only on non-traded goods as we have already noted, but also on non-farm traded goods. We also know that production of non-farm traded goods is fixed, as is the value of farm exports, given p_F^W and $\bar{O}_F$. Therefore, given z_2, the rise in p_F from p_F^0 to p_F^1 would be associated with a deterioration in the current account. It follows that, in this case, the height of the new TT schedule, at Z^3, would be greater than the height of TT^0 at Z^2 ie. a higher domestic interest rate, and hence a stronger capital account, would be required to offset the weaker current account at Z^3 relative to Z^2.

Following a similar line of reasoning, it is immediate that, if the demand for farm commodities was unit own price elastic, then the rise in p_F would have no bearing on Z_{NF} and hence Z_{NFT}. Therefore, the state of the current account would be unaffected, and the height of the new TT schedule at Z^3 would be equal to the height of TT^0 at Z^2.

Finally, had the demand for farm commodities been own price inelastic, nominal (and real) expenditure on non-farm commodities would fall as a result of the rise in p_F, given z_2. Therefore, the volume of expenditure on non-farm traded goods would fall, and the state of the current account would improve. Hence, the height

of the new TT schedule at Z^3 would be less than the height of TT^0 at Z^2.

It is also possible to assess the height of the new TT schedule relative to TT_0, at Z^2. Suppose that, in Figure IV(16), given p_F^1, the level of aggregate nominal expenditure was increased, so that the budget line moved outward from $\frac{z_2}{p_{NT}}$ $\frac{z_2}{p_F^1}$ to the line bb, so that $\frac{z_2}{p_{NF}}$ $\frac{z_2}{p_F^0}$, bb and Engel $(\frac{p_F^1}{p_{NF}}, \varepsilon)$ share a common point of intersection. It is clear that the chosen point on such a budget line (ie. that common point of intersection), when valued at the original or base period prices, p_{NF} and p_F^0, would represent a volume of expenditure equal to Z^2. It is also clear that, provided that farm and non-farm commodities are net substitutes in expenditure, the level of Z_{NF} at that chosen point would be greater than Z_{NF}^2. Therefore, given the new relative prices, a volume of expenditure equal to Z^2 would now be associated with a higher level of demand for non-farm traded goods, and hence with a weaker current account. Therefore, the new TT schedule, at Z^2, would lie above TT^0. Of course, a similar conclusion would hold for all levels of Z, ie. a pure substitution effect away from farm commodities would increase the demand for non-farm and hence non-farm traded goods, resulting in a weaker current account.

It is interesting to recall that, in Model I, the decline in farm production also resulted in an upward (or leftward) movement of the TT schedule. However, in that case, the mechanism at work was the decline in the volume and value of farm exports, so that the state of the current account was weaker at each level of Z. That contrasts with the present case, where the volume and value of farm exports are constant, but where relative prices change in the

domestic economy. Of course, there is no presumption that the extent of the upward movement of the TT schedule in Models I and II would necessarily be equivalent.

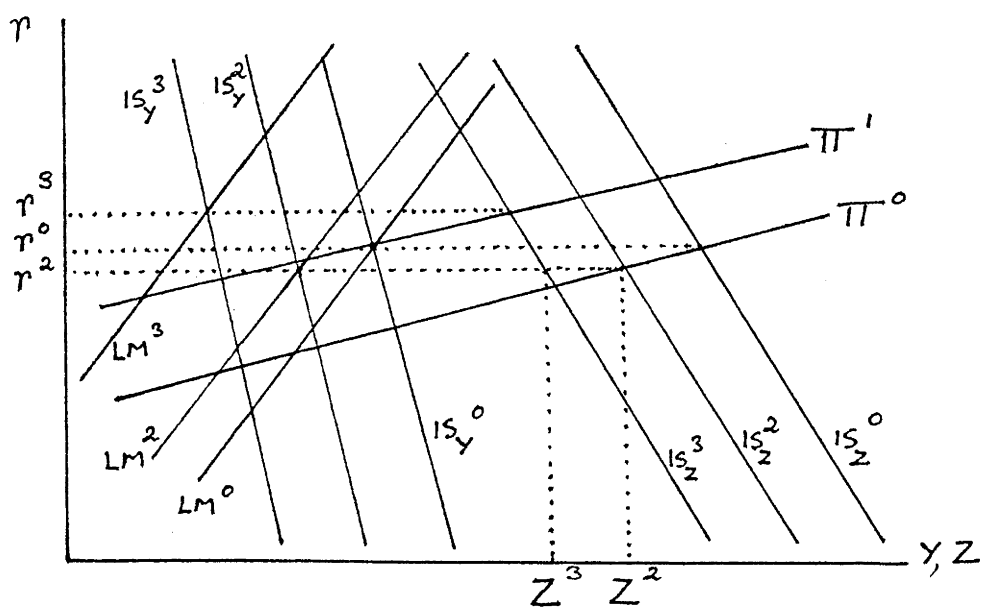
To summarize our discussion of the movement of the TT schedule from TT^0, following the rise in p_F from p_F^0 to p_F^1, we have seen that:

- the new TT schedule would lie above TT^0 for all levels of Z;
- the height of the new TT schedule at Z^3 will be greater than, equal to or less than the height of TT^0 at Z^2, depending on whether the demand for farm commodities is own price elastic, unit elastic or inelastic, respectively.

We are now in a position to combine our analyses of the movements in the IS curves with the above analysis of the movement in the TT schedule. Consider first the case where the demand for farm commodities is own price elastic.

Figure IV(17)

Sector I



In Figure IV(17), IS_Y^0, IS_Y^2, IS_Y^3, IS_Z^0, IS_Z^2 and IS_Z^3 are as described previously. TT^0 represents the original position of the TT schedule, and TT^1 represents its new position. Note that, as required, TT^1 lies above TT^0, and the height of TT^1 at Z^3 is greater than the height of TT^0 at Z^2.

The leftward movement of the IS curves from IS_Y^0 and IS_Z^0 to IS_Y^2 and IS_Z^2 would be associated with a decline in the interest rate from r^0 to r^2, and as drawn, a balance of payments deficit sufficient to move LM to the left from LM^0 to LM^2. However, the leftward movement of the IS curves from IS_Y^2 to IS_Y^3, and from IS_Z^2 to IS_Z^3 would be associated with an increase in the interest rate in this case, from r^2 to r^3, as TT moves from TT^0 to TT^1. In order to be consistent with the higher level of r and balance of payments equilibrium, the LM curve would need to move further to the left, from LM^2 to LM^3. However, the rise in p_F would itself raise the demand for money balances, thus moving LM to the left from LM^2 even with a given nominal money stock. Therefore, it is unclear whether the establishment of LM^3 would require a temporary period of balance of payments deficits, or whether a period of surpluses would be required.

Also note that the rise in r, from r^2, raises the possibility that the new, higher level of r could, in fact, lie above r^0 - for example, in Figure IV(17), $r^3 > r^0$. However, this is, of course, an empirical question.

We know that, from IS_Y^3 and IS_Z^3, the IS curves may move either to the left or to the right in order to establish a new Keynesian equilibrium in the non-traded goods sector. If the movements are to the left then:

- those movements would be associated with deficits in the balance of payments (unless the movement of IS_Z was significantly greater than that of IS_Y). There is a strong presumption, therefore, that the overall impact of the shock in the farm sector on the balance of payments would be to create deficits during the period of adjustment to a new Keynesian and balance of payments equilibrium;
- the interest rate would decline from r^3. However, as it is possible that $r^3 > r^0$, it remains possible that, in the new Keynesian and balance of payments equilibrium, r could lie above r^0. Therefore, as in Model I, there is considerable uncertainty as to the impact of the shock in the farm sector on r.

If IS_Y and IS_Z move to the right from $IS_Y{}^3$ and $IS_Z{}^3$ then:

- unless the rightward movement of IS_Z was significantly greater that that of IS_Y, the movements would be associated with balance of payments surpluses. In other words, the shock in the farm sector is likely to have a smaller deleterious effect on the balance of payments in this case than in the above case where the IS curves moved to the left. It is also suggestive of the possibility that the overall impact of the shock in the farm sector on the balance of payments could be favourable ;
- the interest rate, r, would increase from r^3, so that, even if $r^3 < r^0$, it remains possible that r could eventually rise above r^0. Also, of course, as TT^1 lies above TT^0, it is clear that, should IS_Z move sufficiently to the right to return it to, or to the right of $IS_Z{}^0$, then it is unambiguous that balance of payments equilibrium would require a level of r above r^0.

The analysis of the cases where the demand for farm commodities is unit own price elastic and own price inelastic follows along the same lines as the above, and leads to very similar conclusions. Our earlier discussion of the nature of the movements in the TT schedule, however, allows us to be a little more concrete about the level of the interest rate in the new Keynesian and balance of payments equilibrium relative to the original interest rate, r^0. In Figure IV(17), in the case of a unit own price elasticity, we know that the height of TT^1 at Z^3 would have been the same as the height of TT^0 at Z^2. Therefore, the leftward movement of IS_Y from $IS_Y{}^2$ to $IS_Y{}^3$, and of IS_Z from $IS_Z{}^2$ to $IS_Z{}^3$ would not have required a change in the level of the interest rate, from r^2, in order to maintain balance of payments equilibrium. Then, if the new Keynesian equilibrium required further leftward movements of the IS curves from $IS_Y{}^3$ and $IS_Z{}^3$, it is clear that r would fall below r^2. As $r^2 < r^0$, it follows that, in this case, the new Keynesian and balance of payments equilibrium would have been associated with a level of r below r^0.

In the case where the demand for farm commodities is own price inelastic, we know that, in Figure IV(17), the height of TT^1 at Z^3 would have been less than the height of TT^0 at Z^2. Therefore, the leftward movement of IS_Z from $IS_Z{}^2$ to $IS_Z{}^3$, and of IS_Y from $IS_Y{}^2$ to $IS_Y{}^3$ would require a fall in the interest rate, from r^2, in order to maintain balance of payments equilibrium. Then, if a further leftward movement of the IS curves was to occur as the economy moved towards a new Keynesian equilibrium in the non-traded goods sector, the interest rate would fall even further. Again, as $r^2 < r^0$, it follows that, in the new Keynesian and balance of payments equilibrium, the interest rate would be less than r^0.

Of course, if, in either of these cases, the IS curves had moved to the right from IS_Z^3 and IS_Y^3, upward pressure would be placed on r, so that it remains possible that r could rise beyond r^0. In other words, the ultimate impact of the shock in the farm sector on the interest rate would remain uncertain.

III(4) Concluding Comments on Section III.

In Section III, explicit balance of payments considerations were incorporated into the Model II framework. The model was then used to further examine some aspects of the second paradigm.

It was demonstrated that the effect of the fall in farm production, and the consequent rise in farm prices, was to raise (or shift to the left) the TT schedule. It was noted that, as such, the impact on the TT schedule was qualitatively similar to that in Model I, where a fall in the volume of farm production also served to raise the TT schedule. However, it was emphasised that the mechanisms at work in Model I and in Model II were quite different. Further, there was no presumption that the magnitudes of those upward movements of the TT schedule in the two models would be the same, even for a given decline in farm output.

It proved possible to undertake some additional clarification of the extent of the upward movement of the TT schedule in Model II, by reference to various ranges of own price elasticities of demand for farm commodities.

As was the case in our analysis in Section II, the IS curves IS_Y^3 and IS_Z^3 were again used as focal points in the analysis:

- it was argued that, if the IS curves moved to the left from IS_Y^3 and IS_Z^3, then, under a wide range of circumstances, these movements would be associated with balance of payments

deficits. This indicated that there was a strong presumption that the overall transition from the original Keynesian and balance of payments equilibrium to the post-shock equilibrium would be associated with balance of payments deficits. Such an outcome was noted to be qualitatively similar to that obtained with Model I . It would also seem to raise the question of whether the overall impact of the farm sector shock on the balance of payments, during the adjustment period, could be more deleterious in Model II than in Model I . In other words, could a decline in O_F and J, in the presence of an unchanged volume and value of farm exports, have a more deleterious effect (albeit temporary) on the balance of payments, than a similar decline in O_F and J which actually resulted in a decline in the volume and value of farm exports? The complexity of this issue is such that it was not explored in detail in the present chapter. However, it is taken up in O'Mara et al (1985);

- conversely, if the IS curves move to the right from IS_Y^3 and IS_Z^3, it was argued that, under a wide range of cases, this component of the movement to the new Keynesian and balance of payments equilibrium would be associated with balance of payments surpluses. This implied that the overall deleterious effect on the balance of payments would tend to be less in this case than in the previous case where the IS curves moved to the left. It is also suggestive of the possibility that the transition from the original Keynesian and balance of payments equilibrium to the new, post-shock equilibrium,

could be associated with a net surplus in the balance of payments. This issue is also taken up in O'Mara et al (1985).

Finally, the analysis in Section III indicated that there is substantial uncertainty as to the impact of the decline in O_F and J on the interest rate, given the circumstances postulated in the second paradigm. In particular, in the new Keynesian and balance of payments equilibrium following the shock, the interest rate might lie either above or below its level in the initial equilibrium. Similar ambiguity was also noted in the analysis with Model I . It was possible in the present case, however, to identify some instances where the interest rate in the new Keynesian and balance of payments equilibrium would unambiguously lie below its initial level. In particular, such an outcome would be expected where the demand for farm commodities was either unit own price elastic, or inelastic, and where the IS curves moved to the left from $IS_Y{}^3$ and $IS_Z{}^3$.

Section IV Concluding Comments on Chapter IV

In Chapter IV:

(a) Model II was specified, characterised geometrically and then used to analyse the macroeconomic implications of a shock in the farm sector under the circumstances postulated in the second paradigm. In particular, it was assumed that the volume of farm production declined exogenously, in the presence of an effective constraint on the volume of farm exports (typically in the form of import quotas imposed by overseas markets) and in the absence of buffer stockholding of farm commodities. The decline in the volume of farm production thus needed to be absorbed on the domestic market via a rise in the price of farm commodities. Model II differed from Model I only to the extent necessary to capture the essential features of this alternative marketing environment for farm commodities;

(b) in presenting the results of the analysis, considerable emphasis was given to cross comparisons with the results obtained from Model I, in Chapter III. In the first instance, the analysis abstracted from explicit balance of payments considerations. The state of the balance of payments was subsequently endogenised in the model. However, unlike the earlier analysis in Chapter III, no attempt was made to introduce a degree of flexibility in non-traded goods prices and nominal wages;

(c) the main results and conclusions obtained from the analysis have been summarised in Sections II(5) and III(4) and hence will not be repeated here in detail. Briefly, some of the more interesting points are that:

- an exogenous decline in the volume of farm production could have either a more severe or a less severe impact on non-farm output under the second paradigm than under the first. The possibility was also raised that the decline in farm production could, in fact, have a beneficial impact on non-farm output. This uncertainty as to the impact on non-farm output stems largely from the effects of the induced rise in the price of farm commodities in the present case. In particular, with farm production and prices moving in opposite directions, farm incomes may either rise or fall, and this would then be reflected in consumption and investment expenditure by farm households. Further, the non-farm sector may be either beneficially or adversely affected by a switching of expenditure between farm and non-farm commodities in response to the rise in farm prices. It was shown that, as might be anticipated, the own price elasticity of demand for farm commodities on the domestic market is an important variable under such circumstances;

- it was shown that the overall balance of payments could deteriorate further under the second paradigm than under the first, despite the fact that, under the second paradigm, the volume and value of farm exports are unaffected by the decline in farm production. The more intuitively pleasing outcome that the balance of payments could deteriorate less under the second paradigm was also shown to be possible. There was also a tentative suggestion that the decline in farm production could be associated with a balance of payments surplus. These divergent possibilities for the balance of payments reflect, in large measure, the variety of outcomes that are possible for G.D.P., as noted above, and hence for the demand for money;

- as was the case under the first paradigm, the direction of the impact on the interest rate was highly uncertain. There was no necessary presumption that the exogenous decline in farm production would result in a fall in the interest rate, or that the impact on the interest rate would be identical under the first and second paradigms.

Two final points should be emphasised. Firstly, as noted in (b) above, no attempt was made to develop and explore a variant of Model II in which non-traded goods prices and nominal wages are allowed to vary. This is not to deny that such an extension is important. Rather, it is a reflection of the fact that the issues involved are complex, and that our analysis with the relevant variant of Model I has already provided some feel for the implications of movements in non-traded goods prices and nominal wages within the general model framework. Therefore, it was felt that an exploration of these issues within Model II could be best undertaken within the theoretical simulation variant of the model - as presented in O'Mara et al (1985) and summarised very briefly in Chapter X.

Secondly, because of space limitations, the analysis in the present chapter proceeded, almost entirely, on the assumption that the scale argument in the demand for money function was aggregate production. We saw in our analysis with Model I, however, that the choice of aggregate expenditure rather than aggregate production as the scale argument can be of some significance to the analysis. It seems intuitive that that may also be the case in the present analysis. Therefore, this may represent an interesting and important issue to be taken up in a future research project.

CHAPTER V

MODEL III: SOME ANALYSIS OF THE THIRD PARADIGM

Introduction

In Chapter III, we examined, using Model I, some macroeconomic consequences of a shock in the farm sector, where that shock occurred in the presence of marketing and institutional arrangements for farm commodities which were consistent with the first paradigm. In other words, it was assumed that an exogenous change occurred in the volume of farm production, and that that change in the volume of farm production could be absorbed via an appropriate change in the volume of farm exports at given prices. Then, in Chapter IV, the model was modified slightly to generate Model II, which was used to examine the case where a similar shock occurred to the volume of farm production but which, in that case, needed to be absorbed entirely on the domestic market, via an appropriate change in the price of farm commodities, as dictated by the second paradigm. The analysis will now switch to the third paradigm. In particular, it will be again assumed that an exogenous change occurs in the volume of farm production but which, in this case, is absorbed entirely in a change in the level of stocks of farm commodities, so that neither the volume of farm exports, nor farm prices are affected in the short run. For this purpose, the model will be again modified slightly to produce a version which will be referred to as Model III, which captures this alternative set of marketing and institutional arrangements.

It was noted, in Chapter II, that neither the first nor the second paradigm could be regarded, in themselves, as a complete and accurate representation of any particular Australian agricultural industry at all points in time. Nevertheless, it was argued that

those paradigms were of at least partial relevance to a range of industries, at least in some periods. A similar conclusion was also drawn with respect to the third paradigm. In particular, it was argued that the third paradigm was likely to be of relevance to the wheat and wool industries in some periods, and, perhaps to a lesser extent, the sugar and dairying industries.

In Section II, the algebraic specification of Model III is presented and a geometric characterisation of the model is formulated. The geometric characterisation is then used to undertake some analysis of the third paradigm. As was the case in Chapters III and IV, the initial specification of the model abstracts from explicit balance of payments considerations and it is assumed that non-traded goods prices and nominal wages are fixed. In Section III, the analysis is extended by endogenising the state of the balance of payments in the model. This is followed, in Section IV, by some concluding comments on the analysis.

Finally, it should be noted that, as was the case with Model II in Chapter IV, no attempt is made to develop and explore a variant of Model III in which non-traded goods prices and nominal wages are allowed to vary. Again it is felt that, because of the additional complexity involved, such an extension is better left until a theoretical simulation variant of Model III has been developed.

Section II: Model III - Specification and Some Analysis

II(1) Notation

The notation used in Model III is identical to that described above for Models I and II, with the following addition:

I_P^{FS} - investment in buffer stocks of farm commodities within the domestic economy.

II(2) Model Specification

Farm Sector

The specification of the farm sector of Model III is identical to that for the two earlier variants of Model I, as set out in Sections III and IV of Chapter III. For convenience, it is reproduced below.

(1) $O_F = O_F(\overset{+}{K_F}, \overset{+}{L_F}, \overset{+}{J}, \overset{+}{\alpha})$

(2) $L_F = L_F(\overset{+}{\frac{\delta O_F}{\delta L_F}}, \overset{+}{\frac{p_F}{p_{NT}}} \overset{+}{\frac{p_F}{p_{NFT}}}, \overset{-}{n}, \overset{?}{v})$

(3) $Y_F = O_F - J$

(4) $Y_F^F = \beta Y_F$

(5) $Y_F = Y_F^F + Y_F^{NF}$

(6) $C_P^F = C_P^F(\overset{+}{Y_F^F}, \overset{-}{r})$

(7) $R = Y_F^F - C_P^F$

(8) $I_P^F = I_P^F(\overset{+}{R}, \overset{-}{r})$

The eight variables which are treated as endogenous to the farm sector are:

(1) O_F (2) L_F (3) Y_F (4) Y_F^F (5) Y_F^{NF} (6) C_P^F (7) R

(8) I_P^F

The variables incorporated into the farm sector of the model which are exogenous to the model as a whole are:

(1) K_F (2) J (3) α (4) p_F (5) p_{NFT} (6) p_{NT} (7) v

In addition, the interest rate, r, is exogenous to the farm sector of the model but endogenous to the non-farm sector.

It should be noted that the specification of the farm sector of Model III differs slightly to Model II. In the latter model, farm prices were endogenised by the inclusion of equation (10), and the fact that farm prices were variable meant that a distinction needed to be drawn between the real and the nominal values of several farm sector variables. Similarly, in the most complex variant of Model I, where non-traded goods prices and nominal wages were allowed to vary, there was also a need to distinguish between the real and the nominal values of certain farm sector variables - see Section V of Chapter III.

Non-Farm Sector and Macro Aggregates

Equations (9) to (15) in Model III are identical to the corresponding equations in Model I.

(9) $Y = Y_{NT} + Y_{NFT} + Y_F$

(10) $Y_{NFT} = Y_{NFT}(\overset{+}{K}_{NFT}, \overset{+}{L}_{NFT}, \overset{+}{\alpha}_{NFT})$

(11) $L_{NFT} = L_{NFT}(\overset{+}{\frac{\delta Y_{NFT}}{\delta L_{NFT}}}, \overset{+}{\frac{p_{NFT}}{p_{NT}}}, \overset{+}{\frac{p_{NFT}}{p_F}}, \overset{-}{n}, \overset{?}{v})$

(12) $Y_{NT} = Y_{NT}(\overset{+}{K}_{NT}, \overset{+}{L}_{NT}, \overset{+}{\alpha}_{NT})$

(13) $L_{NT} = \begin{cases} L_{NT}^{*}(\overset{+}{\frac{\delta Y_{NT}}{\delta L_{NT}}}, \overset{+}{\frac{p_{NT}}{p_{NFT}}}, \overset{+}{\frac{p_{NT}}{p_F}}, \overset{-}{n}, \overset{?}{v}) & \text{for } Z_{NT} = Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) \\ L_{NT}^{D}(\overset{-}{K}_{NT}, \overset{-}{\alpha}_{NT}, \overset{+}{Z}_{NT}) & \text{for } Z_{NT} \neq Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) \end{cases}$

(14) $C_P^{NF} = C_P^{NF}(\overset{+}{Y}_{NT}, \overset{+}{Y}_F^{NF}, \overset{+}{Y}_{NFT}, \overset{-}{r})$

(15) $C_P = C_P^{F} + C_P^{NF}$

(16) $I_P^{NF} = I_P^{NF}(\overset{+}{\Delta Y}_{NT}, \overset{-}{r}) + I_P^{FS}$

Equation (16) is a modification of equation (16) in Model I, by virtue of the inclusion of investment in inventories of farm commodities as a component of aggregate non-farm investment.

Equations (17) and (18) are equivalent to their counterparts in Model I.

$$(17) \quad I_P = I_P^{F} + I_P^{NF}$$

$$(18) \quad Z = C_P + C_G + I_P + I_G$$

It is immediate from (16), (17) and (18) that I_P^{FS} is a component of Z. It seems sensible, therefore, when separating Z into those components which are directed onto non-farm traded goods, non-traded goods and farm goods respectively, to treat I_P^{FS} separately. Hence

$$(19) \quad Z_{NFT} = Z_{NFT}(Z - \overset{+}{I_P^{FS}}, \frac{\bar{p}_{NFT}}{p_{NT}}, \frac{\bar{p}_{NFT}}{p_F}, \overset{?}{\varepsilon})$$

$$(20) \quad Z_{NT} = Z_{NT-J}(Z - \overset{+}{I_P^{FS}}, \frac{\bar{p}_{NT}}{p_{NFT}}, \frac{\bar{p}_{NT}}{p_F}, \overset{?}{\varepsilon}) + J$$

$$(21) \quad Z_F = Z - Z_{NFT} - (Z_{NT} - J)$$

In equation (19), the scale argument in the demand function for non-farm traded goods is assumed to be $Z - I_P^{FS}$ i.e. that part of aggregate final expenditure which remains after I_P^{FS} is removed. That reflects the fact that, by definition, I_P^{FS} is directed entirely onto farm commodities. A similar argument applies to the specification of equation (20). It is also clear that, in equation (21), aggregate expenditure on farm commodities, Z_F, will, in general, consist of two components - namely, I_P^{FS}, and a voluntary or non-inventory component.

$$(22) \quad Z_F = O_F - \bar{O}_F$$

Equation (22) serves to endogenise I_P^{FS}. In other words, the I_P^{FS} component of Z_F must move to whatever level is necessary in order to clear the farm commodity market of any farm output which remains after the voluntary domestic expenditure on farm commodities has been absorbed, and after the exogenously constrained volume of farm exports, $\bar{O}_F$, has been met. Of course, the farm commodities in question could be readily conceptualised as being non-traded, simply by setting $\bar{O}_F$ to zero. However, as noted above, and in Chapter II, the main industries for which this third paradigm is likely to be relevant are the wheat and wool industries in some periods, so that, in practice, $\bar{O}_F$ is likely to be positive. It is also interesting to note that equation (22) above is identical to equation (10) in Model II. In the latter case, however, that equation served to endogenise the local price of farm commodities, rather than I_P^{FS}.

Finally, equations (23) to (28) in Model III are identical to equations (22) to (27) in Model I.

$$(23) \quad n = \frac{w}{ap_{NT} + bp_{NFT} + cp_F}$$

$$(24) \quad L = L_{NFT} + L_{NT} + L_F$$

$$(25) \quad L^S = \bar{L}$$

$$(26) \quad E = L$$

$$(27) \quad m^D = m^D(\overset{+}{Y} \text{ or } \overset{+}{Z}, \overset{-}{r})$$

$$(28) \quad m^D = m^S$$

The 20 variables which are treated as endogenous to the non-farm sector of the model are:

(1) Y (2) Y_{NFT} (3) Y_{NT} (4) L_{NFT} (5) L_{NT} (6) C_P^{NF} (7) C_P

(8) I_P^{NF} (9) I_P (10) Z (11) Z_{NFT} (12) Z_{NT} (13) Z_F (14) I_P^{NF}

(15) n (16) L (17) L^S (18) E (19) m^D (20) r

The variables which are exogenous to the non-farm sector of the model but are endogenous to the farm sector are:

(1) Y_F (2) Y_F^{NF} (3) C_P^F (4) I_P^F (5) L_F

The variables which appear in the non-farm sector of the model and which are exogenous to the model as a whole are:

(1) K_{NFT} (2) α_{NFT} (3) p_{NT} (4) p_{NFT} (5) p_F (6) v (7) w

(8) K_{NT} (9) α_{NT} (10) C_G (11) I_G (12) ε (13) J (14) $\bar{L}$

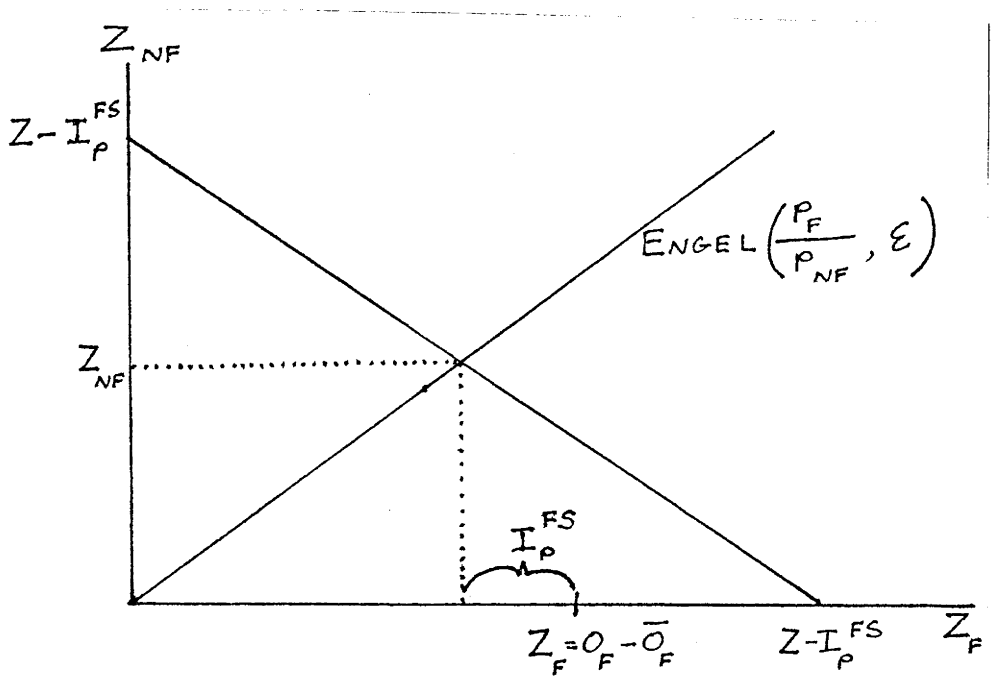
(15) m^S (16) $\bar{O}_F$

II(3) Geometric Characterisation of the Model

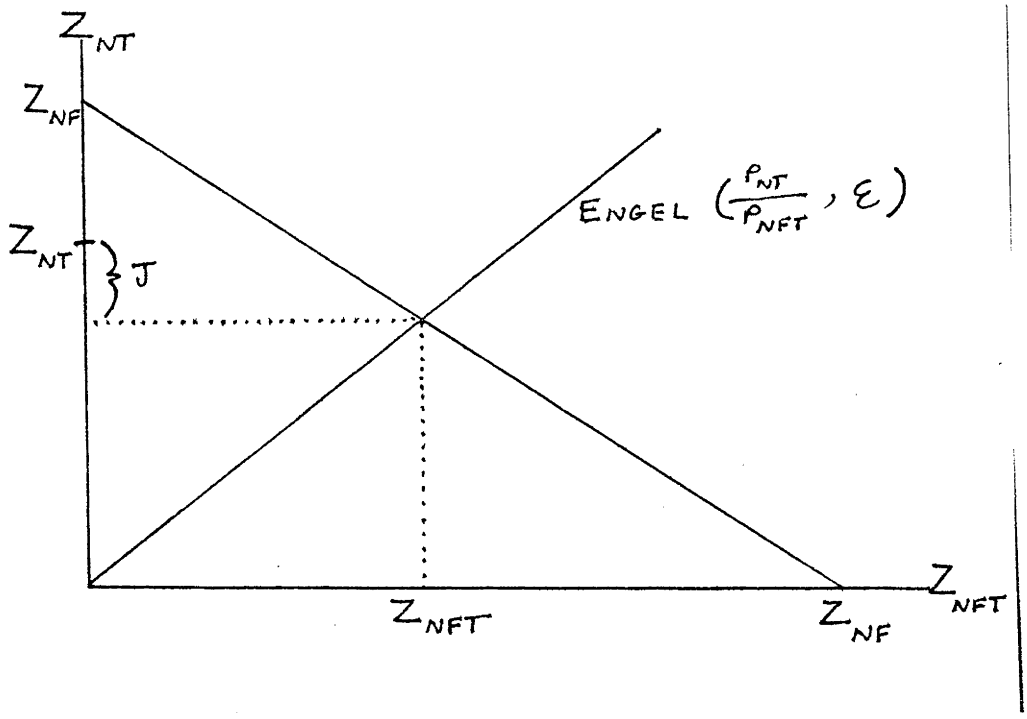
In the geometric characterisation of Model III, Sectors I and III are identical to those described for the original variants of Models I and II. It is convenient, however, to make some modifications to the representation of Sector II.

Figure V(1)

Sector II(1)



Sector II(2)



It will be recalled that, in Model I, aggregate expenditure, Z, was separated, firstly, into its traded and non-traded components, and then expenditure on traded goods was further separated into its non-farm traded and farm components. In Model II, it proved convenient to separate aggregate expenditure firstly into its farm and non-farm components, with aggregate expenditure on farm commodities being constrained to equal $O_F - \bar{O}_F$, so that the farm commodity market would clear. In that case, as we saw, any divergence between $O_F - \bar{O}_F$ on the one hand, and Z_F on the other, was assumed to be eliminated by an appropriate change in p_F.

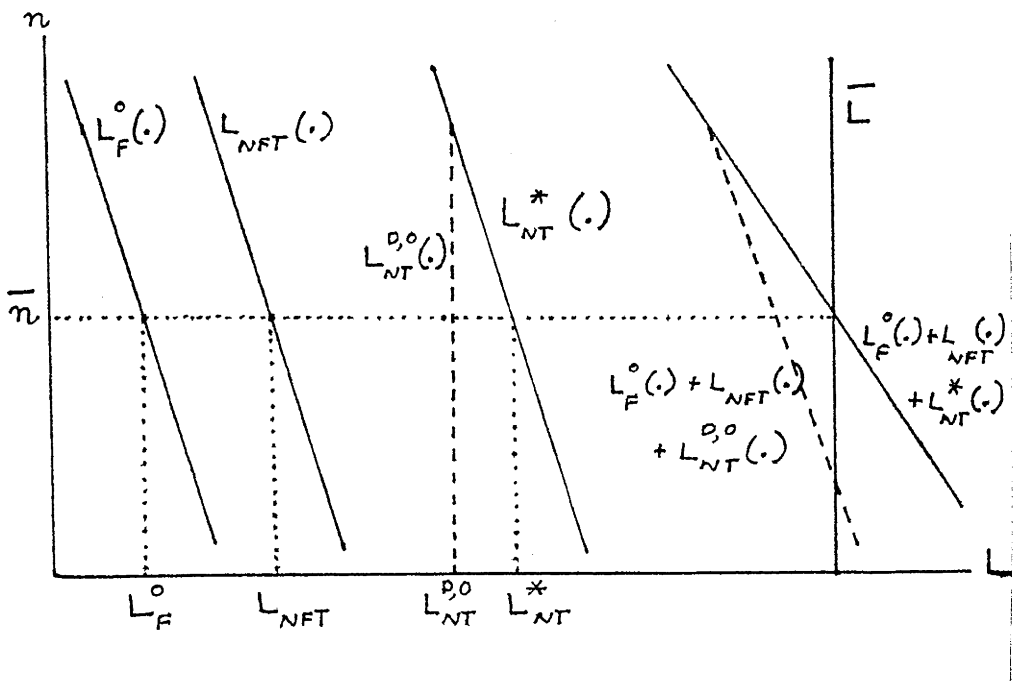
In Model III, aggregate expenditure will be again separated into its farm and non-farm components in the first instance. In this case, however, the budget line in Sector II(1) is based on $Z - I_P^{FS}$, rather than Z, with I_P^{FS} then being added directly onto the voluntary or non-inventory component of demand for farm commodities, to generate aggregate domestic demand for farm commodities, Z_F. Note that, as in Model II, Z_F is constrained to equal $O_F - \bar{O}_F$. The equilibrating variable in this case, however, is I_P^{FS}.

In Sector II(2), the non-farm component of aggregate expenditure, Z_{NF}, is separated into its non-traded and non-farm traded components. Note that, as usual, J is added directly onto the non-traded component of aggregate final expenditure in order to generate total demand for non-traded goods, Z_{NT}.

Sector IV of the model is also identical to Sector IV in Models I and II. The developments which take place in Sector IV during the present analysis are largely identical to those which were described at some length in the analysis with Model I. Therefore, for simplicity, Sector IV will not be explicitly considered in the present case. Before embarking on the analysis, however, it may be useful to briefly review the operation of Sector IV, and to describe, in general terms, the developments which are implicitly assumed to be occurring in Sector IV.

Figure V(2)

Sector IV



In Figure V(2), $L_F^O(.)$ is the initial position of the demand for labour schedule in the farm sector, $L_{NFT}(.)$ is the demand for labour in the non-farm traded goods sector, $L_{NT}^*(.)$ is the optimal demand for labour in the non-traded goods sector, $L_{NT}^{D,O}(.)$ is the initial effective, or demand constrained, demand for labour schedule in the non-traded goods sector, and $\bar{L}$ is the fixed supply of labour. As p_F, p_{NFT}, p_{NT} and w are assumed to be fixed throughout, it follows that relative prices are fixed, and the real wage is fixed at $\bar{n}$. Therefore, no variations occur in $L_{NFT}(.)$ or $L_{NT}^*(.)$, so that the actual level of employment in the non-farm traded goods sector remains at L_{NFT} throughout, and the <u>optimal</u> level of employment in the non-traded goods sector remains at L_{NT}^*.

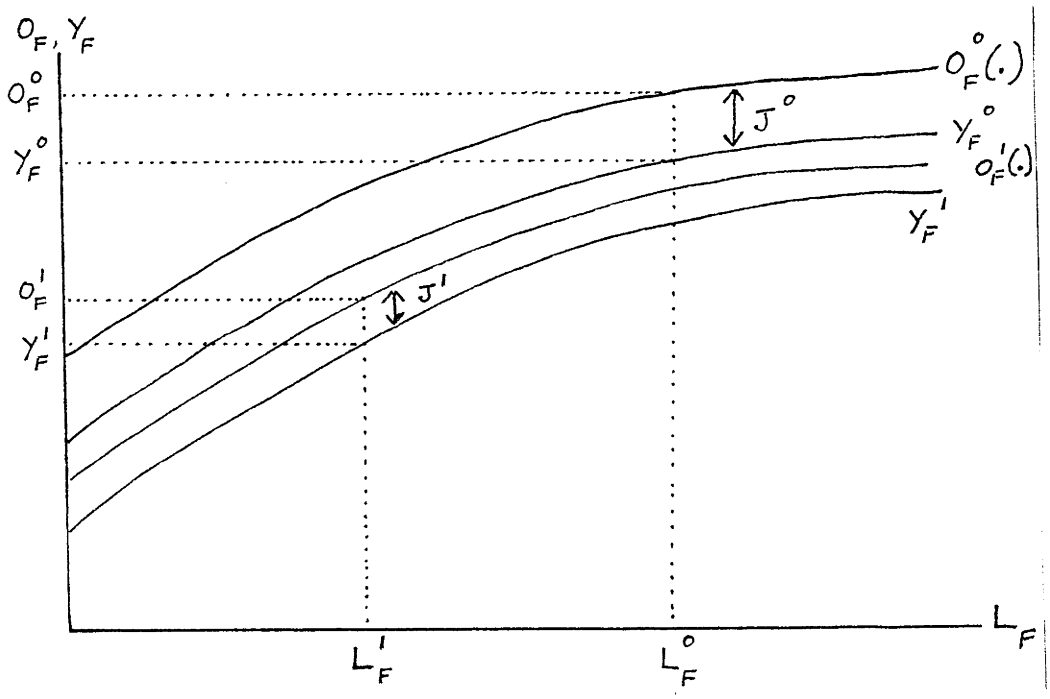
While there are no relative price induced variations in the position of the demand for labour schedule in the farm sector, the assumed adverse weather shock, and the associated decline in the usage of J, will lower the marginal product of labour in the farm sector, causing $L_{NF}(.)$ to move to the left from $L_{NF}^O(.)$. Similarly, any decline in the demand for, and hence production of, non-traded goods will be reflected in a leftward movement of $L_{NT}^D(.)$ from $L_{NT}^{D,O}(.)$. Finally, it is assumed that, at real wage $\bar{n}$, $L_{NT}^D(.)$ remains to the left of $L_{NT}^*(.)$ throughout the analysis i.e. the non-traded goods sector continues to face an effective demand constraint.

II(4) Some Analysis of the Third Paradigm

As was the case in Models I and II, the analysis can commence in Sector III(1) of the model.

Figure V(3)

Sector III(1)

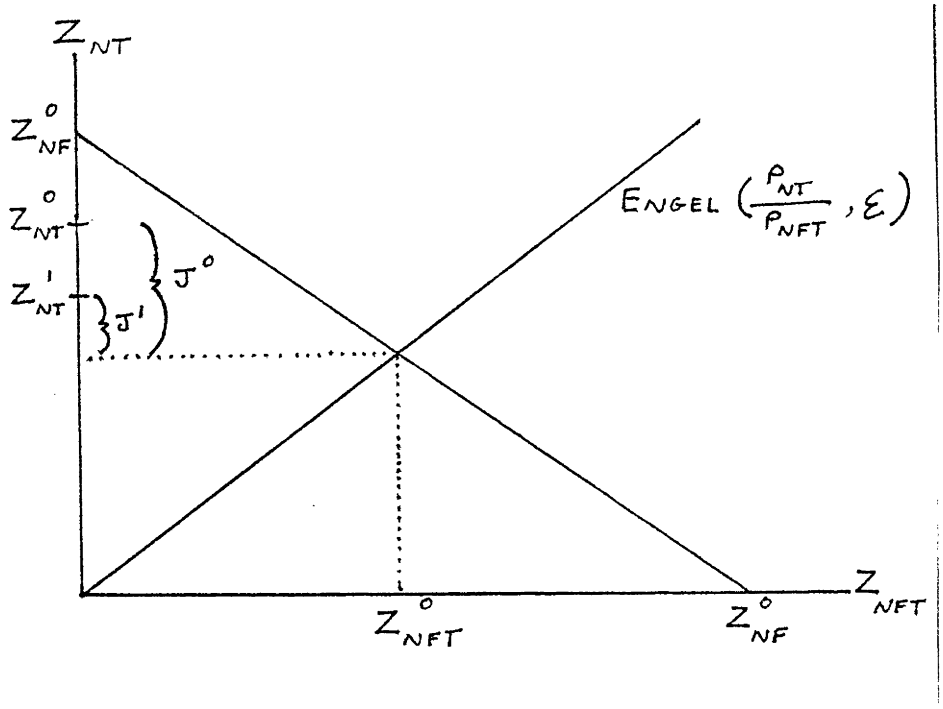


In Figure V(3), the original levels of gross and net farm output and farm employment are given by O_F^0, Y_F^0 and L_F^0 respectively, given that the initial volume of non-primary inputs used in the farm sector is J^0. Following an assumed adverse weather shock, gross and net farm output and farm employment fall to O_F^1, Y_F^1 and L_F^1, given that the weather shock also results in a decline in J from J^0 to J^1.

For simplicity, we will again consider, firstly, the macroeconomic implications of the decline in J, from J^0 to J^1, and then subsequently consider the implications of the decline in O_F and Y_F.

Figure V(4)

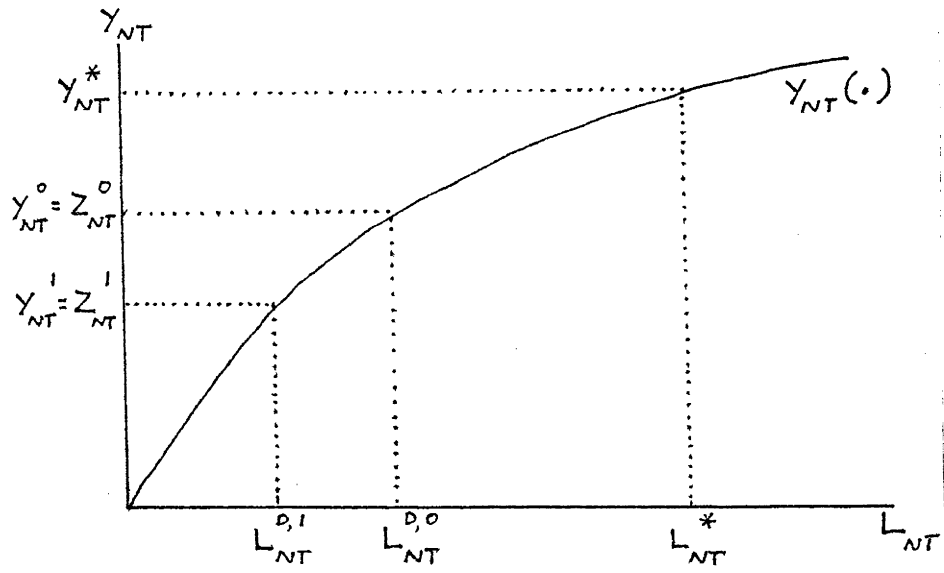
Sector II(2)



In Sector II(2), given the initial level of real final expenditure on non-farm commodities, $Z_{NF}{}^0$, and the initial level of J, J^0, then the initial level of total demand for non-traded goods is $Z_{NT}{}^0$. The decline in the usage of non-primary inputs in the farm sector, from J^0 to J^1, reduces the level of total demand for non-traded goods from $Z_{NT}{}^0$ to $Z_{NT}{}^1$. Note that, because the change in J does not, in itself, represent a change in aggregate final expenditure, the position of the budget line in Sector II(2) is not affected.

Figure V(5)

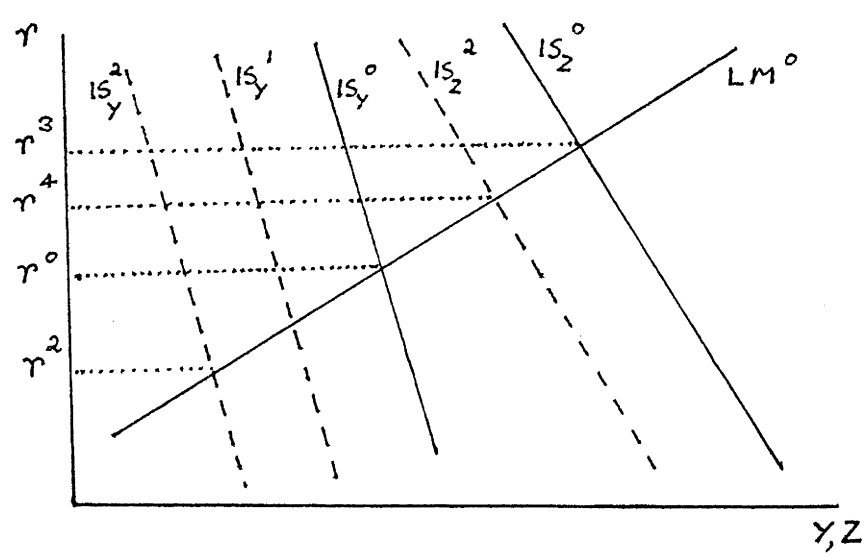
Sector III(3)



In Sector III(3), the initial demand constrained levels of output and employment in the non-traded goods sector are $Y_{NT}^{0} = Z_{NT}^{0}$ and $L_{NT}^{D,0}$. Following the fall in the usage of non-primary inputs in the farm sector, and hence the fall in Z_{NT} from Z_{NT}^{0} to Z_{NT}^{1} in Figure V(4), output and employment in the non-traded goods sector fall to $Y_{NT}^{1} = Z_{NT}^{1}$ and $L_{NT}^{D,1}$ respectively. Note that both Y_{NT}^{0} and Y_{NT}^{1} are, by assumption, less than Y_{NT}^{*}.

Figure V(6)

Sector I



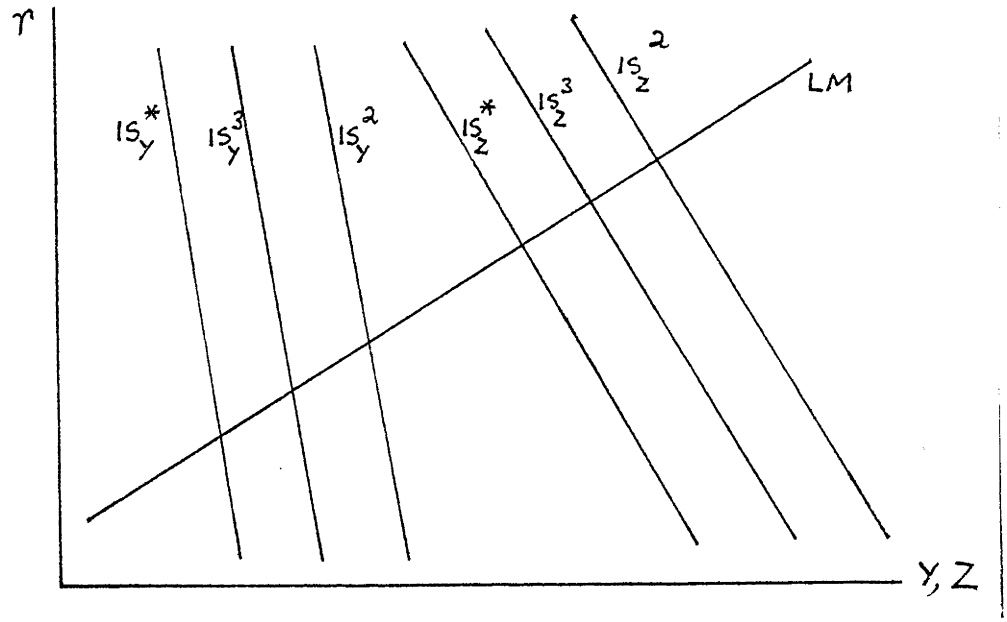
In Sector I, the initial positions of the curves are represented by IS_Y^0, IS_Z^0 and LM^0. The decline in the demand for, and hence production of, non-traded goods in response to the decline in the usage of non-primary inputs in the farm sector causes the IS_Y curve to move to the left, from IS_Y^0 to IS_Y^1, where the horizontal distance between IS_Y^0 and IS_Y^1 is equal to the decline in J. It would be expected that this leftward movement of IS_Y would induce a decline in non-farm consumption and investment expenditure, thus pushing IS_Z to the left from IS_Z^0. This would cause the budget lines in Sector II(1) and II(2) to move inwards, causing a further decline in the demand for non-traded goods, and so on. In other words, a Keynesian demand multiplier process is set in train within the non-traded goods sector, as was described at some length in Model I. It will be assumed that this demand multiplier process is stable, and that sufficient time is available to enable a new Keynesian equilibrium to be established in the non-traded goods sector prior to the coming on stream of the new, lower level of farm output.

Suppose that, in this new Keynesian equilibrium following the decline in J, the IS curves are represented by IS_Y^2 and IS_Z^2 in Figure V(6). Then, if Y is the scale argument in the demand for money function, the interest rate would decline from r^0 to r^2, following this leftward movement of the IS curves. Alternatively, had Z been the scale argument, the interest rate would have fallen from r^3 to r^4.

The next step is to examine the decline in Y_F itself.

Figure V(7)

Sector I



The decline in Y_F causes the IS_Y curve to move to the left from IS_Y^2 to IS_Y^3 in Figure V(7), so that the horizontal distance between IS_Y^2 and IS_Y^3 is equal to the decline in Y_F.

It is interesting and instructive to now compare and contrast the subsequent movements of the IS curves which would follow on from this leftward movement of IS_Y, under the alternative sets of assumptions on which Models I, II and III are based, noting that the movement of IS_Y from IS_Y^2 to IS_Y^3 would be common to each of those models. Firstly, consider Model I. The leftward movement of IS_Y from IS_Y^2 to IS_Y^3 would not, in itself, be directly associated with any movement of the IS_Z curve from IS_Z^2, because the fall in farm output is assumed to be absorbed by a fall in farm exports. However, the fall in Y_F would result in a fall in Y_F^F and Y_F^{NF}, which would, in turn, induce a decline in farm consumption and investment expenditure and non-farm consumption expenditure. These induced falls in expenditure would cause IS_Z to move to the left, from IS_Z^2 to IS_Z^3 in Figure V(7). (As was observed in Chapter III,

given that the marginal propensity to invest out of farm residual funds could exceed unity, there is no necessary relationship between the horizontal distance between IS_Y^3 and IS_Y^2 on one hand, and between IS_Z^3 and IS_Z^2 on the other). The leftward movement of IS_Z from IS_Z^2 would cause the budget lines in Sector II of the model to move inwards, lowering the demand for, and hence production of, non-traded goods. The decline in Y_{NT} would be reflected in a leftward movement of IS_Y from IS_Y^3 in Sector I, which would induce a further leftward movement of IS_Z from IS_Z^3 and so on, in a negative Keynesian demand multiplier process. It was noted that, provided that this multiplier process was stable, a new Keynesian equilibrium in the non-traded goods sector would eventually be established, with the equilibrium IS_Y curve, IS_Y^*, lying to the left of IS_Y^3, and the equilibrium IS_Z curve, IS_Z^*, lying to the left of IS_Z^3.

Now reconsider Figure V(7) in the context of the Model II assumptions. In that case, the fall in O_F and Y_F was associated with a rise in p_F. It was demonstrated in Chapter IV that, on the assumption that the levels of nominal expenditure implied by the various points along IS_Z^2 remained unchanged, in the first instance, following the fall in O_F and the rise in p_F, the IS_Z curve would move to the left from IS_Z^2 to (say) IS_Z^3. It was then emphasised that **the direction and extent of any subsequent movements of the IS curves from IS_Y^3 and IS_Z^3 was ambiguous. Under a wide range of plausible circumstances, the new IS curves associated with a Keynesian equilibrium in** the non-traded goods sector could lie to the left of IS_Y^3 and IS_Z^3. While this was noted to be a qualitatively similar outcome to that which would have been expected in Model I, it was argued that there was no presumption that the relative magnitudes of the movements in the two models would have been the same. Further, under a range of plausible circumstances, the new Keynesian equilibrium IS curves

could also lie to the right of their positions at IS_Y^3 and IS_Z^3 - an outcome which would almost certainly be both quantitatively and qualitatively different to that in Model I. Finally, the change in p_F in Model II was also reflected in a leftward movement of the LM curve, given the nominal money stock.

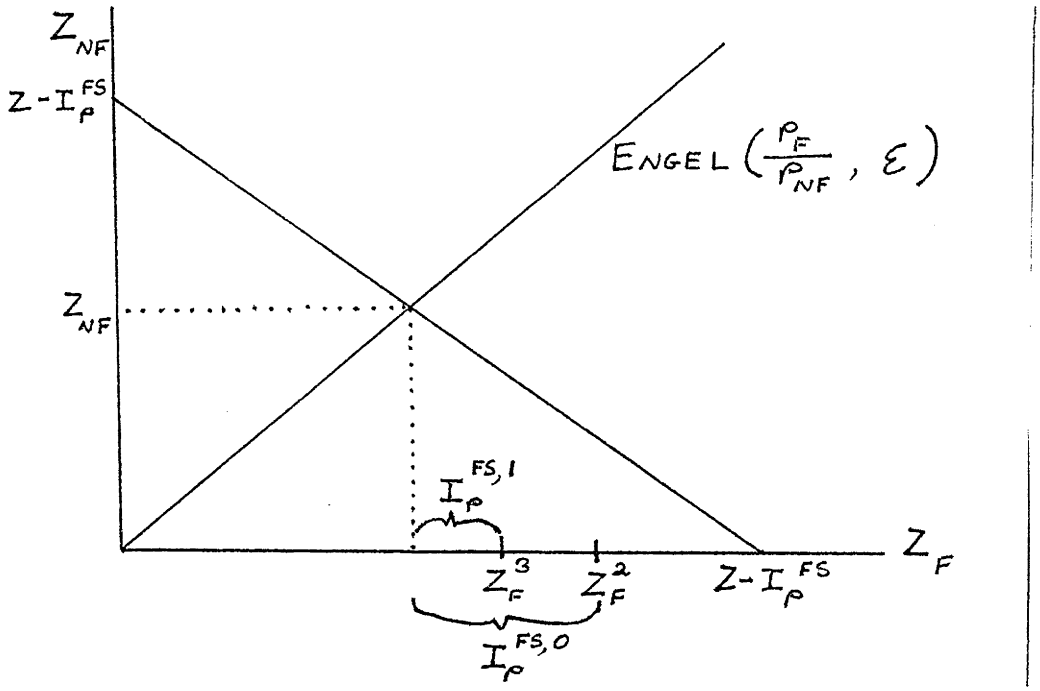
Returning now to Model III, the decline in O_F and Y_F would not be associated, in this case, with either a fall in exports of farm commodities (as in Model I), or with a rise in farm prices (as in Model II). Rather, the level of inventory investment in farm commodities, I_P^{FS}, would fall, so that stocks of farm commodites would either fall, or rise less quickly than otherwise. The decline in I_P^{FS} would be equivalent to the decline in O_F. In terms of Figure V(7), the leftward movement of IS_Y from IS_Y^2 to IS_Y^3 would be directly associated with a leftward movement of IS_Z from IS_Z^2 to (say) IS_Z^3, as I_P^{FS} falls.

There are two important points which should be stressed with respect to the movement of IS_Z from IS_Z^2 to IS_Z^3. Firstly, that movement is independent of, and in addition to, the effect on IS_Z of any <u>induced</u> decline in farm consumption and investment expenditure and in non-farm consumption expenditure which would result from the decline in Y_F^F and Y_F^{NF}, such as was described above for Model I.

Secondly, for any given level of the interest rate, the movement of IS_Z from IS_Z^2 to IS_Z^3 has no impact on the demand for, and hence the production of, non-traded goods, and therefore does not result, in itself, in any further movement of the IS_Y curve from IS_Y^3. For example, in Sector II(1), in Figure V(8), the budget line is unaffected, thus leaving Z_{NF} and hence Z_{NT} unchanged. Aggregate demand for farm commodities falls from Z_F^2 to Z_F^3 as I_P^{FS} falls from $I_P^{FS,0}$ to $I_P^{FS,1}$ i.e. as IS_Z moves from IS_Z^2 to IS_Z^3.

Figure V(8)

Sector II(1)



In addition to this decline in the I_P^{FS} component of aggregate final expenditure, there would also be, of course, an induced decline in farm consumption and investment expenditure, and in non-farm consumption expenditure, as a result of the decline in Y_F^F and Y_F^{NF}. That induced decline in expenditure would shift IS_Z further to the left from IS_Z^3 in Figure V(7), thus reducing Z_{NT} in Sector II(2), so that Y_{NT} would fall and IS_Y would move further to the left from IS_Y^3 and so on. In other words, a negative Keynesian demand multiplier process would be set up, pushing IS_Y and IS_Z to the left from IS_Y^3 and IS_Z^3. Assuming that this multiplier process is stable, a new Keynesian equilibrium would eventually be established in the non-traded goods sector - represented by IS_Y^* and IS_Z^* in Figure V(7).

As all prices, including p_F, are assumed to be fixed in both Model III and in the relevant variant of Model I, it is clear that the decline in Y_F^F and Y_F^{NF} would be the same in both models. Therefore, this <u>induced</u> effect on aggregate expenditure, and the subsequent multiplier effects in the non-traded goods sector, would be identical in both Models III and I. It follows that, in the new

Keynesian equilibrium in the non-traded goods sector, the position of IS_Y^*, in Figure V(7), would be common to both Models III and I. However, because the change in I_P^{FS} in Model III was not required in Model I, the position of IS_Z^* in Model III would lie to the left of its position in Model I - the horizontal distance between these two alternative IS_Z^* curves being equal to the fall in I_P^{FS}.

The above discussion might be summarized as follows:

(1) the macroeconomic implications of a decline in O_F and J, under the circumstances postulated by the third paradigm, as examined in Model III, very closely parallel the implications of the same shock in the farm sector under the circumstances postulated by the first paradigm, as examined in Model 1 . In particular, when a new Keynesian equilibrium is established in the non-traded goods sector following the decline in O_F and J, the position of the equilibrium IS_Y curve, IS_Y^*, is common to both models, and lies unambiguously to the left of the initial pre shock IS_Y curve, IS_Y^0. The new equilibrium IS_Z curve, IS_Z^*, also lies unambiguously to the left of its initial position, IS_Z^0, in both cases. However, in Model III, IS_Z^* would lie to the left of its position in Model I by the extent of the decline in I_P^{FS};

(2) while there is a strong parallel between the macroeconomic implications of a decline in O_F and J under the first and the third paradigms, any similarity or correspondence between the second and the third paradigms is much weaker or more tenuous. This, of course, is quite consistent with the finding, in Chapter IV, that the analysis of the second paradigm tended to diverge significantly from that of the first paradigm.

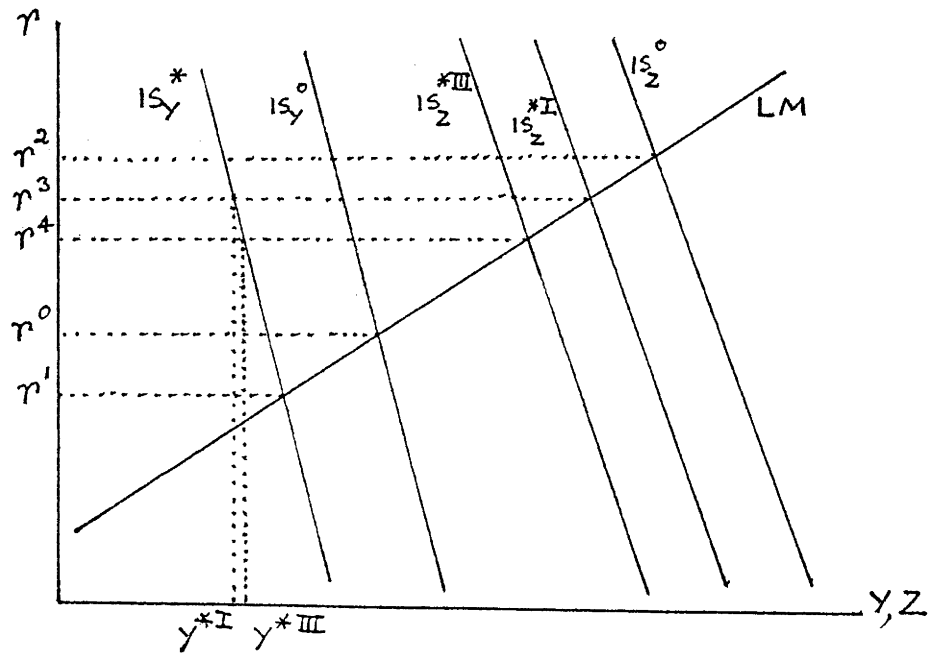
Finally, given the very strong parallel which exists between the implications of the first and third paradigms, it is worth investigating briefly the one major difference between the two paradigms - the greater leftward movement of IS_Z under the third paradigm. As might be anticipated, the potential significance or otherwise of this issue would again seem to hinge on the definition of the scale argument in the demand for money function.

In Figure V(9), IS_Y^0 and IS_Z^0 are the initial IS curves in both Models III and I . IS_Y^* is the position of the IS_Y curve, in both models, when a new Keynesian equilibrium is established in the non-traded goods sector following the shock in the farm sector. IS_Z^{*III} is the position of the new Keynesian equilibrium IS_Z curve in Model III and IS_Z^{*I} is its position in Model I .

If Y was the scale argument in the demand for money function, then, given LM, the interest rate would decline from its initial level of r^0 to r^1 in the new post shock Keynesian equilibrium, and that would be true in both Models I and III . In other words, the

Figure V(9)

Sector I



greater leftward movement of IS_Z in Model III would be of no consequence for the determination of the interest rate. However, if Z was the scale argument, then the interest rate would decline from its initial level of r^2, to r^3 in Model I, or further to r^4 in Model III. Therefore, in this latter case, the first and third paradigms would differ in their implications for the interest rate. Of course, these alternative implications for the interest rate also carry through to several other important variables, such as output (and hence employment). For example, in Model III with Z the scale argument, the actual level of Y in the new Keynesian equilibrium would be Y^{*III}, whereas in Model I, its level would be lower, at Y^{*I}, because $r^3 > r^4$.

II(5) Concluding Comments on Section II

Model III was specified to facilitate an examination of the implications of a shock to the volume of farm production, where that shock did not result in either a change in the volume of farm exports, or a change in the relative price of farm commodities on the domestic market, but rather where it is absorbed by a change in the level of stocks of farm commodities in the short run.

The analysis proceeded, to a large extent, by comparing and contrasting the results and implications obtained from Model III with those obtained earlier in Models I and II. It was demonstrated that, from a macroeconomic viewpoint, the analysis with Model III was very similar to that with Model I. It was suggested that the major difference between the analyses of the first and third paradigms was that a shock to the volume of farm production would have a larger impact on aggregate final expenditure under the third paradigm than under the first - a result which is quite intuitive given that investment in farm inventories represents a component of aggregate final expenditure. The significance or otherwise of this

difference, at least in the context of these most basic variants of Models I and III, was argued to hinge on the scale argument in the demand for money function. If the true scale argument in the demand for money function was aggregate final expenditure, Z, then important variables such as the demand for money, the interest rate, output and employment would tend to differ between the two paradigms.

In contrast, no significant similarity or parallel was found between the analyses with Models III and II. This would seem to indicate that a shock to the volume of farm production, under the circumstances postulated by the third paradigm (and indeed, also by the first paradigm) could have a substantially different impact on a range of important macroeconomic variables than the same shock under the second paradigm.

Section III Some Analysis with an Endogenous Balance of Payments.

III(1) Notation and Model Specification

No new notation is introduced in the present variant of Model III.

The balance of payments is endogenised by adding three equations to the non-farm and macroeconomic aggregates sector of the model.

$$(29) \quad \dot{m}^S = \dot{d} + BP$$

$$(30) \quad k = k(\overset{+}{r}, \overset{-}{r}^W, \overset{+}{\dot{e}}^E, \overset{?}{\mu})$$

$$(31) \quad BP = p_{NFT}Y_{NFT} + p_F\bar{O}_F - p_{NFT}Z_{NFT} + k$$

The additional endogenous variables in the present variant of the model are m^S, k and BP. The additional exogenous variables are d, r^W, $\dot{e}^E$ and μ.

Equations (29) and (30) are identical to the corresponding equations in Models I and II. However, equation (31), which serves to endogenise the state of the balance of payments in the model, differs from the corresponding equation in those earlier models. In Model I, the volume of farm exports was assumed to be endogenous and variable, so that the contribution of the farm sector to the current account was specified to be $p_FO_F - p_FZ_F$, rather than $p_F\bar{O}_F$. In Model II, the equation for the balance of payments incorporated $\bar{O}_F$, as in (31) above, but on that occasion, p_F^W rather than p_F was used. The use of p_F^W reflected the assumption that the constraint on the volume of farm exports was the result of import quotas on farm commodities imposed by overseas markets, forcing a divergence between p_F and p_F^W. It was further assumed that such quotas were held by local residents, so that p_F^W was relevant for the determination of the state of the current account. In the present case, however, in equation (31), p_F is used because the assumed existence of buffer stockholding obviates the need for any divergence between p_F and p_F^W.

It should be noted, of course, that in the special case of a non-traded commodity, $\bar{O}_F$ in (31) would be zero. However, as argued above, and in Chapter II, the two main industries for which this third paradigm is likely to be relevant, at least in some periods, are wool and wheat, which are both major export industries. Therefore, it is sensible to conceptualise $\bar{O}_F$ as a substantial positive quantity.

III(2) Geometric Characterisation of the Model.

Sectors II, III and IV in the geometric characterisation of the model are identical to those described in Section II above. Sector I, however, needs to be modified by the inclusion of a TT schedule to indicate the combinations of r and Z which are consistent with balance of payments equilibrium.

As has been observed in Chapters III and IV, in locating the position of the TT schedule in Sector I only the direct partial effect of Z on the balance of payments via the current account is considered along the horizontal axis, and the direct, partial effect of r on net capital inflow along the vertical axis. In other words, with all other factors which affect the current account given, the state of the current account can be assessed for each level of Z. Similarly, with all other factors which affect net capital inflow given, a level of the interest rate can be found which would produce a rate of net capital inflow or outflow just sufficient to counteract the current account balance, thus producing an overall zero balance of payments.

From (31), the current account elements of the balance of payments are:

$$p_{NFT}Y_{NFT} + p_F\bar{O}_F - p_{NFT}Z_{NFT}$$

It will be recalled that p_{NFT}, p_F and $\bar{O}_F$ are exogenously given in the model, and Y_{NFT}, while endogenous, is a function only of exogenous variables in the current specification. Therefore, p_{NFT}, Y_{NFT}, p_F and $\bar{O}_F$ are not affected by changes in Z.

Consider the variable Z_{NFT}. From (19)

$$Z_{NFT} = Z_{NFT}(Z - \overset{+}{I_P}{}^{FS}, \frac{\bar{p}_{NFT}}{p_{NT}}, \frac{\bar{p}_{NFT}}{p_F}, \overset{?}{\varepsilon})$$

It is clear that, given the values of the exogenous variables p_{NFT}, p_{NT}, p_F and ε, and the value of the endogenous variable $I_P{}^{FS}$, then Z_{NFT} is an increasing function of Z, and hence the current account balance is a decreasing function of Z.

As $I_P{}^{FS}$ is an endogenous variable in the model, it is also necessary, of course, to consider the interactions between Z and $I_P{}^{FS}$ in (19). For present purposes, it is sufficient to distinguish between two types of such interaction:

(1) a change in $I_P{}^{FS}$ which results directly from the need to absorb a change in O_F at given prices, in the presence of $\bar{O}_F$. As $I_P{}^{FS}$ is a component of Z, then it is clear that, with other factors unchanged, $I_P{}^{FS}$ and Z would change by an equivalent amount, and in the same direction, so that the term $Z - I_P{}^{FS}$ in (19) would be unchanged. In other words, a change in Z which corresponds exactly to a change in $I_P{}^{FS}$, with $\bar{O}_F$ given, has no effect on Z_{NFT} and hence would have no impact on the current account. This would need to be recognised in an appropriate movement in the TT schedule in Sector I;

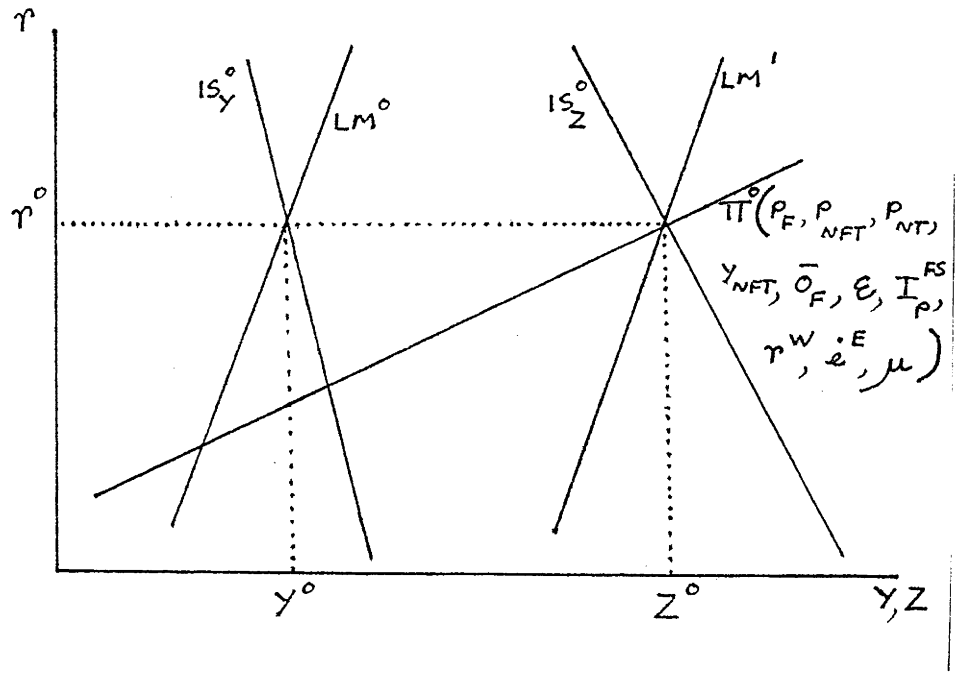
(2) with both O_F and $\bar{O}_F$ given, a change in some component of aggregate expenditure would, in general, induce some change in I_P^{FS}, because a proportion of the change in expenditure would fall onto farm commodities, and hence would need to be absorbed by a change in stocks of farm commodities. For simplicity, this second aspect of the interaction between Z and I_P^{FS} will be ignored in the ensuing analysis. This is consistent with the approach adopted in Model II where the impact of more general changes in Z on the demand for farm commodities, and hence on p_F, were explicitly ignored i.e. attention was focussed only on those changes in p_F which could be directly attributable to an exogenous change in O_F.

Finally, from (30), given r^W, $\dot{e}^E$ and μ, k is an increasing function of r. Therefore, drawing the various strands of the argument together, the TT schedule is positively sloped, and can be drawn for given values of the variables p_F, p_{NFT}, p_{NT}, Y_{NFT}, $\bar{O}_F$, ε, I_P^{FS}, $\dot{e}^E$, r^W and μ. Of these variables, we will be concerned with assessing the implications for the TT schedule of variations in I_P^{FS}, where those variations are directly associated with changes in O_F. Of course, as noted in Chapter III, in the special case where international capital flows are assumed to be perfectly mobile, the TT schedule would be horizontal at the world interest rate, r^W. This special case is also of some interest in the present context, and will be briefly considered in Section III(3).

In Figure V(10), given IS_Y^0, IS_Z^0 and TT^0, LM^0 is consistent with balance of payments equilibrium if Y is the scale argument in the demand for money function, and LM^1 is consistent with balance of payments equilibrium if Z is the scale argument.

Figure V(10)

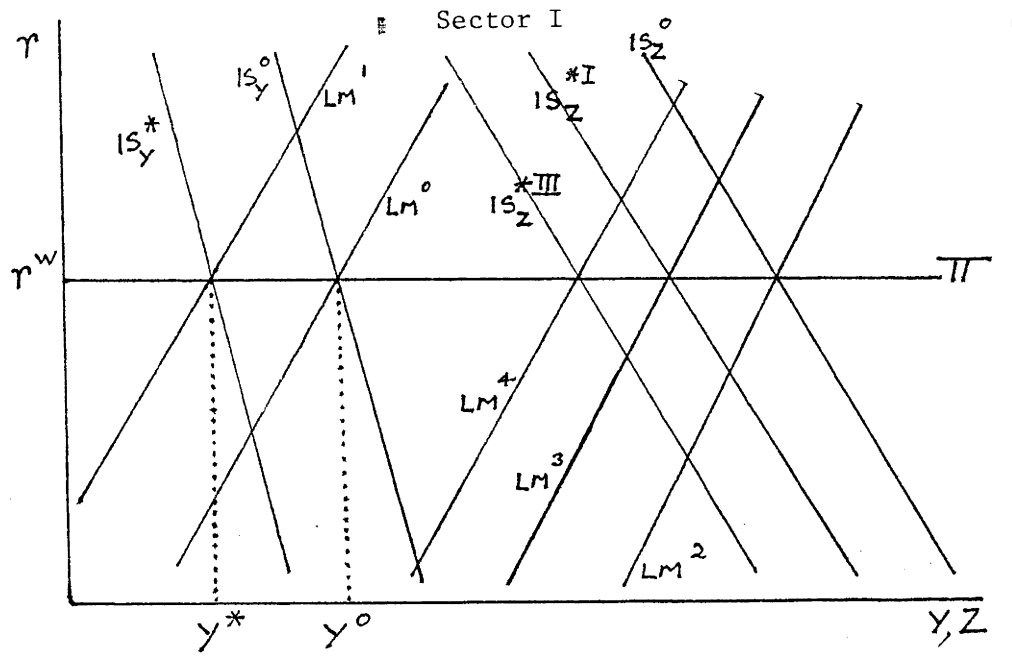
Sector I



III(3) Some Analysis of the Third Paradigm

As the only significant difference between the two variants of Model III lies in Sector I, the present analysis will focus on Sector I. The special case where international capital flows are assumed to be perfectly mobile will be considered first, because several interesting and perhaps counterintuitive results emerge from that framework.

Figure V(11)



In Figure V(11), IS_Y^0 and IS_Z^0 are the initial positions of the IS curves, in either Model I or Model III. IS_Y^* is the position of the IS_Y curve in the new Keynesian equilibrium following the shock in the farm sector, and, as was demonstrated in Section II, would be common to Model III and the first two variants of Model I. IS_Z^{*III} is the position of the IS_Z curve in the new Keynesian equilibrium in Model III and IS_Z^{*I} is its position in the relevant variants of Model I. The TT schedule, of course, is horizontal at the world interest rate, r^W.

It is clear that, with IS_Y^* common to both Models I and III and with the interest rate fixed at r^W, the decline in Y as a result of the shock in the farm sector would be identical in both Model I and III - falling from Y^0 to Y^* in Figure V(11). In other words, a given change in O_F and J would have an equivalent effect on Y under the assumptions of both the first and the third paradigms - in each case being correctly measured by the horizontal distance between IS_Y^0 and IS_Y^*.

Just as the distinction between the first and the third paradigms may be of little consequence in determining the impact of the change in O_F and J on Y and r in this framework, it may also be irrelevant for the determination of the state of the balance of payments during the adjustment to the new post-shock Keynesian and balance of payments equilibrium. In particular, suppose that Y was the scale argument in the demand for money function. Prior to the shock in the farm sector (i.e. given IS_Y^0), the LM curve, LM^0, in Figure V(11), would have been consistent with balance of payments equilibrium in both Models I and III . Following the leftward movement of IS_Y from IS_Y^0 to IS_Y^*, and assuming no change in the domestic credit component of the money supply, a balance of payments deficit would occur, sufficient to shift LM from LM^0 to LM^1, at which point balance of payments equilibrium would be re-established. This would be true regardless of whether Model I or Model III was being considered. In other words, even though the value and volume of farm exports would fall in Model I while remaining fixed at $p_F\bar{O}_F$ in Model III, the impact of the shock in the farm sector on the overall balance of payments would be identical in both cases.

Now suppose, however, that Z was the scale argument in the demand for money function. In this case, given IS_Z^0 and TT, then LM^2 would be consistent with an initial balance of payments equilibrium in Models I and III . When a new Keynesian equilibrium is established following the decline in O_F and J, IS_Z moves to the left from IS_Z^0 to IS_Z^{*III}, given the Model III assumptions. This would require a balance of payments deficit during the adjustment period sufficient to shift LM to the left from LM^2 to LM^4, at which point balance of payments equilibrium would be re-established. However, under the Model I assumptions, the leftward movement of the IS_Z curve would not be as great - moving from IS_Z^0 to IS_Z^{*I}. Therefore,

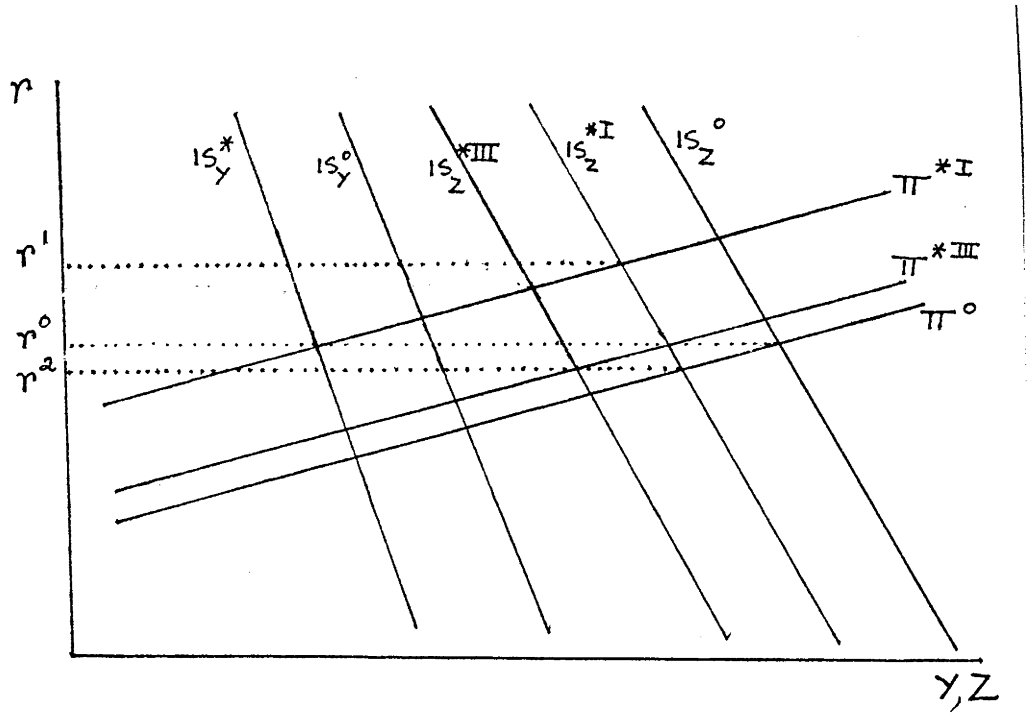
a smaller balance of payments deficit would be required during the adjustment period - sufficient to shift LM to the left from LM^0 to LM^3.

To summarize then, the distinction between the assumptions under-lying the first and the third paradigms may be of significance for the state of the balance of payments during the adjustment period if Z is the scale argument in the demand for money function, but may not be if Y is the true scale argument. Further, to the extent that the state of the balance of payments during the adjustment period does, in fact, differ between the two models, it would tend to be weaker in Model III than in Model I. This is despite the fact that, as dictated by the first and third paradigms, the volume and value of farm exports would fall in Model I but remain unchanged in Model III.

The next step in the analysis is to consider the more realistic case of less than perfectly mobile international capital flows.

Figure V(12)

Sector I



In Figure V(12), IS_Y^o, IS_Z^o and TT^0 are the positions of the IS and TT curves prior to the exogenous shock in the farm sector. It will be again assumed that these curves would be relevant to both the Model I and Model III frameworks - which could be interpreted as an assumption that, in the initial equilibrium, $I_P^{FS} = 0$. When a new Keynesian equilibrium is established following the shock in the farm sector, the position of the IS_Y curve is given by IS_Y^*, and would be common to both Models I and III. The new Keynesian equilibrium IS_Z curve in Model III is represented by IS_Z^{*III}, and in Model I by IS_Z^{*I}.

In the earlier analysis with Model I, in Chapter III, it was argued that, because O_F was an argument in the positioning of the TT schedule, the fall in O_F would raise the TT schedule from TT^0 to (say) TT^{*I} in Figure V(12). Given IS_Z^{*I}, the interest rate in the new Keynesian and balance of payments equilibrium would thus be r^1. As drawn in Figure V(12), $r^1 > r^0$. However, it was argued that there was a substantial degree of ambiguity about the level of the interest rate in the new Keynesian and balance of payments equilibrium relative to its initial level. In particular, r^1 could be either greater than, or less than, r^0.

Now consider the Model III framework. The movement of IS_Z from IS_Z^0 to IS_Z^{*III} could, in principle, be considered in two stages - firstly, the movement from IS_Z^0 to IS_Z^{*I}, and secondly, the movement from IS_Z^{*I} to IS_Z^{*III}. It will be recalled that, in Model III, the TT schedule is drawn for given values of the variables (p_F, p_{NFT}, p_{NT}, Y_{NFT}, $\bar{O}_F$, ε, I_P^{FS}, $\dot{e}^E$, r^W, μ). The decline in I_P^{FS} which occurs is, of course, captured in, and represented by, the second component of the movement of IS_Z i.e. by the movement from IS_Z^{*I} to IS_Z^{*III}. As each of the remaining variables in this

listing is given, then it follows that, in Model III, the movement of IS_Z from IS_Z^0 to IS_Z^{*I} is not associated with any movement in the TT schedule itself. Hence, the interest rate unambiguously declines from r^0 to r^2 in Figure V(12).

The movement in IS_Z from IS_Z^{*I} to IS_Z^{*III} is associated with an equivalent change in I_P^{FS}. As argued in Section III(2), such a change would leave the current account of the balance of payments unaffected. Therefore, the TT schedule would move upwards from TT^0 to TT^{*III} in Figure V(12), so that the point of intersection between TT^{*III} and IS_Z^{*III} would occur at the same level of the interest rate as the point of intersection between IS_Z^{*I} and TT^0 i.e. r^2.

Several conclusions follow immediately:

(1) **in Model III, the interest rate in the new Keynesian and balance of payments equilibrium would be <u>unambiguously</u> lower than in the initial equilibrium ie. $r^2 < r^0$. This contrasts with the result which was established in Model I, as noted above, that the new equilibrium interest rate in that case could lie either above or below r^0;**

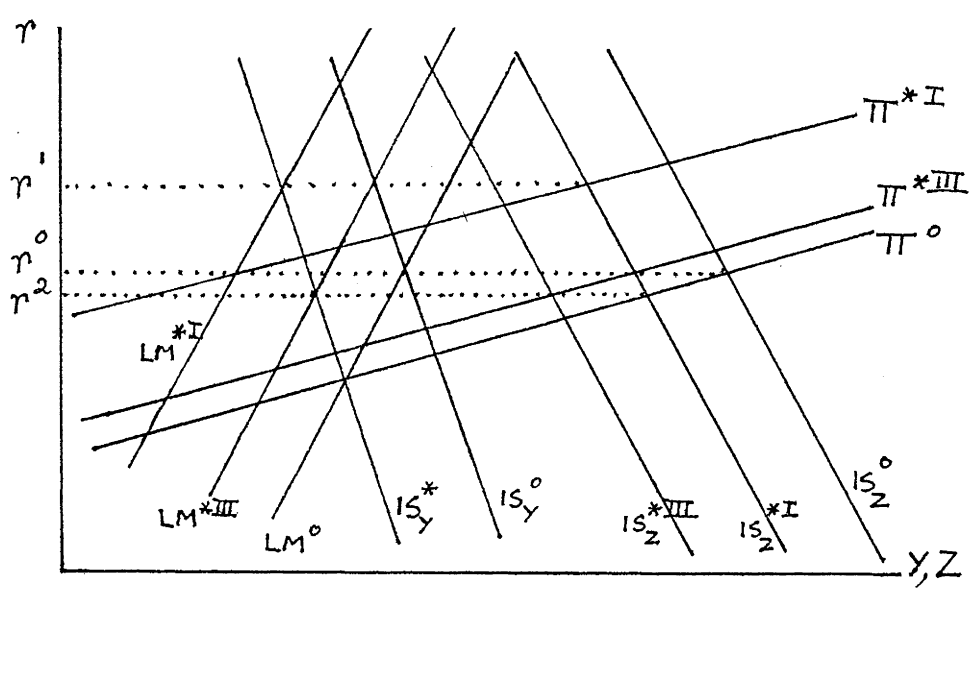
(2) in Model III, the new equilibrium interest rate is unambiguously below its new equilibrium level in Model I i.e. in terms of Figure V(12), r^2 is unambiguously less than r^1, even where $r^1 < r^0$. This is immediate because TT^{*I} lies above TT^0, so that the point of intersection between TT^{*I} and IS_Z^{*I} must occur at a higher level of the interest rate than the point of intersection between IS_Z^{*I} and TT^0 and hence between IS_Z^{*III} and TT^{*III};

(3) it follows from (2) above that, as IS_Y^* is common to both Model I and Model III, the actual level of Y in the new Keynesian equilibrium following the shock in the farm sector would be higher in Model III than in Model I.

Turning now to the state of the balance of payments during the adjustment period, we can consider first the case where the scale argument in the demand for money function is assumed to be Y.

Figure V(13)

Sector I



In Figure V(13), the IS and TT schedules are as described previously in Figure V(12). With Y the scale argument in the demand for money function, LM^0 would be consistent with an initial balance of payments equilibrium. As IS_Y^* is common to both Models I and III and as $r^1 > r^2$, it is clear that, in the new Keynesian and balance of payments equilibrium following the shock in the farm sector, the LM curve in the Model III framework would lie to the right of its position in the Model I framework i.e. LM^{*III} would lie to the right of LM^{*I}. In other words, assuming no change in the domestic credit component of the money supply, the balance of payments deficit during the adjustment period would be <u>less severe</u> in Model III than in Model I .

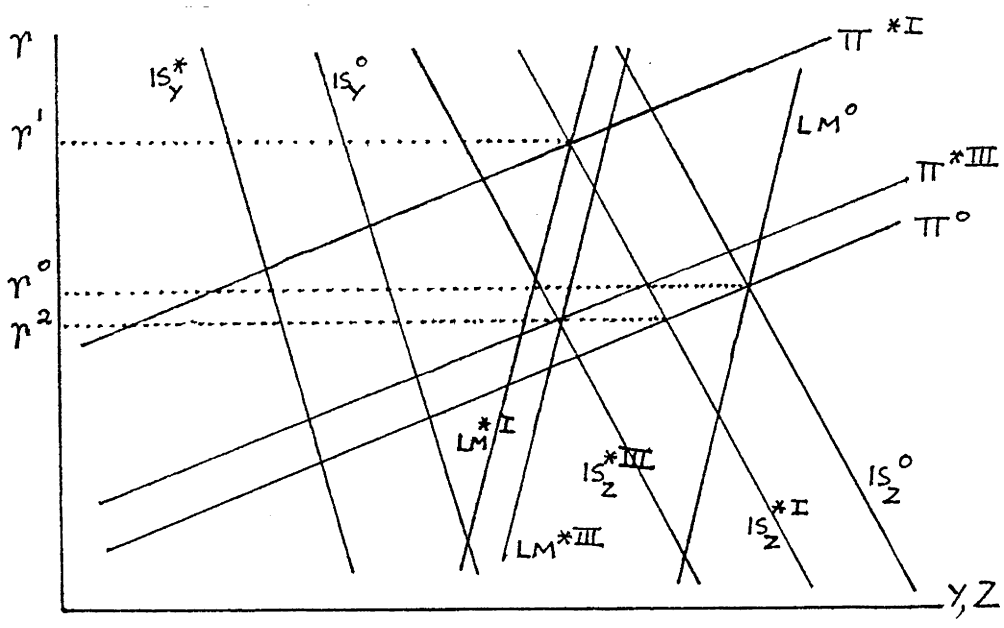
Two points should be noted about this result. Firstly, it contrasts with the result noted above for the case where international capital flows were assumed to be perfectly mobile. It will be recalled that, in that case, the deficit in the balance of payments during the adjustment period was identical in both Models I and III, given Y to be the scale argument.

Secondly, the result that the state of the balance of payments during the adjustment period would be relatively stronger in Model III than in Model I may be intuitively appealing, given that the value and volume of farm exports remain fixed in Model III but fall in Model I .

Next, consider the case where Z is assumed to be the scale argument in the demand for money function.

Figure V(14)

Sector I



In Figure V(14), given Z to be the scale argument, LM^0 would be consistent with an initial balance of payments equilibrium. Given the movement of IS_Z from IS_Z^0 to IS_Z^{*III} in the Model III

framework, a sufficient balance of payments deficit would be required to shift LM from LM^0 to LM^{*III} in order to re-establish balance of payments equilibrium. In contrast, in the Model I framework, the balance of payments deficit during the adjustment period would have been such as to shift LM from LM^0 to LM^{*I}.

As drawn in Figure V(14), LM^{*III} lies to the right of LM^{*I}, implying a smaller balance of payments deficit during the adjustment period in Model III than in Model I . It should be noted, however, that, as IS_Z^{*III} lies to the left of IS_Z^{*I}, while $r^1 > r^2$, the relative positions of LM^{*III} and LM^{*I} are largely ambiguous, at least at the level of sophistication attempted in the present analysis. In other words, during the period of adjustment to a new Keynesian and balance of payments equilibrium, the balance of payments deficit in Model III could be either larger than or smaller than (or, indeed, equal to) that which would have occurred in Model I .

This result also contrasts with that noted above for the case where international capital flows were assumed to be perfectly mobile. In that case, given Z as the scale argument, it was unambiguous (although perhaps somewhat counterintuitive), that the balance of payments deficit would be larger in Model III than in Model I .

III(4) Concluding Comments on Section III

Following the now familiar procedure, the original specification of Model III was modified to incorporate explicit balance of payments considerations. Some attention was given, firstly, to the case where international capital flows are perfectly mobile, and then to the case of imperfectly mobile capital flows.

Where capital is perfectly mobile:

- if Y is the scale argument in the demand for money function, the decline in farm output would have the same impact on the state of the balance of payments under the assumptions underlying both the first and the third paradigms;
- if Z is the scale argument, however, the balance of payments would tend to be relatively weaker under the third paradigm than under the first. This is despite the fact that, in the third paradigm, the value and volume of farm exports are unaffected by the decline in farm output, whereas in the first paradigm, the value and volume of farm exports fall. This reflects the fact that, under the third paradigm, the decline in the level of investment in farm inventories results in a greater decline in Z and hence in the demand for money;
- as the interest rate is fixed, the impact of the shock in the farm sector on Y is adequately measured by the horizontal movement of the IS_Y curve.

Where capital is not perfectly mobile:

- the interest rate in the new Keynesian and balance of payments equilibrium following the decline in farm output would be unambiguously lower than in the initial equilibrium. This contrasts with the analysis of the first paradigm, in Chapter III, where it was concluded that the impact of the decline in farm output on the interest rate was uncertain;
- in the new Keynesian and balance of payments equilibrium following the shock in the farm sector, the interest rate in Model III would be unambiguously below its level in Model I. Amongst other things, this would suggest that the shock in the farm sector would tend to have a smaller impact on the gross volume of production in the economy under the third paradigm than under the first;

- if Y is the scale argument in the demand for money function, then the impact of the shock in the farm sector on the balance of payments during the adjustment to the new Keynesian and balance of payments equilibrium would be less severe under the third paradigm than under the first;
- in contrast, if Z is the scale argument, then the impact of the decline in farm production on the balance of payments could be either more severe, or less severe, under the third paradigm than under the first.

Section IV - Concluding Comments on Chapter V

In Chapter V:

(a) Model III was specified, characterised geometrically and then used to examine the macroeconomic implications of a shock in the farm sector under the circumstances postulated by the third paradigm. In particular, it was assumed that the volume of farm production declined exogenously but, because of the assumed existence of buffer stockholding of farm commodities in the present case, there was no requirement for either a fall in the volume of farm exports (as was required under the first paradigm), or for a rise in the domestic price of farm commodities (as was required under the second paradigm). Model III differed from Models I and II only to the extent necessary to capture the essential features of this alternative marketing environment for farm commodities;

(b) in presenting the results, considerable emphasis was given to cross comparisons with the results obtained from Model II, in Chapter IV and, more particularly, from Model I in Chapter III. In the first instance, the analysis abstracted from explicit balance of payments considerations. The state of the balance of payments was subsequently endogenised in the model. As in Model II, but unlike Model I, no attempt was made to introduce a degree of flexibility of non-traded goods prices and nominal wages;

(c) while the analysis concentrated on the case of an exogenous decline in the volume of farm production, a largely parallel analysis could, of course, be undertaken for the case of an exogenous increase in the volume of farm production;

(d) the main results to emerge from the closed economy analysis were summarised in Section II(5) and, from the open economy analysis, in Section III(4). Briefly, some of the more important points are that:

- in the closed economy case, there was a very strong parallel between the present analysis and the corresponding analysis of the first paradigm, in Chapter III. In both cases, the decline in the volume of farm production set in train a negative Keynesian demand multiplier process in the non-traded goods sector and placed downward pressure on the interest rate. It was argued that the decline in the interest rate would be identical under both paradigms if Y was the true scale argument in the demand for money function, or, if Z was the true scale argument, the decline would be greater under the third paradigm than under the first;

- in the open economy case, there was a strong presumption that the decline in farm production would be associated with a temporary deficit in the <u>overall</u>

balance of payments. This is despite the fact that (because of a run down in the level of stocks of farm commodities) the volume and value of farm exports were unchanged. It was argued that, under some circumstances, the temporary balance of payments deficit could be larger than that which would have been expected in Model I. In general, the temporary balance of payments deficits represented a stock adjustment of the money supply in response to the decline in the demand for money which resulted, in turn, from the decline in farm production and the associated negative multiplier effects;

- even in the open economy case, there was a strong presumption that the decline in farm production would place downward pressure on the interest rate. That contrasts with the analysis of the first and second paradigms, where the direction of change in the interest rate tended to become ambiguous once explicit balance of payments considerations were introduced. In the present case, the decline in farm production is unambiguously associated with an improvement in the current account because: (1) the demand for traded goods is reduced by the overall decline in economic activity; while (2) the volume and value of farm exports is unchanged; and (3) there is, by assumption, no possibility of an expenditure switching effect away

from farm commodities and onto non-farm traded goods in response to a change in the relative price of farm and non-farm commodities. Hence, with the current account unambiguously stronger, a lower interest rate is required in order to generate a level of net capital inflow consistent with overall clearance of the balance of payments. With the level of the interest rate thus determined, equilibrium in the money market is re-established via temporary balance of payments deficits, as noted above.

Two final points should be noted. Firstly, the choice of scale argument in the demand for money function emerged as perhaps a more significant issue in this analysis of the third paradigm than was the case in the earlier analyses of the first and second paradigms - although, of course, the issue was raised on several occasions in those earlier chapters. It warrants close attention in any subsequent analyses that may be undertaken with a theoretical simulation variant of Model III and, ultimately, with an empirical variant of the model.

Secondly, as noted above, no attempt was made to develop and explore a variant of Model III in which non-traded goods prices and nominal wages are endogenously determined. As with Model II, it is considered that this more complex extension of the analysis is best left until a theoretical simulation variant of Model III has been developed.

CHAPTER VI

MODEL IV: SOME ANALYSIS OF THE FOURTH PARADIGM

Introduction

In Chapters III, IV and V, we considered various aspects of the first, second and third paradigms, as defined in Chapter II. In particular, in Chapter III, we examined the case of an exogenous change in the volume of farm production, in the presence of a perfect residual export market for farm commodities. Then, in Chapter IV, a change in the volume of farm output was again considered, but in that case, it was assumed that the relevant farm commodity was either non-traded, or faced an effective constraint on the volume of exports, so that the change in output needed to be absorbed by non-inventory expenditure on the domestic market. A change in the volume of farm production was considered yet again in Chapter V, with the assumption in that case being that the change in output was absorbed via a change in domestic stocks of farm commodities at given prices. Now, in Chapter VI, we will consider the fourth paradigm, which, as set out in Chapter II, requires a change in emphasis from an exogenous change in farm production, to an exogenous change in the price of farm commodities (recalling that, while a change in farm prices also formed part of the second paradigm, it was an endogenous price change in that case, being induced by the exogenous change in farm output).

It is perhaps natural to conceptualise the fourth paradigm in terms of the simple hypothetical model which was used for illustrative purposes in Chapter II. It was noted that, in that model, the overseas price of farm commodities was assumed to be given exogenously, and that an exogenous change in that price would flow directly through into the prices paid for farm commodities by domestic consumers and received by domestic producers. While the market structures of the Australian beef, mutton and lamb industries are

considerably more complex than this simple model, it was argued that the concept of an exogenous price change on an overseas market flowing through to the domestic price of a farm commodity could be relevant to these industries in some periods - for example, a change in the price of beef in the United States in a period when the U.S. beef import quota was largely ineffective. Further, it was argued that an exogenous change in the size of overseas import quotas on beef, mutton and lamb could produce, in effect, an exogenous price change for those commodities on the domestic market. Similarly, while the small country assumption in the simple model is inappropriate for the Australian wool industry, it remains sensible to conceptualise an exogenous change in, for example, the overseas demand for wool which then may be manifested in an 'exogenous' price change in the Australian wool market. In addition, changes in the overseas prices of wheat, sugar and dairy products can have a direct bearing on the prices received by domestic producers of these commodities (although, of course, the effect on the prices paid by domestic consumers is likely to be much more indirect and mitigated, because of the effect of home consumption price schemes and various other forms of protection).

In the analysis which follows, there is no presumption that the exogenous overseas influence (whatever its precise nature) on the local price of farm commodities would have an identical effect on both the price received by producers and paid by domestic consumers. This, of course, is in recognition of the additional complications raised by, for example, home consumption price schemes for wheat, sugar and dairy products, or by the lack of strict homogeneity between domestic and export grades of beef. It is assumed, however, that both measures of the domestic price move in the same direction,

and no significant consideration is given to the special (although not irrelevant) case where consumer prices remain fixed while producer prices change.

For simplicity, it is also assumed throughout that the exogenous price change does not induce a change in the production of farm commodities. Such an assumption is not implausible in relatively short term analyses and, of course, is consistent with the approach adopted in earlier chapters.

In Section II, some aspects of the fourth paradigm are examined in the context of Model IV, which differs from its counterparts in earlier chapters only to the extent necessary to permit a focus on the issues raised by the fourth paradigm. The analysis is extended in Section III by incorporating explicit balance of payments considerations into the Model IV framework. Some concluding comments are made in Section IV.

Finally, it should be noted that the manipulation of Model IV in the presence of a price change follows along similar lines to that presented previously in Section V of Chapter III (where non-traded goods prices were allowed to vary) and again in Chapter IV (where farm prices were determined endogenously). Therefore, in the present case, much of the detailed analysis has been relegated to appendices.

Section II: Model IV - Specification and Some Analysis

II(1) Notation and Model Specification

No new notation is introduced in the specification of Model IV .

Farm Sector

(1) $O_F = O_F(\overset{+}{K_F}, \overset{+}{L_F}, \overset{+}{J}, \overset{+}{\alpha_F})$

(2) $L_F = L_F\left(\overset{+}{\frac{\delta O_F}{\delta L_F}}, \overset{+}{\frac{p_F}{p_{NT}}}, \overset{+}{\frac{p_F}{p_{NFT}}}, \bar{n}, \overset{?}{\dot{v}}\right)$

(3) $Y_F = O_F - J$

(4) $y_F = p_F O_F - p_{NT} J$

(5) $y_F^F = \beta y_F$

(6) $y_F = y_F^F + y_F^{NF}$

(7) $C_P^F = C_P^F\left(\overset{+}{\frac{y_F^F}{p}}, \bar{r}\right)$

(8) $R = y_F^F - p.C_P^F$

(9) $I_P^F = I_P^F\left(\overset{+}{\frac{R}{p}}, \bar{r}\right)$

As in Model II and the relevant variant of Model I, price variability necessitates a distinction between the real and the nominal values of several of the variables in the farm sector of the model. However, in Model I, of course, p_{NT} rather than p_F was assumed to be variable while, in Model II, an additional equation was incorporated in order to endogenise the movements in p_F in response to exogenous changes in O_F. In Model IV, any movements in p_F are assumed to have their origins overseas and hence are treated as exogenous to the model.

The variables which are treated as endogenous to the farm sector of the model are:

(1) O_F (2) L_F (3) Y_F (4) y_F (5) y_F^F (6) y_F^{NF} (7) C_P^F

(8) R (9) I_P^F

The variables which appear in the farm sector of the model and which are endogenous to the non-farm and macroeconomic aggregates sector of the model are:

(1) n (2) p (3) r.

The variables which are exogenous to the model as a whole are:

(1) K_F (2) J (3) α_F (4) p_{NT} (5) p_{NFT} (6) v.

<u>Non-Farm Sector and Macroeconomic Aggregates</u>

(10) $Y = Y_{NT} + Y_{NFT} + Y_F$

(11) $Y_{NFT} = Y_{NFT}(\overset{+}{K_{NFT}}, \overset{+}{L_{NFT}}, \overset{+}{\alpha_{NFT}})$

(12) $L_{NFT} = L_{NFT}(\overset{+}{\frac{\delta Y_{NFT}}{\delta L_{NFT}}}, \overset{+}{\frac{p_{NFT}}{p_{NT}}}, \overset{+}{\frac{p_{NFT}}{p_F}}, \bar{n}, \overset{?}{v})$

(13) $Y_{NT} = Y_{NT}(\overset{+}{K_{NT}}, \overset{+}{L_{NT}}, \overset{+}{\alpha_{NT}})$

(14) $L_{NT} = \begin{cases} L^*_{NT}(\overset{+}{\frac{\delta Y_{NT}}{\delta L_{NT}}}, \overset{+}{\frac{p_{NT}}{p_{NFT}}}, \overset{+}{\frac{p_{NT}}{p_F}}, \bar{n}, \overset{?}{v}) \text{ for } Z_{NT} = Y_{NT}(K_{NT}, L^*_{NT}, \alpha_{NT}) \\ L^D_{NT}(\overset{-}{K_{NT}}, \bar{\alpha}_{NT}, \overset{+}{Z_{NT}}) \text{ for } Z_{NT} \neq Y_{NT}(K_{NT}, L^*_{NT}, \alpha_{NT}) \end{cases}$

(15) $C_P^{NF} = C_P^{NF}(\overset{+}{\frac{p_{NT}Y_{NT}}{p}}, \overset{+}{\frac{p_{NFT}Y_{NFT}}{p}}, \overset{+}{\frac{y_F^{NF}}{p}}, \bar{r})$

(16) $C_P = C_P^F + C_P^{NF}$

(17) $I_P^{NF} = I_P^{NF}(\overset{+}{\Delta Y_{NT}}, \bar{r})$

(18) $I_P = I_P^F + I_P^{NF}$

(19) $Z = C_P + C_G + I_P + I_G$

(20) $Z_{NFT} = Z_{NFT}(\overset{+}{Z}, \overset{-}{\frac{p_{NFT}}{p_{NT}}}, \overset{-}{\frac{p_{NFT}}{p_F}}, \overset{?}{\varepsilon})$

(21) $Z_{NT} = Z_{NT-J}(\overset{+}{Z}, \overset{-}{\frac{p_{NT}}{p_{NFT}}}, \overset{-}{\frac{p_{NT}}{p_F}}, \overset{?}{\varepsilon}) + J$

(22) $Z_F = Z - Z_{NFT} - (Z_{NT} - J)$

(23) $n = \dfrac{w}{ap_{NT} + bp_{NFT} + cp_F}$

(24) $L = L_{NFT} + L_{NT} + L_F$

(25) $L^S = \bar{L}$

(26) $E = L$

(27) $m^D = m^D(\overset{+}{Y \text{ or } Z}, \overset{+}{p}, \overset{-}{r})$

(28) $m^D = m^S$

(29) $p = \lambda_1 p_{NT} + \lambda_2 p_{NFT} + \lambda_3 p_F; \quad \sum_{i=1}^{3} \lambda_i = 1$

As p is to be used as an implicit expenditure deflator, and as p_F will vary exogenously in the present analysis, it is clear that λ_1, λ_2 and λ_3 should be endogenous and flexible. However, following the approach adopted in Models I and II, equations to endogenise these weights will not be set out explicitly in this algebraic specification of Model IV, but the weights will, nevertheless, be treated as endogenous in the subsequent manipulation of the geometric characterisation of the model.

The variables which are treated as endogenous to the non-farm and macroeconomic aggregates sector of the model are:-

(1) Y (2) Y_{NT} (3) Y_{NFT} (4) L_{NFT} (5) L_{NT} (6) C_P^{NF} (7) C_P

(8) I_P^{NF} (9) I_P (10) Z (11) Z_{NT} (12) Z_{NFT} (13) Z_F (14) n

(15) L (16) L^S (17) E (18) m^D (19) r (20) p

The variables which appear in this sector of the model and which are endogenous to the farm sector are:

(1) Y_F (2) y_F^{NF} (3) C_P^F (4) I_P^F (5) L_F

The variables which are exogenous to the model as a whole are:

(1) K_{NFT} (2) α_{NFT} (3) p_{NFT} (4) p_{NT} (5) p_F (6) v (7) K_{NT}

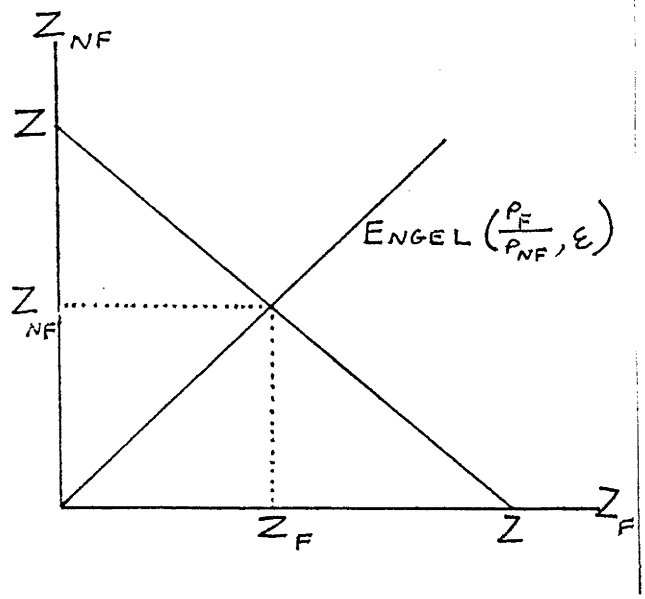
(8) α_{NT} (9) C_G (10) I_G (11) ε (12) J (13) w (14) $\bar{L}$

II(2) Geometric Characterisation of the Model

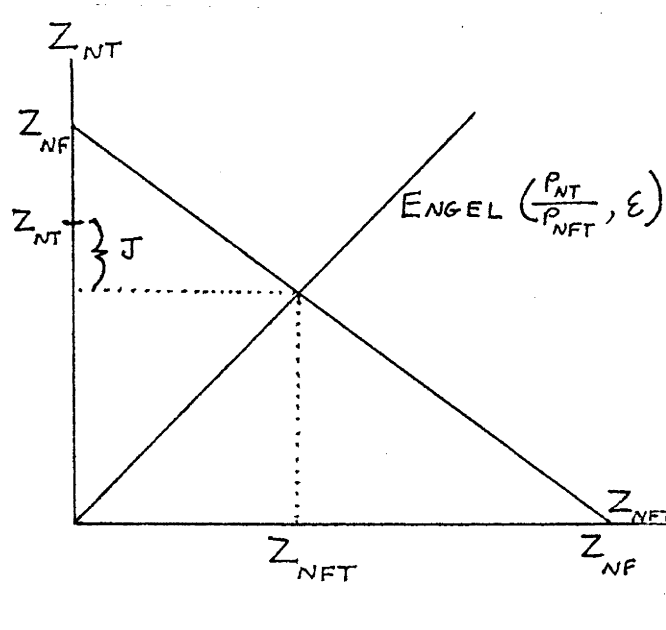
Sectors I and III of Model IV are identical to their counterparts in the relevant variants of Models I, II and III.

Figure VI(1)

Sector II(1)



Sector II(2)

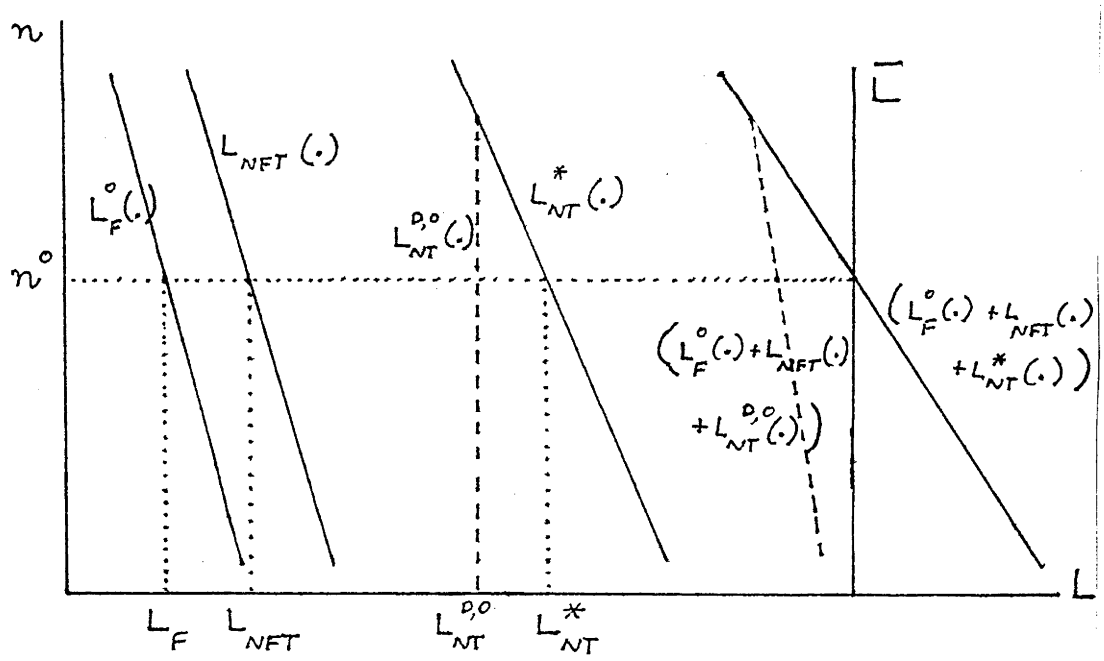


Sector II of the model is similar to Sector II of Model II in that, for convenience, aggregate final expenditure, Z, is separated firstly into its farm and non-farm components, and the non-farm component is then further separated into its non-traded and non-farm traded components. However, unlike Model II, no additional constraint is imposed on the level of Z_F.

Sector IV of the model is also identical to its counterparts in earlier models. As in the analysis with Models II and III, the developments in Sector IV of the present model will be described in general terms below, so that there will then be no requirement to explicitly consider Sector IV in the subsequent analysis. This helps to simplify the analytical exposition in later sections.

Figure VI(2)

Sector IV



In Figure VI(2), $L_F^0(.)$ is the initial position of the demand for labour schedule in the farm sector, $L_{NFT}(.)$ is the demand for labour in the non-farm traded goods sector, $L_{NT}^*(.)$ is the optimal demand for labour in the non-traded goods sector, $L_{NT}^{D,0}(.)$ is the initial effective or demand constrained demand for labour schedule in the non-traded goods sector, and $\bar{L}$ is the fixed supply of labour.

As p_{NT}, p_{NFT} and w are assumed to be fixed throughout, it is clear that an exogenous rise (say) in p_F would lower the real wage, n, from its initial position at n^0. Further, as p_F has risen relative to p_{NT} and p_{NFT}, then $L_F(.)$ would move to the right from $L_F^0(.)$. Hence, it would be unambiguous that L_F would increase, and that, in turn, would imply a rise in O_F in Sector III(1). However, as noted above, this induced effect of the change in p_F on L_F and O_F will be ignored in the present analysis. The fall in the relative price of non-traded and non-farm traded goods would also cause $L_{NFT}(.)$ and $L_{NT}^*(.)$ to move to the left. In that case however, the effect of these leftward movements on L_{NFT} and L_{NT}^* would be exactly offset by the fall in n, so that L_{NFT} and L_{NT}^* would remain unchanged. In other words, the assumption that output and employment in the non-farm traded goods sector, and the <u>optimal</u> level of output and employment in the non-traded goods sector are unaffected by exogenous changes in p_F are quite consistent with the specification of the model.

While $L_{NT}^*(.)$ and L_{NT}^* are fixed, the effective demand for labour in the non-traded goods sector, $L_{NT}^D(.)$, of course, is free to move to the left or right of its initial position at $L_{NT}^{D,0}(.)$ as the demand for, and hence actual production of, non-traded goods rises or falls. It is assumed, however, that at the ruling level of the real wage, $L_{NT}^D(.)$ always lies to the left of $L_{NT}^*(.)$, ie, the non-traded goods sector always faces an effective demand constraint.

II(3) Some Analysis of the Fourth Paradigm

In Appendix A, Model IV is used to examine some of the macro-economic consequences of an exogenous increase in p_F. It is assumed throughout the analysis that the rise in p_F has no impact on the volume of production in the farm sector. It is also assumed that, while the rise in p_F would increase y_F and hence y_F^F and y_F^{NF}, the level of consumption and investment expenditure undertaken by farm households, and consumption expenditure undertaken by non-farm households in receipt of y_F^{NF}, would be unaffected.

It is demonstrated that, even under these circumstances, the rise in p_F would, in general, have some impact on important macro-economic variables such as Y_{NT}, Y and r. In particular:

- the rise in p_F would have no impact on Y_{NT}, Y and r only in the special case where the domestic demand for farm commodities was unit own price elastic, Z was the true scale argument in the demand for money function, and the price and volume of expenditure elasticities of demand for nominal balances were both unity;
- if the demand for farm commodities was price elastic, then there is a strong presumption that the rise in p_F would result in an increase in Y_{NT} and Y, and would impose upward pressure on the interest rate;

- if the demand for farm commodities was own price inelastic, then there is a strong presumption that the rise in p_F would have a contractionary effect on Y_{NT} and Y. However, the impact on the interest rate is more uncertain. If Z is the scale argument in the demand for money function, then it is likely that r would fall. If, however, Y was the scale argument, then r could either rise or fall.

In Appendix B, the more realistic case is considered where the rise in y_F^F and y_F^{NF} is assumed to induce a rise in consumption and investment expenditure by farm households, and in consumption expenditure by non-farm households in receipt of y_F^{NF}. In this case:

- if the demand for farm commodities was either unit own price elastic, or own price elastic, then there is a strong presumption that the rise in p_F would increase Y, Y_{NT} and r. Such an outcome would seem to accord with intuition or conventional wisdom;

- if the demand for farm commodities was own price inelastic, then the direction of the impact of the rise in p_F on Y_{NT}, Y and r is uncertain. In other words, it remains possible that the rise in p_F could cause Y_{NT} and Y to fall. Further, the direction of the impact of the rise in p_F on r could not be significantly clarified, in this case, by appeal to the choice of scale argument in the demand for money function.

Section III: Some Analysis with an Endogenous Balance of Payments

III(1) Model Specification

No new notation is introduced in the present variant of Model IV. The state of the balance of payments is endogenised by adding three equations to the original specification of Model IV.

$$(30) \quad \dot{m}^S = \dot{d} + BP$$

$$(31) \quad k = k(\overset{+}{r}, \overset{-}{r^W}, \overset{+}{\dot{e}^E}, \overset{?}{\mu})$$

$$(32) \quad BP = p_{NFT}\, Y_{NFT} + p_F\, O_F - p_{NFT}\, Z_{NFT} - p_F\, Z_F + k$$

The three additional endogenous variables in the model are:

(1) m^S (2) k (3) BP

The additional exogenous variables are:

(1) d (2) r^W (3) $\dot{e}^E$ (4) μ

It is apparent that the balance of payments identity, equation (32), is identical to that used in the relevant variants of Model I. In other words, the specification is designed to capture the case where the farm sector is assumed to operate in the presence of a perfect residual export market for farm commodities, so that an exogenous change in the overseas price of farm commodities would flow directly into the prices received by domestic producers and paid by domestic consumers, with the value of farm exports then being determined accordingly. As such, it is of direct relevance, for example, to the beef, mutton and lamb industries in those periods when constraints on the volume of imports of farm commodities, imposed by overseas markets, are largely ineffective. It is also largely relevant to the wool industry in those instances where an exogenous change in the overseas demand for Australian wool occurs in the absence of any change in stocks by the A.W.C.

In contrast, the specification of equation (32) is not completely satisfactory, in itself, for industries such as wheat, sugar and dairying. As was noted in Chapter II, the presence of home consumption price schemes and other protective devices in those industries implies that, in general, changes in the prices of those commodities on overseas markets are not reflected precisely in the prices received by domestic producers and, more particularly, in the prices paid by domestic consumers. However, it is felt that the present analysis would provide some broad feel for the macroeconomic impact of an exogenous change in the overseas price of those commodities. Further, it would provide a framework into which a more detailed specification of the determination of the domestic price of the relevant farm commodities could be incorporated at a later date.

Similarly, the present specification is not strictly relevant for the beef, mutton and lamb industries in those periods when constraints on the volume of exports are effective. The specification of the balance of payments identity used in Model II would, of course, be much more relevant to that case. A major implication of this latter specification, as discussed in Chapter II, would be that, provided that the constraint on the volume of exports remained effective, an exogenous change in the overseas price of beef, mutton and lamb would have little, if any, bearing on the prices paid by domestic consumers and received by local producers. On the other hand, an exogenous change in the size of the constrained volume of exports could influence the domestic price. In view of this, it would probably be useful to analyse this case separately and in more detail at a later date.

III(2) Some Analysis of the Fourth Paradigm

The geometric characterisation of the present variant of Model IV is presented in Appendix C. In Appendix D, some analysis is presented for the case where the rise in p_F and hence in y_F, y_F^F and y_F^{NF} is assumed not to induce any increase in consumption or investment expenditure:

- three cases are examined: (1) unit own price elastic demand for farm commodities; (2) own price inelastic demand for farm commodities; and (3) own price elastic demand for farm commodities;
- in the case of unit own price elasticity:
  - .. there is a strong presumption that the rise in p_F would be associated with a fall in r. This contrasts with the corresponding case in Section II, where it was argued that it was likely that r would be unchanged or higher following the rise in p_F;
  - .. there is a strong presumption that the rise in p_F would be associated with balance of payments surpluses during the adjustment period;
- in the case where the demand for farm commodities is own price inelastic:
  - .. there is a strong presumption that the rise in p_F would be associated with a fall in r. In the corresponding case in Section II, it was argued that the impact of the rise in p_F on r was

ambiguous, at least where Y was the scale argument in the demand for money function;

.. the rise in p_F could be associated with either balance of payments surpluses or deficits during the adjustment period. This ambiguity was present regardless of the choice of scale argument in the demand for money function;

- in the case where the demand for farm commodities is own price elastic;

  .. the rise in p_F could be associated with either a rise or a fall in r. In the corresponding case in Section II, it was argued that there was a strong presumption that the rise in p_F would cause r to rise;

  .. there is a strong presumption that the rise in p_F would be associated with surpluses in the balance of payments during the adjustment period.

In Appendix E, the rise in y_F, and hence in y_F^F and y_F^{NF}, is assumed to induce an increase in aggregate expenditure. The main elements of the results in this case are that:

.. the impact of the rise in p_F on the interest rate is always ambiguous, regardless of the size of the own price elasticity of demand for farm commodities;

.. there is a strong presumption that the period of adjustment to a new Keynesian and balance of payments equilibrium, following the rise in p_F, would be associated with balance of payments surpluses, except in the case of own price inelastic demand where the outcome is ambiguous.

Section IV Concluding Comments on Chapter VI

In Chapter VI:

(a) Model IV was specified, characterised geometrically and then used to examine the macroeconomic implications of a shock in the farm sector under the circumstances postulated by the fourth paradigm. In particular, it was assumed that an exogenous increase occurred in the price of farm commodities on overseas markets and that this then flowed through into the prices received by farmers and paid by domestic consumers of farm commodities. In other words, whereas the focus of attention in the first three paradigms was on exogenous shocks to the volume of farm production (coupled, in the case of the second paradigm, with an induced change in farm prices), the focus of attention in the fourth paradigm shifted to that of an exogenous shock to farm prices. Model IV differed from Models I, II and III only to the extent necessary to facilitate an examination of this alternative type of shock;

(b) explicit balance of payments considerations were ignored in the first instance. The state of the balance of payments was subsequently endogenised in the model. Non-traded goods prices and nominal wages were held fixed throughout. Also, for simplicity, it was assumed that the endogenous increase in farm prices did not induce a

change in the volume of farm production. It was considered that such additional complexities were best left until a theoretical simulation variant of Model IV has been developed;

(c) the main results obtained from the analysis were summarised in Sections II(3) and III(2) and hence will not be repeated in detail. Briefly, some of the more important points were that:

- if the demand for farm commodities is own price inelastic, then the rise in farm prices on overseas markets could be associated with a decline in output and employment in the non-farm sector and, more particularly, in the non-traded goods sector. The intuitive explanation for such a result is quite clear. While farm incomes, and hence the level of expenditure originating from farm households, would benefit from a rise in farm prices, there would also be a switching of aggregate expenditure away from non-farm commodities and towards farm commodities. Therefore, the net effect on the demand for non-farm, and hence non-traded, commodities is ambiguous. If a net decline in the demand for non-farm commodities were to occur, then output and employment in the non-traded goods sector would fall, producing, in turn, a negative Keynesian demand multiplier process in that sector;
- in the case of a price elastic demand for farm commodites it is, of course, largely unequivocal that output in the non-traded goods sector would increase. Expenditure originating from farm households would be enhanced by

the rise in farm prices while, in this case, there would also be a switching of aggregate expenditure towards non-farm, and hence non-traded, commodities;

- in the open economy analysis, the impact of the increase in farm prices on the interest rate was largely ambiguous. This reflects the fact that the state of the current account is subject to a variety of influences which may work in opposite directions, making the net impact on the current account (and hence the level of net capital inflow required for balance of payments equilibrium) uncertain. For example, it is intuitive that the rise in farm prices would increase the value of farm exports. However, the aggregate demand for traded goods may increase if the overall level of economic activity were to increase, or fall if economic activity were to decline. Further, the demand for non-farm traded goods may be either increased or reduced by the switching of aggregate expenditure between farm and non-farm commodities. It is interesting to note, too, that some degree of ambiguity as to the direction of change in the interest rate was also evident in the closed economy analysis - again reflecting the variety of income and substitution effects which are at work in the present case;
- it may be intuitive that an exogenous increase in farm prices, which resulted in an increase in the volume and value of farm exports, would produce at least a temporary improvement in the state of the balance of payments. However, in the analysis, several broad sets of (not necessarily implausible) circumstances

were identified under which temporary balance of payments deficits would be likely to accompany the rise in farm prices. Typically, this more counter-intuitive outcome tended to emerge in those cases where the rise in farm prices resulted in a fall in economic activity (as noted above) and hence in the demand for money.

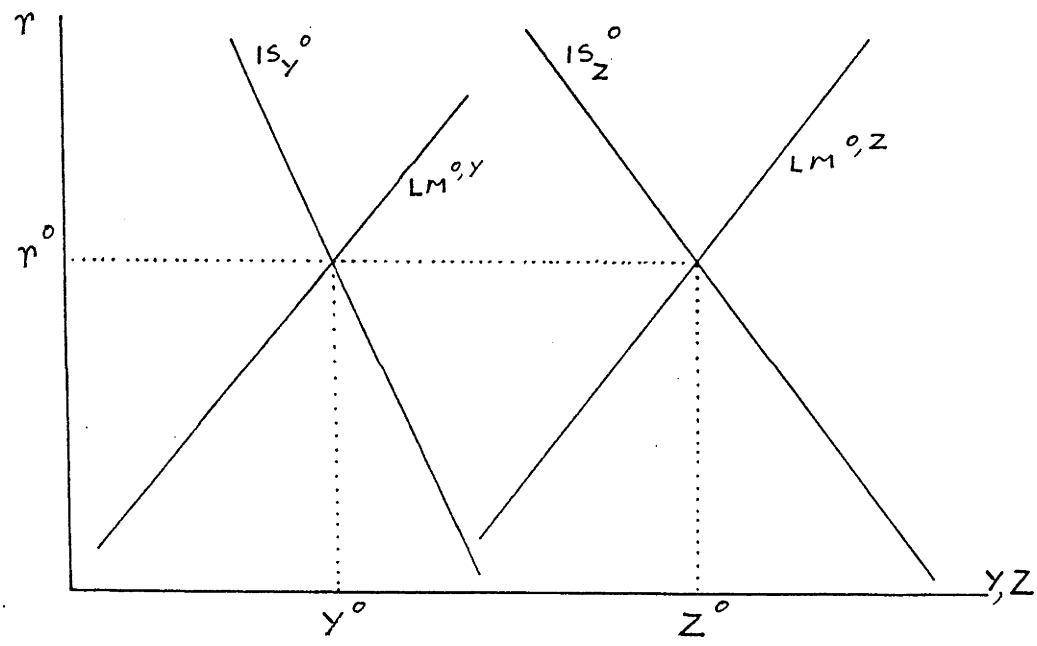
Finally, it would be useful, as part of a future research project, to analyse the case of an exogenous change in the price received by producers of farm commodities, but with the price paid by domestic consumers largely unaffected (such an analysis would be relevant, for example, for the wheat, sugar and dairy industries). It is clear that the Model IV framework could be readily modified for that purpose. Similarly, an exogenous change in the price of farm commodities on overseas markets could be examined in the presence of an effective constraint on the volume of farm exports (which would be relevant, for example, to the beef, mutton and lamb industries in some periods). The Model II framework, developed and explored in Chapter IV, could be readily utilised for that purpose.

Appendix A

Suppose that p_F rises exogenously. By assumption, there is no production or employment response in the farm sector, ie, O_F, Y_F and L_F remain at their pre-shock levels. However, it is clear from equations (3), (4), (5) and (6) that, while O_F and Y_F are unchanged, the rise in p_F will produce a rise in y_F, and hence in y_F^F and y_F^{NF}.

Figure VI(3)

Sector I



Suppose that, in Figure VI(3). the initial positions of the IS curves are given by IS_Y^0 and IS_Z^0. Also suppose that, if Y is the scale argument in the demand for money function, the initial LM curve is $LM^{0,Y}$, so that the initial level of the interest rate is r^0. Alternatively, if Z is the scale argument, suppose that the initial nominal money stock is larger so that the initial position of the LM curve is $LM^{0,Z}$, and the initial interest rate is again r^0.

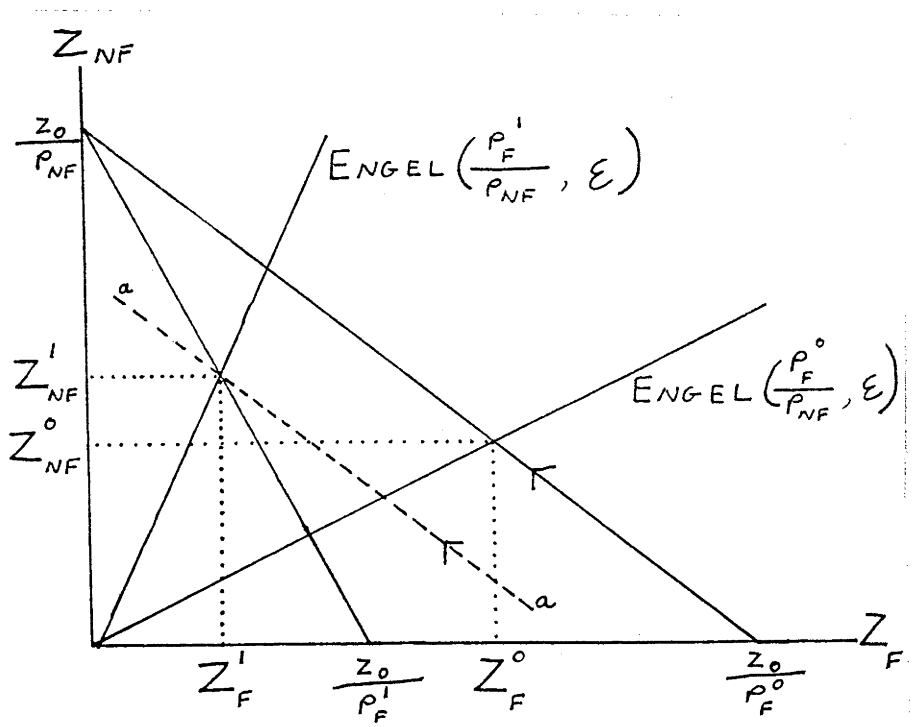
As the rise in p_F engenders no change in Y_F, IS_Y remains at IS_Y^0 in the first instance (unlike our earlier analysis of the first three paradigms, where the assumed exogenous change in O_F and Y_F was

reflected directly in a shift of the IS_Y curve). It will be initially assumed that the rise in y_F^F does not induce a rise in consumption or investment expenditure by farm households, and that the rise in y_F^{NF} does not induce a rise in consumption expenditure by those non-farm households in receipt of y_F^{NF}. (These assumptions, of course, will be relaxed later.) The problem, then, is to assess the impact of the rise in p_F on the volume of aggregate final expenditure, given the assumed absence of any induced increase in expenditure. To that end, a procedure similar to that adopted in Model II and the relevant variant of Model I can again be employed.

For each volume of expenditure measured along IS_Z^0, a corresponding level of nominal expenditure can be obtained, using the given values for p_{NT}, p_{NFT} and the original, pre-shock level of p_F. Assuming that those levels of nominal expenditure remain fixed as p_F rises, the impact of the rise in p_F on the volume of expenditure can be readily assessed in Sector II(1) of the model. In particular, consider the original volume of expenditure Z^0, in Figure VI(3), and let its nominal value be z_o.

Figure VI(4)

Sector II(1)

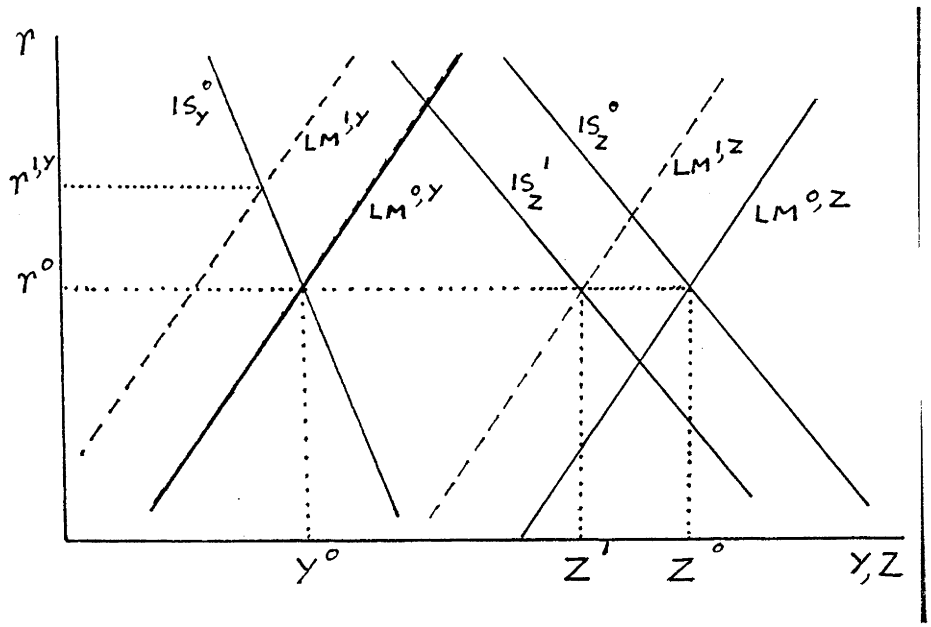


In Figure VI(4), given z_0 and p_F^0, the original budget line has intercepts $\frac{z_0}{p_{NF}}$ $\frac{z_0}{p_F^0}$. The break-up of expenditure into its farm and non-farm components is determined by the point of intersection between that budget line and the Engel Curve drawn for the original relative prices, so that the initial volume of expenditure on farm commodities is Z_F^0, and on non-farm commodities is Z_{NF}^0. The rise in p_F from p_F^0 to p_F^1 rotates the budget line so that its horizontal intercept becomes $\frac{z_0}{p_F^1}$. The chosen point on this new budget line is Z_F^1 Z_{NF}^1 - where the new budget line intersects Engel $(\frac{p_F^1}{p_{NF}}, \varepsilon)$. It is clear that, in general, this new expenditure bundle, when valued at the original relative prices, will represent a volume of expenditure less than Z^0. In other words, a line drawn through $Z_F^1 Z_{NF}^1$ and parallel to $\frac{z_0}{p_{NF}}$ $\frac{z_0}{p_F^0}$ will (in the absence of a corner solution), lie entirely inside the original budget line.

This procedure could, in principle, be repeated for each point along IS_Z^0, in order to trace out a new IS_Z curve in Sector I - say IS_Z^1. Each point along IS_Z^1 is associated with the same level of nominal expenditure as its horizontally opposing point on IS_Z^0 but, because p_F^1 is greater than p_F^0, that given level of nominal expenditure is associated with a smaller volume of expenditure in the presence of p_F^1.

Figure VI(5)

Sector I



The next step is to assess the impact of the rise in p_F on the LM curve. Consider first the case where the scale argument in the demand for money function is Z. In particular, suppose that (not implausibly) the price and volume of expenditure elasticities of the demand for nominal money balances were both unity. It would follow that, as horizontally opposing points on IS_Z^0 and IS_Z^1 are associated with the same level of nominal expenditure, the LM curve would move to the left from $LM^{0,Z}$ to $LM^{1,Z}$, so that IS_Z^1 and $LM^{1,Z}$ would also intersect at interest rate r^0. In other words, with a given nominal money stock, the rise in p_F would not impose any pressure on the interest rate. Of course, if the price and/or real expenditure elasticity of the demand for nominal balances were not unity, then some upward or downward pressure on the interest rate may be evident.

Alternatively, suppose that Y was the scale argument. Provided that the price elasticity of the demand for money was greater than zero, then the LM curve would move to the left from $LM^{0,Y}$, to say, $LM^{1,Y}$ and it is unambiguous that, given IS_Y^0, upward pressure would

be placed on the interest rate, rising from r^0 to $r^{1,Y}$.

The next step is to assess whether the IS curves, $IS_Y{}^0$ and $IS_Z{}^1$, are consistent with a Keynesian equilibrium in the non-traded goods sector of the economy. As has been noted in earlier analyses, if any pair of horizontally opposing points on an IS_Y and an IS_Z curve are not consistent with a Keynesian equilibrium in the non-traded goods sector, then the same would apply to all other horizontally opposing points on the IS curves. For our purposes, it is convenient to focus on the points r^0Y^0 on $IS_Y{}^0$, and r^0Z^1 on $IS_Z{}^1$.

We know that, by assumption, $IS_Y{}^0$ and $IS_Z{}^0$, and hence r^0Y^0 and r^0Z^0 were consistent with a Keynesian equilibrium in the non-traded goods sector. As J is given, we also know that r^0Y^0 and r^0Z^1 would be consistent with a Keynesian equilibrium only in the special case where the non-traded component of Z^1 was equal to the non-traded component of Z^0. The circumstances under which this would occur can be readily ascertained from Sector II of the model.

Consider Sector II(1) of the model, in Figure VI(4). As drawn, the demand for farm commodities is own price elastic, so that, following the rise in p_F from $p_F{}^0$ to $p_F{}^1$, Z_{NF} increased from $Z_{NF}{}^0$ to $Z_{NF}{}^1$. The higher level of Z_{NF} would then imply a higher level of Z_{NT} in Sector II(2). In other words, if the demand for farm commodities is own price elastic, the non-traded component of Z^1 is greater than the non-traded component of Z^0. Conversely, if the demand for farm commodities had been own price inelastic in Figure VI(4), it is clear that $Z_{NF}{}^1 < Z_{NF}{}^0$, and hence the non-traded component of Z^1 would be less than the non-traded component of Z^0. Finally, of course, in the special case where demand was unit own price elastic, $Z_{NF}{}^1 = Z_{NF}{}^0$, so that the non-traded component of Z^1 would be equal to the non-traded component of Z^0.

Therefore, in the special case where the demand for farm commodities is unit own price elastic, the IS curves IS_Y^0 and IS_Z^1 would be consistent with a Keynesian equilibrium in the non-traded goods sector. In other words, there would be no pressure for the IS curves to move from IS_Y^0 and IS_Z^1. Whether the actual level of Y would vary from Y^0 would depend on whether the interest rate varied from r^0. For example, as noted above, if Z was the scale argument in the demand for money function, and if the price and volume of expenditure elasticities of demand for nominal balances were both unity, then r would remain at r^0, and hence Y would remain at Y^0. On the other hand, if Y was the scale argument, then it is largely unambiguous that r would rise above r^0, so that Y would fall below Y^0.

In the case where the demand for farm commodities is own price elastic (as drawn in Figure VI(4)), IS_Y^0 and IS_Z^1 would be associated with excess demand for farm commodities, ie the non-traded component of Z^1 would be greater than the non-traded component of Z^0, and hence would also be greater than the non-traded component of Y^0. This, of course, would set in train a positive Keynesian demand multiplier process in the non-traded goods sector, as has been described at length in earlier analyses. In brief, production of non-traded goods would increase in Sector III(3) of the model, and that would be reflected in a rightward movement of IS_Y from IS_Y^0 in Figure VI(5). To the extent that the increase in Y_{NT} induced a rise in consumption expenditure by non-farm households, and a rise in non-farm investment, the IS_Z curve would move to the right from IS_Z^1, which would further increase the demand for non-traded goods and so on. Provided that this demand multiplier process was stable, a set of IS curves consistent with a new Keynesian equilibrium in the non-traded goods sector would be established to the right of IS_Y^0 and IS_Z^1. It is clear that this rightward movement of the IS curves would be associated with upward pressure on the interest rate,

regardless of the scale argument in the demand for money function.

In general then, in this case, even though the rise in p_F has, by assumption, no impact on the volume of farm production, or on consumption or investment expenditure by farm households, or on consumption expenditure by non-farm households in receipt of y_F^{NF}, it nevertheless has a beneficial impact on non-traded goods production, and there is a strong presumption that it would impose upward pressure on the interest rate.

Where the demand for farm commodities is own price inelastic, the IS curves IS_Y^0 and IS_Z^1 would be associated with an excess supply of non-traded goods, ie. the non-traded component of Z^1 would be less than the non-traded component of Z^0, and hence would be less than the non-traded component of Y^0. In this case, a negative Keynesian demand multiplier process would be set in train. Production of non-traded goods would fall in Sector III(3), which would be reflected in a leftward movement of IS_Y from IS_Y^0 in Sector I, in Figure VI(5). To the extent that this would cause consumption and investment expenditure in the non-farm sector to fall, IS_Z would move to the left from IS_Z^1, and so on. Provided that this multiplier process was stable, new Keynesian equilibrium IS curves would be established to the left of IS_Y^0 and IS_Z^1 respectively.

The impact of the rise in p_F on the ultimate equilibrium level of the interest rate is less clear in this case. For example, if Z was the scale argument, and if the leftward movement of IS_Z from IS_Z^0 to IS_Z^1 had left the interest rate unaffected at r^0 (as drawn in Figure VI(5)), then the further leftward movement of IS_Z from IS_Z^1 should ensure that the interest rate would fall below r^0. However, if Y was the scale argument, then some initial upward pressure would have been evident on the interest rate, raising it from r^0 to $r^{1,Y}$ in Figure VI(5), as noted above. It is unclear, therefore, whether

the subsequent leftward movement of IS_Y from IS_Y^0 would be sufficient to push the interest rate back down to a level below r^0, or whether, in the new Keynesian equilibrium, the interest rate would remain above r^0.

The preceding analysis could be summarized as follows:

(1) even in the absence of an induced increase in farm production in response to a rise in p_F, and also in the absence of a consumption or investment response to the rise in y_F^F and y_F^{NF}, the rise in p_F would, in general, cause Y_{NT} and hence Y to change:

- the change in Y_{NT} could be in either an upward or a downward direction, depending substantially on whether the domestic demand for farm commodities was own price elastic or inelastic respectively;
- in the special case of a unit own price elasticity of demand for farm commodities, the rise in p_F <u>may</u> cause some change in Y_{NT}, depending on whether the rise in p_F also has some impact on the interest rate;

(2) the nature of the impact of the rise in p_F on r is rather uncertain:

- in the special case where the demand for farm commodities is unit own price elastic, the scale argument in the demand for money function is Z, and the price and volume of expenditure elasticities of the demand for money are both unity, then r is likely to be unaffected by the rise in p_F;
- if the demand for farm commodities is own price elastic, then there is a strong presumption that the rise in p_F would be associated with a rise in r;

- if the demand for farm commodities is own price inelastic and if Z is the scale argument in the demand for money function, then there is a strong presumption that the rise in p_F would lower the interest rate;
- if the demand is own price inelastic, and if Y is the scale argument in the demand for money function, then there is substantial ambiguity as to whether the rise in p_F would raise or lower the interest rate.

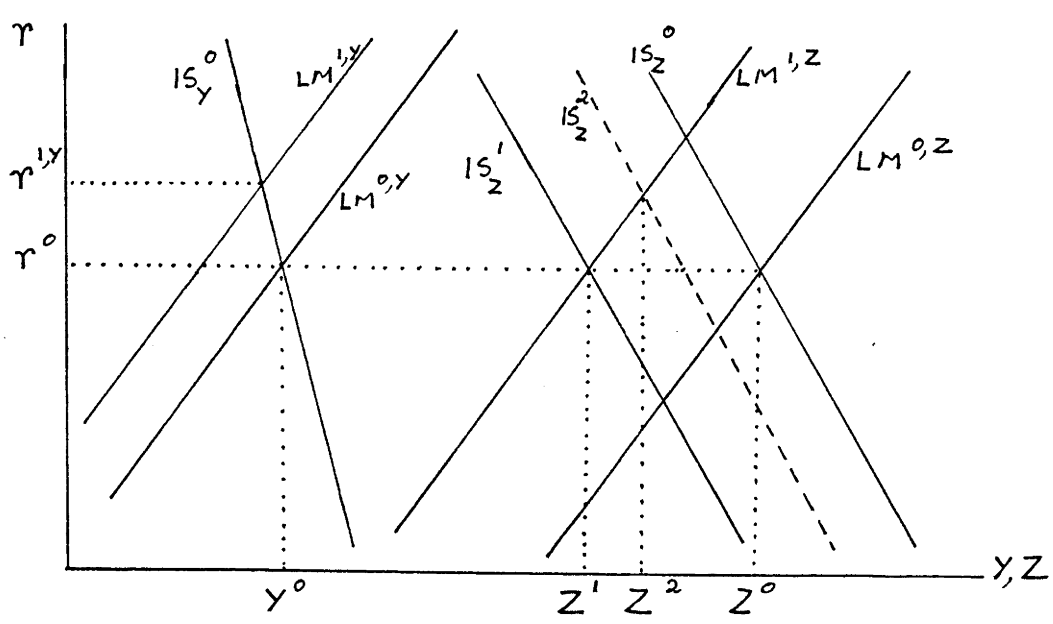
Appendix B

The analysis in Appendix A was based on an assumption that the rise in y_F, and hence in y_F^F and y_F^{NF}, engendered by the exogenous rise in p_F, did not induce a rise in consumption or investment expenditure by farm households, or in consumption expenditure by non-farm households in receipt of y_F^{NF}. This assumption will now be relaxed, ie. it will now be assumed that the rise in y_F induces a rise in the level of expenditure via one or more of the above channels.

Consider, firstly, the case where the demand for farm commodities is unit own price elastic.

Figure VI(6)

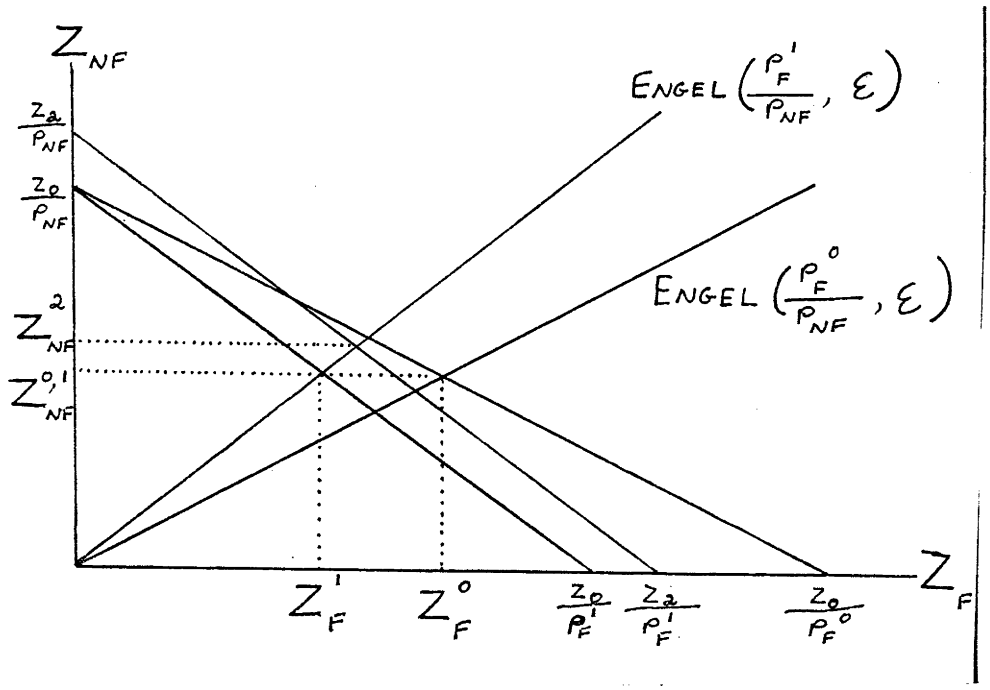
Sector I



In Figure VI(6), the initial, pre shock, positions of the IS curves are given by IS_Y^0 and IS_Z^0. Following the rise in p_F, and assuming a unit own price elasticity of demand for farm commodities and no expenditure response to the rise in y_F, the IS curves IS_Y^0 and IS_Z^1 would be consistent with a Keynesian equilibrium in the non-traded goods sector, as described at length above. The LM curves, $LM^{0,Z}$, $LM^{1,Z}$, $LM^{0,Y}$ and $LM^{1,Y}$ are also as described above with respect to Figure VI(5).

In the present case, of course, the IS curve does not remain at IS_Z^1 in Figure VI(6). Rather, the induced rise in expenditure would push the IS_Z curve to the right from IS_Z^1 to (say) IS_Z^2. Supposing that Z was the scale argument in the demand for money function, so that $LM^{1,Z}$ was the relevant LM curve, the actual volume of expenditure would rise from Z^1 to Z^2 in Figure VI(6). (Of course, had Y been the scale argument, so that $LM^{1,Y}$ was the relevant LM curve, then the interest rate would have remained at $r^{1,Y}$ in the first instance following the rightward movement of IS_Z from IS_Z^1. However, the analysis would follow along similar lines to that set out below). The impact of this rightward movement of IS_Z can be assessed in Sector II(1) of the model.

Figure VI(7)



In Figure VI(7), $\frac{z_0}{p_{NF}}$ $\frac{z_0}{p_F}$ is the position of the budget line following the rise in p_F from p_F^0 to p_F^1 but prior to any induced increase in expenditure. The chosen bundle on that budget line, $Z_{NF}^{0,1}$ Z_F^1, when valued at pre-shock prices, is equal to Z^1 in Figure VI(6). We know that the volume of expenditure on non-farm commodities, $Z_{NF}^{0,1}$, is common to both Z^0 and Z^1 in this case, (because the demand for farm commodities is assumed to be unit own price elastic). The induced increase in expenditure, from Z^1 to Z^2 in Figure VI(6), pushes the budget line in Figure VI(7) outwards to $\frac{z_2}{p_{NF}}$ $\frac{z_2}{p_F^1}$. It is clear that, in general, this would raise Z_{NF} from $Z_{NF}^{0,1}$ to (say) Z_{NF}^2.

The rise in Z_{NF} from $Z_{NF}^{0,1}$ to Z_{NF}^2 would imply a rise in Z_{NT} in Sector II(2). As IS_Y^0 and IS_Z^1 were consistent with a Keynesian equilibrium in the non-traded goods sector, it is clear, therefore, that IS_Y^0 and IS_Z^2 would be associated with excess demand for non-traded goods. Production of non-traded goods, in Sector III(3) of the model, would increase, and that would be reflected, in turn, in a

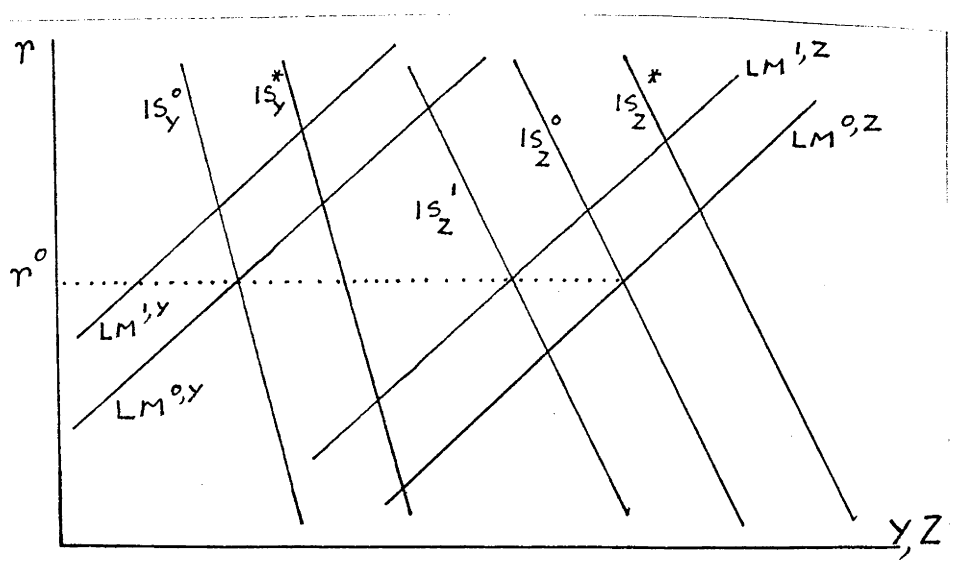
rightward movement of IS_Y from IS_Y^0 in Figure VI(6). To the extent that the rise in Y_{NT} induces a further increase in consumption and investment expenditure in the non-farm sector, IS_Z would move to the right from IS_Z^2, and so on, in a positive Keynesian demand multiplier process. Therefore, provided that this multiplier process is stable, a new Keynesian equilibrium would eventually be established with IS_Y lying to the right of IS_Y^0 and IS_Z lying to the right of IS_Z^1.

In general then, in the case of a unit own price elasticity of demand for farm commodities, a rise in p_F would raise Y_{NT} and Y. There is also a strong presumption that the rise in p_F would result in a higher interest rate in the new post-shock Keynesian equilibrium than in the initial pre-shock equilibrium. In particular, if Z was the scale argument in the demand for money function, then the rightward movement of IS_Z from IS_Z^1 in Figure VI(6) would raise r above r^0. Similarly, if Y was the scale argument, then the rightward movement of IS_Y from IS_Y^0, in Figure VI(6), would raise the interest rate above $r^{1,Y}$, where $r^{1,Y} > r^0$.

The next step is to consider the case where the demand for farm commodities is own price elastic.

Figure VI(8)

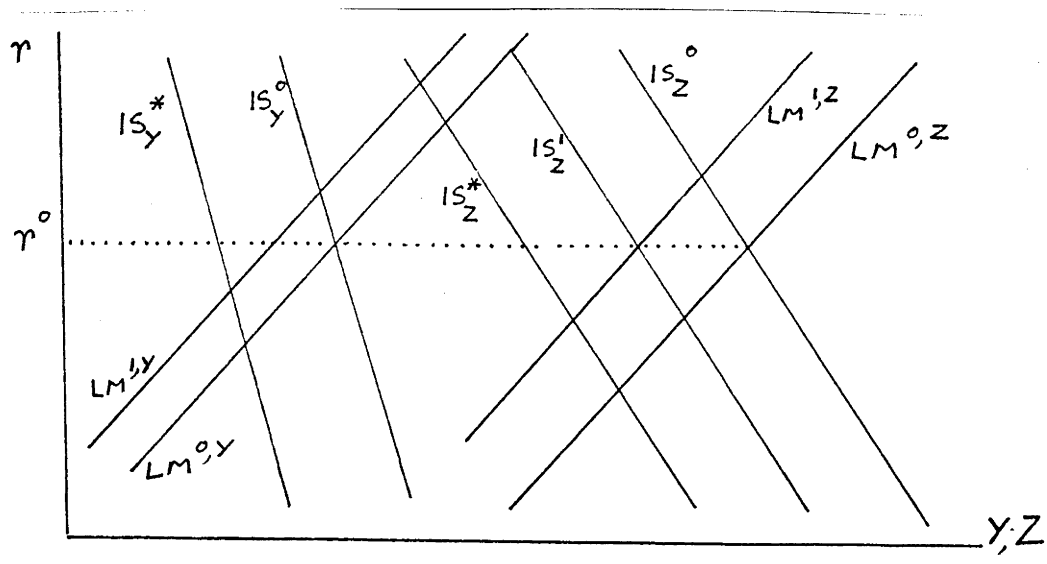
Sector I



In Figure VI(8), IS_Y^0, IS_Z^0, IS_Z^1, and the LM curves are as described previously. We saw earlier that, even when the rise in y_F^F is assumed not to induce any increase in expenditure, the IS curves, IS_Y^0 and IS_Z^1, would not be consistent with a Keynesian equilibrium in the non-traded goods sector. Rather, those IS curves would be associated with an excess demand for non-traded goods, leading to a positive demand multiplier process. Suppose that, when a new Keynesian equilibrium is established, the positions of the IS curves are given by IS_Y^* and IS_Z^* in Figure VI(8). It is clear that, in the present case, the assumed rise in expenditure would push the IS_Z curve further to the right from IS_Z^*. That would be reflected, in Sector II(1), in a rise in Z_{NF}, and hence in Z_{NT}, so that Y_{NT} would increase in Sector III(3). The IS_Y curve would therefore move to the right from IS_Y^*. In other words, a further positive Keynesian demand multiplier process would be set in train, indicating that the rise in p_F has a more stimulating effect on Y_{NT} and Y than in the earlier analysis where the induced rise in expenditure was ignored. This additional rightward movement of the IS curves would also reinforce the presumption in that earlier analysis that the rise in p_F would result in an increase in the interest rate from r^0.

Finally, consider the case where the demand for farm commodities is own price inelastic.

Figure VI(9)
Sector I



In Figure VI(9), IS_Y^0, IS_Z^0, IS_Z^1, and the LM curves are each as has been described previously. We know that, with a price inelastic demand for farm commodities, and in the absence of any induced rise in expenditure following the rise in p_F, the IS curves IS_Y^0 and IS_Z^1 would be associated with an excess supply of non-traded goods. Suppose that the ensuing negative Keynesian demand multiplier process was stable and that, when a new Keynesian equilibrium was established in the non-traded goods sector, the positions of the IS curves were represented by IS_Y^* and IS_Z^* in Figure VI(9).

It is clear that the rise in expenditure which would be induced by the rise in y_F would push the IS_Z curve to the right of its position at IS_Z^*. Following the now familiar line of argument, that would create a situation of excess demand for non-traded goods, causing IS_Y to move to the right from its position at IS_Y^*, and so on, in a positive Keynesian demand multiplier process.

The ultimate position of the IS_Y curve relative to IS_Y^0, following the above positive multiplier process, is unclear. In other words, IS_Y may remain to the left of IS_Y^0, or move to the right of IS_Y^0. In that sense, the net impact of the rise in p_F may be either expansionary or contractionary. Similarly, the ultimate position of IS_Z relative to IS_Z^1 and IS_Z^0 is also unclear.

This uncertainty about the ultimate position of the IS curves is also reflected in substantial uncertainty as to the net impact of the rise in p_F on the interest rate. In particular:

- if Y is the scale argument in the demand for money function, and if the ultimate position of IS_Y is either coincident with, or to the right of of IS_Y^0, then r would rise above r^0;
- if Y is the scale argument, and if the ultimate

position of the IS_Y curve is to the left of IS_Y^0, then r may lie either above or below r^0 (noting that $LM^{1,Y}$ lies to the left of $LM^{0,Y}$);

- if Z is the scale argument then the ultimate level of r would be less than, equal to, or greater than r^0 depending on whether the ultimate position of IS_Z is to the left of, coincident with, or to the right of IS_Z^1, respectively.

Appendix C

Sectors II, III and IV in the geometric characterisation of the model are identical to those described in Section II above. Sector I, however, needs to be modified by the inclusion of a TT schedule to indicate the combinations of Z and r which are consistent with balance of payments equilibrium. The procedure adopted in the present case in order to locate the position of the TT schedule parallels that employed in Chapters III, IV and V.

From equation (32), the current account elements of the balance of payments are:

(33) $CAB = p_{NFT}\, Y_{NFT} + p_F\, O_F - p_{NFT}\, Z_{NFT} - p_F\, Z_F$ where CAB is the current account balance.

We know that p_{NFT} and p_F are exogenous variables in the model. Further, while Y_{NFT} and O_F are endogenous variables, they are functions only of exogenous variables in the present specification, and hence are unaffected by changes in Z.

Consider the variable Z_{NFT}. From equation (20), we know that:

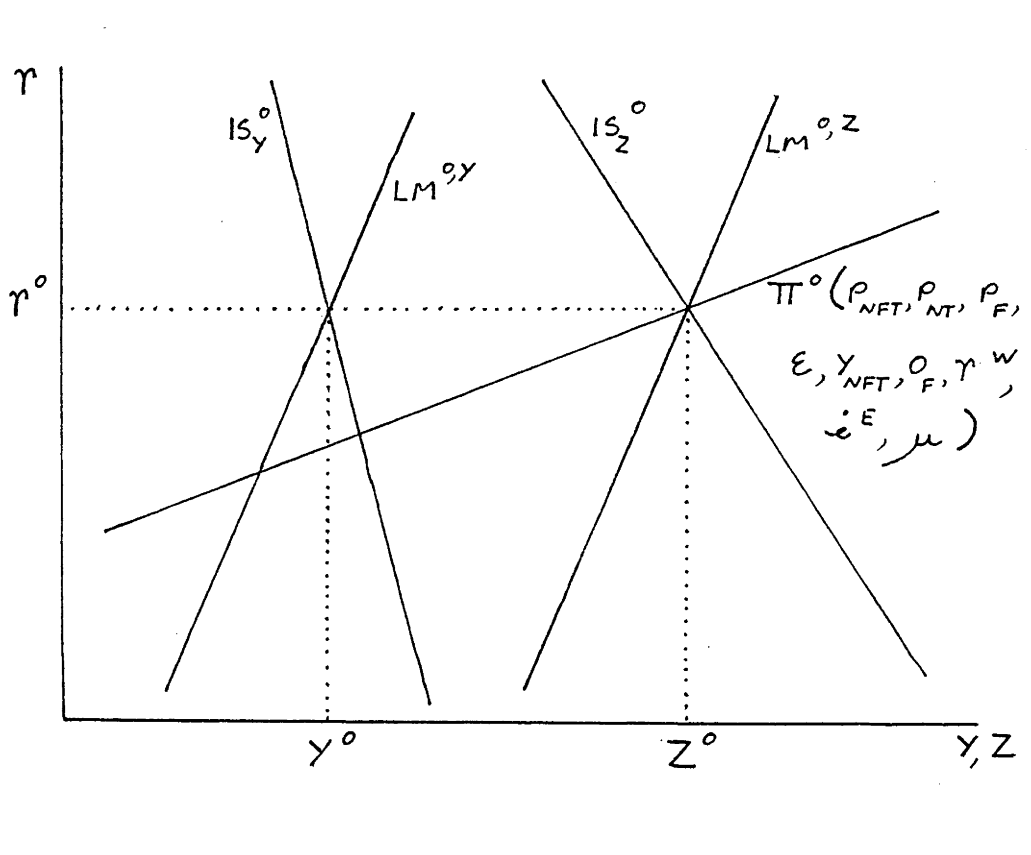
(20) $$Z_{NFT} = Z_{NFT}\left(\overset{+}{Z}, \frac{p_{NFT}}{p_{NT}}, \frac{p_{NFT}}{p_F}, \overset{?}{\varepsilon}\right)$$

Given the values of the exogenous variables p_{NFT}, p_{NT}, p_F and ε, then Z_{NFT} is an increasing function of Z. Similarly, from (20), (21) and (22), given p_{NFT}, p_F, p_{NT} and ε, and provided that the sum of the expenditure elasticities of domestic demand for non-farm traded and non-traded goods is less than unity, then Z_F is also an increasing function of Z.

It follows from the above that, given p_{NFT}, p_{NT}, p_F, ε, Y_{NFT} and O_F, the current account balance is a decreasing function of Z. Similarly, from (31), given r^W, $\dot{e}^E$ and μ, k is an increasing function

Figure VI(10)

Sector I



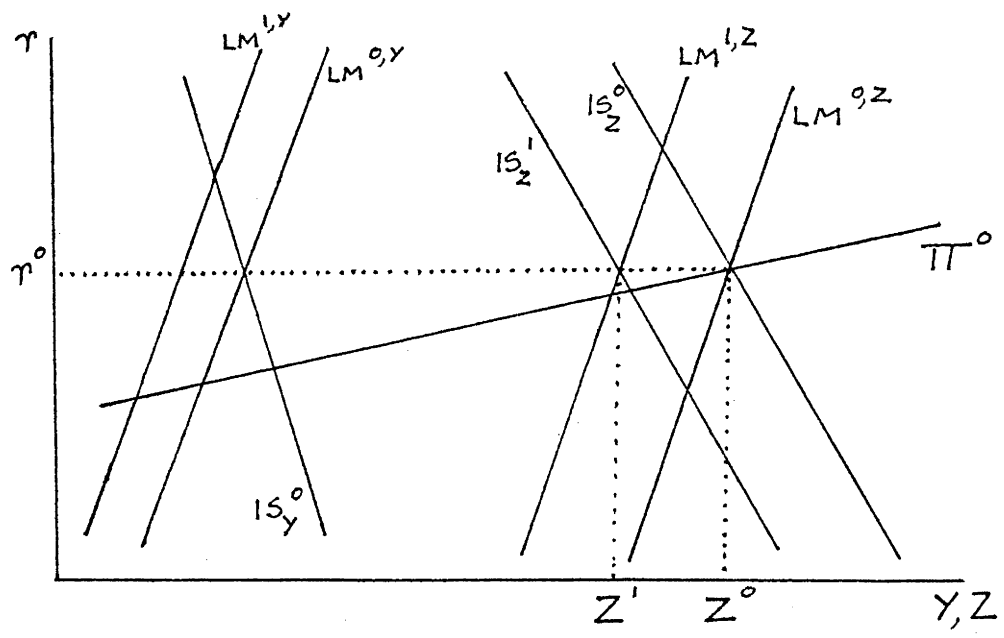
of r. Therefore, given p_{NFT}, p_{NT}, p_F, ε, Y_{NFT}, O_F, r^W, $\dot{e}^E$ and μ, a positively sloped TT schedule can be drawn to indicate combinations of Z and r which are consistent with balance of payments equilibrium - as in Figure VI(10).

In Fig.VI(10), given IS_Y^o, IS_Z^o and TT^o, the interest rate consistent with balance of payments equilibrium is determined by the point of intersection between IS_Z^o and TT^o, ie. r^o. If Y is the scale argument in the demand for money function, then the LM curve consistent with an initial balance of payments equilibrium would be $LM^{o,Y}$, while, if Z was the scale argument, the corresponding initial LM curve would be $LM^{o,Z}$.

Appendix D

Figure VI(11)

Sector I



As in the first part of the analysis in Section II, it will be assumed that, while the rise in p_F would cause a rise in y_F, and hence in y_F^F and y_F^{NF}, there is no induced increase in farm consumption and investment expenditure, or in consumption expenditure by non-farm households in receipt of y_F^{NF}.

In Fig.VI(11), the initial pre-shock positions of the curves are represented by IS_Y^0, IS_Z^0, TT^0, and either $LM^{0,Z}$ or $LM^{0,Y}$, depending on whether the scale argument in the demand for money function is Z or Y respectively. The initial level of the interest rate is r^0, which is consistent with balance of payments equilibrium.

As we saw in the analysis in Appendix A, in the absence of any induced rise in expenditure, the rise in p_F would cause the IS_Z curve to move to the left from IS_Z^0 to IS_Z^1. If Z was the scale argument, and if the price and volume of expenditure elasticities of the demand for money were both unity, then LM would also move to the left, from $LM^{0,Z}$ to $LM^{1,Z}$, so that IS_Z^1 and $LM^{1,Z}$ continue to intersect at r^0. Alternatively, had the scale argument been Y, then LM would have moved to the left from $LM^{0,Y}$ to $LM^{1,Y}$, and hence IS_Y^0 and $LM^{1,Y}$ would, in general, intersect at a level of the interest rate above r^0.

Suppose that, in the above case, the own price elasticity of demand for farm commodities was unity. We know from our earlier analysis in Appendix A that, in this case, IS_Y^0 and IS_Z^1 would be consistent with a Keynesian equilibrium in the non-traded goods sector. In other words, the IS curves would not be pushed from their positions at IS_Y^0 and IS_Z^1 by a positive or negative Keynesian demand multiplier process within the non-traded goods sector.

The problem, then, is to assess the impact of the exogenous rise in p_F on the position of the TT schedule relative to TT^0 in Fig.VI(11). It will then be possible to assess the level of the interest rate which

would be consistent with balance of payments equilibrium following the rise in p_F, and hence the change in the nominal money stock which would be required in order to shift the LM curve accordingly.

From (32):

(33) $CAB = p_{NFT} Y_{NFT} + p_F O_F - p_{NFT} Z_{NFT} - p_F Z_F$, where CAB is the current account balance. As p_{NFT} is exogenous, and Y_{NFT} and O_F are endogenous but fixed, it is clear that the total partial derivative of CAB with respect to p_F is:

$$(34) \quad \frac{\delta CAB}{\delta p_F} = (O_F - Z_F) + \frac{\delta CAB}{\delta p_{NFT} Z_{NFT}} \cdot \frac{\delta p_{NFT} Z_{NFT}}{\delta p_F} + p_F \left(\frac{\delta CAB}{\delta Z_F} \cdot \frac{\delta Z_F}{\delta p_F}\right)$$

Assuming that the farm sector is a net exporter, then the first term on the R.H.S. would be positive, while the terms $\frac{\delta CAB}{\delta p_{NFT} Z_{NFT}}$ and $\frac{\delta CAB}{\delta Z_F}$ are clearly negative. Therefore, we need to consider the signs of the terms $\frac{\delta p_{NFT} Z_{NFT}}{\delta p_F}$ and $\frac{\delta Z_F}{\delta p_F}$ which can be done readily in Sector II(1).

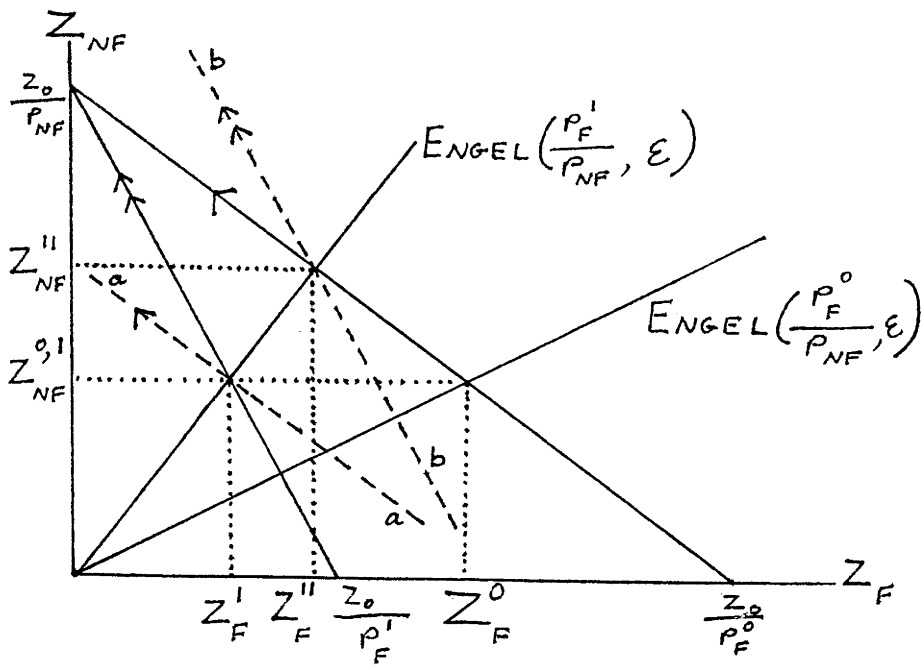
In Figure IV(12), let 3_0 be the nominal equivalent of the original volume of expenditure, Z_0, so that the original budget line has intercepts $\frac{3_0}{p_F^0}$ $\frac{3_0}{p_{NF}}$. The original volume of expenditure on farm commodities is Z_F^0 , and on non-farm commodities is $Z_{NF}^{0,1}$. We know that, given 3_0, the rise in p_F from p_F^0 to p_F^1 would rotate the budget line so that its horizontal intercept would become $\frac{3_0}{p_F^1}$, and the volume of expenditure on farm commodities would fall from Z_F^0 to Z_F^1. The assumption that the demand for farm commodities is unit own price elastic, of course, implies that Z_{NF} remains at $Z_{NF}^{0,1}$.

It is clear that the bundle Z_F^1 $Z_{NF}^{0,1}$, when valued at the original prices, p_{NF} and p_F^0, is less than Z^0, ie. the line aa, drawn parallel to the original budget line and passing through the

point Z_F^1 $Z_{NF}^{0,1}$ lies entirely inside the original budget line. Suppose, however, that in the presence of the new higher level of p_F, p_F^1, aggregate nominal expenditure was increased above 3_0 sufficiently to move the budget line in Figure VI(12) outwards from $\frac{3_0}{p_{NF}}$ $\frac{3_0}{p_F^1}$ to the line bb. The chosen point on this line, Z_F^{11} Z_{NF}^{11}, lies on the original budget line and hence, when valued at the original, pre-shock prices, would represent a volume of expenditure equal to Z^0. It is clear that, provided farm and non-farm commodities are <u>net</u> substitutes in expenditure, then $Z_F^{11} < Z_F^0$ and $Z_{NF}^{11} > Z_{NF}^{0,1}$. This higher level of Z_{NF}, of course, would then imply a higher level of Z_{NFT} in Sector II(2).

Figure VI(12)

Sector II(1)



In general then, given the volume of expenditure Z^0, the rise in p_F from p_F^0 to p_F^1 would lower Z_F and raise Z_{NFT}

ie. $\frac{\delta p_{NFT} Z_{NFT}}{\delta p_F}$ +ve , $\frac{\delta Z_F}{\delta p_F}$ -ve.

Returning to equation (34), the first term on the R.H.S. would be

positive (as noted above), the second term on the R.H.S. would be negative, and the third would be positive. In other words, the sign of the total partial deriviative of the current account balance with respect ot p_F is ambiguous. In terms of Figure VI(11), the height of the new TT schedule, at volume of expenditure Z^0, may be greater than, euqal to, or less than the height of TT^0 at Z^0.

It is also important to compare and contrast the state of the current account at volume of expenditure Z^1, following the price rise, with the state of the current account at Z^0 prior to the price rise. In terms of Sector II(1), in Figure VI(12), this requires a comparison of the state of the current account at $Z_{NF}^{0,1}$ Z_F^1 on one hand, and at $Z_{NF}^{0,1}$ Z_F^0 on the other. It is immediate that the current account at $Z_{NF}^{0,1}$ Z_F^1 is stronger than at $Z_{NF}^{0,1}$ Z_F^0 because, with O_F unchanged, $Z_F^1 < Z_F^0$ and $p_F^0 < p_F^1$, both the volume and value of farm exports are higher at $Z_{NF}^{0,1}$ Z_F^1, while Y_{NFT}, Z_{NFT} and p_{NFT} are, of course, identical at both points.

The implications of the preceding analysis could be summarised as follows:

(1) at volume of expenditure Z^0, the state of the current account, following the rise in p_F from p_F^0 to p_F^1, may be stronger than, identical to, or weaker than, its state prior to the price rise. Therefore, the height of the new, post-shock TT schedule at Z^0 may be, respectively, less than, equal to or greater than the height of TT^0 at Z^0;

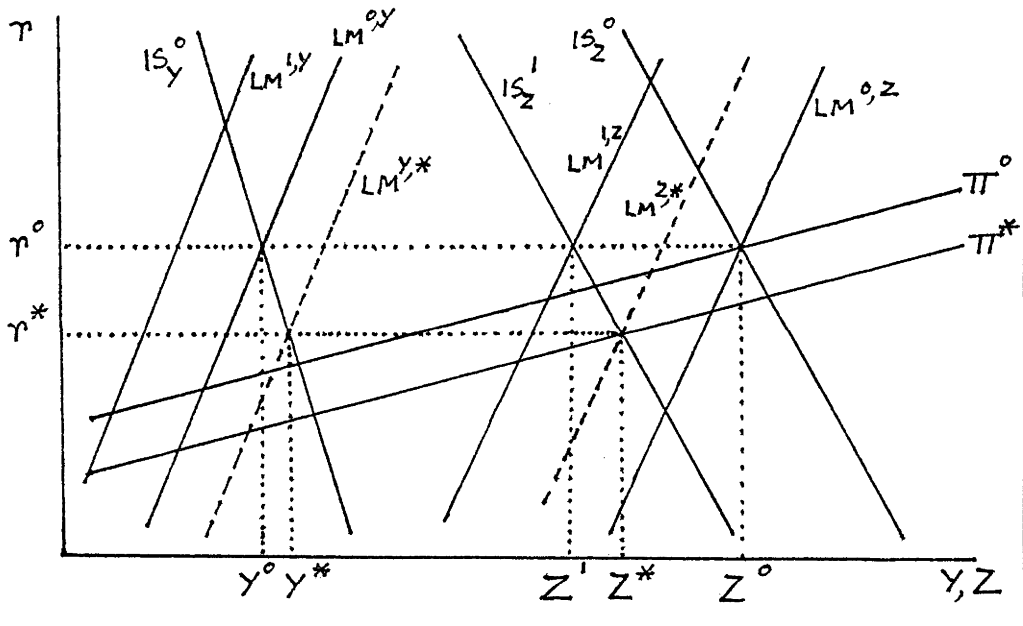
(2) at volume of expenditure Z^1, the state of the current account following the rise in p_F would be unambiguously stronger than at Z^0 prior to the price rise. Therefore, the height of the new, post shock TT schedule, at Z^1, would be less than the height of TT^0 at Z^0.

In Figure VI(13), IS_Y^0, IS_Z^0, IS_Z^1, TT^0, $LM^{o,Y}$, $LM^{1,Y}$, $LM^{0,Z}$ and $LM^{1,Z}$ are each as described previously, in the context of Figure VI(11). Suppose that, following the rise in p_F from p_F^0 to p_F^1, the TT curve shifted from TT^0 to TT^*. It is clear that TT^* satisfies the criterion noted above, ie. the height of TT^* at Z^1 is less than the height of TT^0 at Z^0 and the height of TT^* at Z^0 is (arbitrarily) less than the height of TT^0 at Z^0.

Several implications follow immediately from Figure VI(13):

Figure VI(13)

Sector I



(1) given that IS_Z^1 is negatively sloped and that TT^* is positively sloped, it is clear that, in the new Keynesian and balance of payments equilibrium following the rise in p_F, the interest rate will be lower than in the pre-shock equilibrium, ie. $r^* < r^0$:

- this result contrasts with that established in the corresponding case in Section II. It will be recalled that, in Section II, where the rise in p_F did not induce a rise in

expenditure, and where the demand for farm commodities was unit own price elastic, then there was a strong presumption that the interest rate would either remain unchanged, or would increase. The outcome was shown to be dependent, to some extent, on the choice of scale argument in the demand for money function, whereas the above conclusion that $r^* < r^0$ is independent of the scale argument;

- there is a strong presumption that the transition to the new Keynesian and balance of payments equilibrium, following the rise in p_F, would be associated with balance of payments surpluses. For example, if Z was the scale argument in the demand for money function, then balance of payments surpluses would occur until the nominal money stock had been increased sufficiently to shift the LM curve in Figure VI(13) from $LM^{1,Z}$ to $LM^{Z,*}$. Similarly, if Y was the scale argument, then balance of payments surpluses would occur until the LM curve had been shifted from $LM^{1,Y}$ to $LM^{Y,*}$. Of course, there is no necessary presumption that the <u>extent</u> of these balance of payments surpluses during the adjustment period would be independent of the scale argument.

Of course, the analysis can be readily extended to the cases where the demand for farm commodities is own price inelastic and own price elastic, while persisting with the assumption that the rise in y_F does not induce any increase in consumption or investment

expenditure.

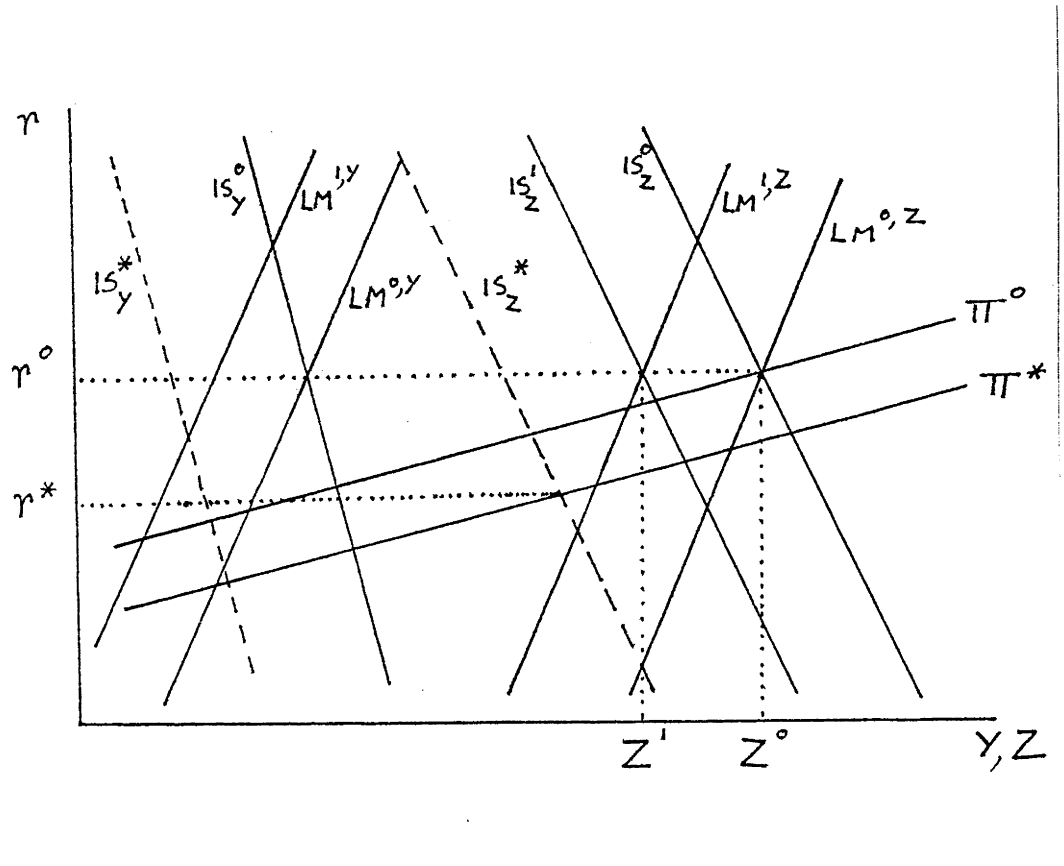
Suppose that the demand for farm commodities was own price inelastic. In terms of Sector II(1) of the model, only one substantive difference would be required to the representation of the unit own price elastic case in Figure VI(12). In particular, in Figure VI(12), the chosen point on the budget line $\frac{3_0}{p_{NF}} \frac{3_0}{p_F^1}$ would represent a smaller volume of expenditure on non-farm commodities than at the chosen point on the original budget line, $\frac{3_0}{p_{NF}} \frac{3_0}{p_F^0}$, as was discussed at some length in Appendix A. It follows immediately that the state of the current account at volume of expenditure Z^1 would again be stronger than at volume of expenditure Z^0 - not only would the volume and value of farm exports be higher, but Z_{NFT} would be lower. As in the unit elastic case, the impact of the rise in p_F on the state of the current account, at volume of expenditure Z^0, remains ambiguous, ie. in the presence of the higher relative price of farm commodities, the chosen point on the original budget line $\frac{3_0}{p_{NF}} \frac{3_0}{p_F^0}$ would change so as to imply a lower level of Z_F (and hence a larger volume and value of farm exports), but also a higher level of Z_{NF}, and hence Z_{NFT}.

Therefore, in the case where the demand for farm commodities is own price inelastic:

- the height of the post shock TT schedule at Z^0 may be greater than, less than, or equal to the height of the original TT schedule at Z^0;
- the height of the post shock TT schedule at Z^1 will be lower than the height of the original TT schedule at Z^0.

Figure VI(14)

Sector I



In Figure VI(14), IS_Y^0, IS_Z^0, IS_Z^1, $LM^{0,Z}$, $LM^{1,Z}$, $LM^{0,Y}$, $LM^{1,Y}$ and TT^0 are as described previously, in Figure VI(11). Suppose that, following the rise in p_F from p_F^0 to p_F^1, the TT schedule shifts from TT^0 to TT^*, noting that TT^* clearly satisfies the criteria noted above.

We know, from our analysis in Appendix A, that, given that the demand for farm commodities is assumed to be own price inelastic, IS_Z^1 and IS_Y^0 would not be consistent with a Keynesian equilibrium in the non-traded goods sector. Rather, those curves would be associated with an excess supply of non-traded goods, setting in train a negative

Keynesian demand multiplier process, which would push IS_Z to the left from IS_Z^1 and IS_Y to the left from IS_Y^0. Suppose that this multiplier process is stable, so that the IS curves IS_Y^* and IS_Z^* are consistent with the re-establishment of a Keynesian equilibrium in the non-traded goods sector. Several implications follow immediately:

- in the new, post shock Keynesian and balance of payments equilibrium, the interest rate is unambiguously lower than in the pre-shock equilibrium. In terms of Figure VI(14), $r^* < r^0$. This is unambiguous because we know that the point of intersection between TT^* and IS_Z^1 must occur at an interest rate below r^0, and any subsequent movement of IS_Z to the left from IS_Z^1 would result in a further lowering of the interest rate. In contrast, it will be recalled that, in the corresponding case in Section II, there was a degree of ambiguity as to the direction of the net impact of the rise in p_F on r. In particular, if Z was the scale argument in the demand for money function, there was a strong presumption that r would fall. However, if Y was the scale argument, it was argued that r could either rise of fall;

- the transition from the original Keynesian and balance of payments equilibrium to the post-shock equilibrium could be associated with either balance of payments deficits or surpluses. Suppose, for example, that Z was the scale argument in the demand for money function. Given IS_Z^* and TT^* in Figure VI(14), it is clear that, in order for a balance of payments equilibrium to be re-established, the nominal money stock would need

to fall, via balance of payments deficits, until the LM curve had been shifted leftward from $LM^{1,Y}$ sufficiently to share a common point of intersection with IS_Z^* and TT^*. On the other hand, had the point of intersection between IS_Z^* and TT^* been to the right of the point of intersection between TT^* and $LM^{1,Z}$, then balance of payments surpluses would have been required in order to bring about a common point of intersection between IS_Z^*, TT^* and LM.

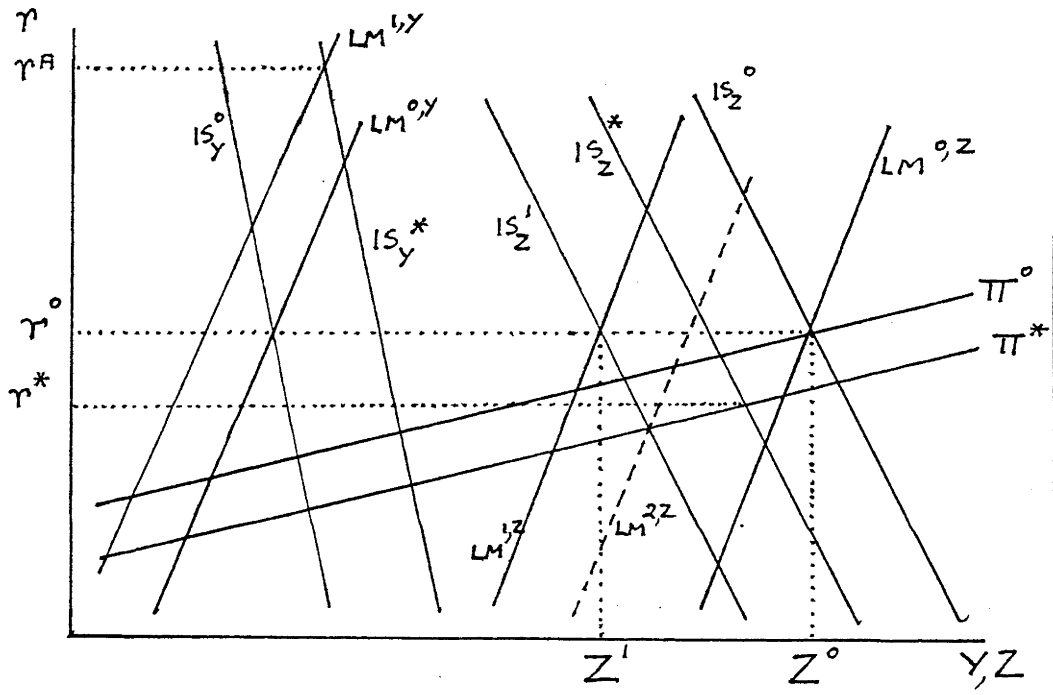
A similar analysis can be undertaken for the case where Y is the scale argument. As drawn in Figure VI(14), IS_Y^* and $LM^{1,Y}$ intersect at a level of the interest rate above r^*. Therefore, balance of payments surpluses would occur until LM had been shifted to the right from $LM^{1,Y}$ sufficiently to ensure that IS_Y^* and LM intersect at interest rate r^*. Conversely, had IS_Y^* and $LM^{1,Y}$ intersected at a level of the interest rate below r^*, then balance of payments deficits would occur during the adjustment period.

Finally, consider the case where the demand for farm commodities is own price elastic. In terms of Sector II(1), in Figure VI(12), we know that the chosen point on the budget line $\frac{3_0}{p_{NF}} \frac{3_0}{p_{F}{}^1}$ would imply a higher real and nominal level of expenditure on non-farm commodities than would the chosen point on the original budget line prior to the rise in p_F. However, we also know that the decline in nominal expenditure on farm commodities would be absorbed via an additional increase in the value and volume of farm exports, while only part of the additional expenditure on non-farm commodities would, in general, be directed onto non-farm traded goods. It remains unambiguous, therefore, that the state of the current account at

volume of expenditure Z^1 would be stronger than the state of the current account at Z^0. It is also clear that, in general, the state of the current account at Z^0, following the rise in p_F, could be stronger than, identical to or weaker than its state at Z^0 prior to the rise in p_F.

Figure VI(15)

Sector I



In Figure VI(15), the curves $IS_Y{}^0$, $IS_Z{}^0$, $IS_Z{}^1$, $LM^{0,Y}$, $LM^{1,Y}$, $LM^{0,Z}$, $LM^{1,Z}$ and TT^0 are each as has been described previously. TT^* is the new post-shock TT schedule.

We know, from our analysis in Appendix A that, where the demand for farm commodities is own price elastic, $IS_Y{}^0$ and $IS_Z{}^1$ are not consistent with a Keynesian equilibrium in the non-traded goods sector. Rather, $IS_Y{}^0$ and $IS_Z{}^1$ would be associated with an excess demand for non-traded goods, which would set in train a positive Keynesian demand multiplier process, pushing the IS curves to the right from $IS_Y{}^0$ and $IS_Z{}^1$. Suppose, as usual, that this multiplier process is stable, so that a new Keynesian equilibrium in the non-traded goods sector is established

with IS_Y at IS_Y^* and IS_Z at IS_Z^*. The important implications are as follows:

(1) there is a degree of ambiguity as to the ultimate impact of the rise in p_F on the interest rate. We know that IS_Z^1 and TT^* must intersect at an interest rate below r^0. However, the subsequent rightward movement of IS_Z from IS_Z^1 would put upward pressure on the interest rate. As drawn in Figure VI(15), IS_Z^* and TT^* intersect at interest rate $r^* < r^0$, implying a net decline in the interest rate. However, for a sufficiently large rightward movement of IS_Z from IS_Z^1, that result could have been reversed.

This result stands somewhat in contrast to the corresponding result in Section II. There, it was argued that there was a <u>strong</u> presumption that the rise in p_F would place upward pressure on the interest rate;

(2) there is a strong presumption that the adjustment to the new Keynesian and balance of payments equilibrium would be associated with balance of payments surpluses. For example, suppose that Z was the scale argument in the demand for money function. Even in the absence of any rightward movement of IS_Z from IS_Z^1 in Figure VI(15), a balance of payments surplus would be required to shift LM from $LM^{1,Z}$ to $LM^{2,Z}$ in order to re-establish balance of payments equilibrium. It is clear that, provided that the LM curves are steeper than TT^*, any rightward movement of IS_Z from IS_Z^1 would be associated with

further balance of payments surpluses.

Consider also the case where Y is the scale argument. As IS_Y^* lies to the right of IS_Y^0, and as IS_Y^0 and $LM^{1,Y}$ intersect at an interest rate above r^0, it is clear that, while ever $r^* < r^0$, the LM curve would need to move to the right from $LM^{1,Y}$ in order to re-establish balance of payments equilibrium. Even where $r^* > r^0$ (as noted to be a possibility in (1) above), there are a wide range of circumstances where balance of payments surpluses would be required during the adjustment period. For example, given IS_Y^* in Figure VI(15), r^* would need to exceed r^A before the presumption of balance of payments surpluses would be invalidated.

Appendix E

In Appendix E, we will relax the assumption that the rise in p_F, and hence in y_F, y_F^F and y_F^{NF}, does not induce an increase in consumption and investment expenditure by farm households, and in consumption expenditure by non-farm households in receipt of y_F^{NF}. We will again consider, in turn, the cases where the demand for farm commodities is unit own price elastic, own price inelastic and own price elastic.

Consider, firstly, the case where the demand for farm commodities is unit own price elastic. We know that, in Figure VI(13), in the presence of a unit own price elasticity of demand for farm commodities, and in the absence of any induced increase in expenditure, the IS curves IS_Y^0 and IS_Z^1 were consistent with a Keynesian equilibrium in the non-traded goods sector. In the present case, however, the induced increase in expenditure, following the rise in p_F, would push IS_Z to the right from IS_Z^1, setting in train a positive Keynesian demand multiplier process, ie. there would occur a cumulative rightward movement of the IS curves from IS_Y^0 and IS_Z^1 in Figure VI(13). The implications of this, of course, are qualitatively very similar to those outlined above for the case of an own price elastic demand for farm commodities and no induced increase in expenditure. In particular:

- the ultimate impact of the rise in p_F on r is ambiguous. While IS_Z^1 and TT^* in Figure VI(13) intersect at an interest rate below r^0, it is clear that that result could be reversed if the rightward movement of IS_Z from IS_Z^1 is sufficiently large;
- there is a strong presumption that the transition to the new Keynesian and balance of payments equilibrium,

following the rise in p_F, would be associated with balance of payments surpluses. In Figure VI(13), we know that, if Z was the scale argument in the demand for money function, a balance of payments surplus was required in order to shift the LM curve from $LM^{1,Z}$ to $LM^{Z,*}$, given IS_Z^1. Any subsequent rightward movement of IS_Z from IS_Z^1 would require a rightward movement of LM from LM^{Z*} in order to re-establish balance of payments equilibrium, ie. further balance of payments surpluses would occur during the adjustment period. Similarly (as we saw in the context of Figure VI(15)), balance of payments surpluses would also be required under a wide range of circumstances where Y was the scale argument in the demand for money function.

Next, consider the case where the demand for farm commodities is own price inelastic. We saw, in the analysis with Figure VI(14), that, in the absence of any induced increase in expenditure, there was a strong presumption that the rise in p_F would result in a lowering of the interest rate, but the impact on the state of the balance of payments during the adjustment period was unclear. The essential difference, in the present case, is that the induced increase in expenditure would shift the IS_Z curve to the right from IS_Z^* which would, of course, set in train a positive Keynesian demand multiplier process, leading to a cumulative rightward movement of the IS curves from IS_Y^* and IS_Z^*. It is immediate that:

- the net outcome for the balance of payments remains uncertain. If the transition of the IS curves from IS_Y^0 and IS_Z^0 to IS_Y^* and IS_Z^*, in Figure VI(14), had been associated with balance of payments surpluses,

then this subsequent rightward movement of the IS curves would tend to increase and reinforce those surpluses. If, however, the transition to IS_Y^* and IS_Z^* had been associated with balance of payments deficits, then the subsequent rightward movement of the IS curves from IS_Y^* and IS_Z^* may or may not be sufficient to eliminate the balance of payments deficits;

- the outcome for the interest rate is also uncertain in this case. While IS_Z^* and TT^*, in Figure VI(14), necessarily intersect at an interest rate below r^0, the rightward movement of IS_Z from IS_Z^* in the present case may or may not be sufficient to reverse that outcome.

Finally, consider the case where the demand for farm commodities is own price elastic. We saw, in Figure VI(15), that, in the absence of any induced increase in expenditure following the rise in p_F, the outcome for the interest rate was uncertain but also that there was a strong presumption that the transition to the new Keynesian and balance of payments equilibrium would be associated with balance of payments surpluses. In the present case, the induced increase in expenditure would push IS_Z to the right from IS_Z^* in Figure VI(15), leading to a cumulative rightward movement of the IS curves from IS_Y^* and IS_Z^* as a positive Keynesian demand multiplier process is set in train in the non-traded goods sector. It is immediate that:

- the outcome for the interest rate remains unclear. For example, if the point of intersection between IS_Z^* and TT^* in Figure VI(15) had occurred at a level of the interest rate above r^0, then the subsequent rightward movement of IS_Z from IS_Z^*

would place further upward pressure on the interest rate. If, however, the point of intersection between IS_Z^* and TT^* had occurred at a level of the interest rate below r^0 (as drawn in Figure VI(15)), then the subsequent rightward movement of IS_Z^* may or may not be sufficient to raise r above r^0;

- there remains a strong presumption that the adjustment to the new Keynesian and balance of payments equilibrium would be associated with balance of payments surpluses, ie. the rightward movement of IS_Y from IS_Y^* and IS_Z from IS_Z^* in Figure VI(15) would tend to reinforce the balance of payments surpluses which would have accompanied the movement of IS_Y from IS_Y^0 to IS_Y^* and IS_Z from IS_Z^0 to IS_Z^*.

CHAPTER VII

MODEL V - SOME ANALYSIS OF THE FIFTH PARADIGM

Introduction and Motivation

In Chapter VII, we will analyse some of the issues raised by the fifth paradigm, using the Model V framework, which very closely resembles the variant of Model III in which the state of the balance of payments was endogenised. It will be recalled, from Chapter II, that the fifth paradigm focuses on the direct linkage which has existed, until recently, between, on the one hand, the seasonality of farm production and, on the other, changes in the domestic credit component of the money supply, with a particular emphasis on the Australian wheat industry.

Marketing of wheat in Australia has been monopolised by the Australian Wheat Board (A.W.B.) since 1948 - for some detail on various aspects of the A.W.B.'s operations, see, for example, Longworth (1966,1967), Longworth and Knopke (1982), I.A.C. (1978), O'Mara (1979). The A.W.B. has traditionally operated an advance payment scheme whereby wheat growers are paid a substantial proportion of the anticipated total return from the crop immediately upon delivery of the wheat to the A.W.B. However, as sales of wheat on the domestic and export markets proceed only gradually, it is often at least twelve months before all of the wheat delivered to the A.W.B. from any particular crop is sold and the proceeds received by the A.W.B. Therefore, in order to meet the advance payments to growers, the A.W.B. has traditionally faced a substantial borrowing requirement just prior to the wheat harvest.

Up until the 1978-79 season, the advance payment to wheat growers by the A.W.B. was financed entirely by the Rural Credits Department (R.C.D.) of the Reserve Bank - in other words, it was financed by

the creation of domestic credit. During this period, the A.W.B. was the major beneficiary of R.C.D. funds - for further detail on the history and role of the R.C.D., and the dominant role played by the A.W.B. in the operations of the R.C.D., see, for example, B.A.E. (1979,1982).

The 1978-79 wheat crop was of a then record size, and the full realisation of its size coincided with an observation that the money supply was growing at a rate in excess of the target set by the monetary authorities - due partly to the seasonal budget deficit and the reasonably strong balance of payments at that time. In order to reduce the monetary consequences of R.C.D. funding of the record wheat crop, the A.W.B. was directed to seek commercial funding for a substantial proportion of the advance payment. This practice was continued and extended in the 1979-80 and 1980-81 seasons, and since 1981-82, the A.W.B.'s advance payment has been financed entirely by commercial borrowing. It should also be noted that, initially, the A.W.B. was directed to limit its commercial fund raising activities to the domestic capital market. However, some relaxation of this constraint has occurred in more recent seasons.

These changes in policy towards the funding of the A.W.B.'s advance payment to wheat growers, which have occurred since 1978-79, would seem to suggest that policy makers and policy advisers perceive some significant difference in the implications of commercial funding relative to R.C.D. funding. It would also suggest that, within the context of commercial funding, domestic and overseas borrowing by the A.W.B. are not necessarily regarded as being formally equivalent.

The policy of insisting on commercial funding of the A.W.B.'s advance payment was recently endorsed by the Committee of Inquiry into the Australian Financial System (Campbell Committee) (1981). The

Committee, in fact, recommended the complete abolition of the R.C.D. Unfortunately, the Final Report offered very little commentary on the expected implications of commercial funding relative to R.C.D. funding. However, they noted that removal of the R.C.D.:

> "... would entail greater recourse by the Australian Wheat Board and other rural produce marketing bodies to commercial funding. The Committee notes that the arrangements for financing the wheat crop have been changed in recent years to lessen but so far not to eliminate the injection of liquidity from the Reserve Bank. Fully funding the wheat crop from commercial markets would not eliminate all associated seasonality aspects from financial markets. Given present wheat marketing arrangements, characterised by large first advance payments, commercial funding would give rise to some seasonal upward pressure on interest rates." (para. 6.39) (emphasis added).

It would seem, from the above passage, that the Committee viewed R.C.D. funding and commercial funding as carrying different implications for the interest rate - in particular, the interest rate would tend to vary more under commercial funding arrangments, while liquidity (and hence the money supply?) would vary less under commercial funding.

In a later passage, the Committee argued that:

> "...outflows of cash from the Reserve Bank add to the liquidity base of the private sector; although in this context relatively unimportant, in overall terms R.C.D. credit flows have typically accentuated underlying seasonal volatility in the liquidity base..." (para. 39.66).

The significance of this passage is that no distinction seems to be drawn between that component of the liquidity base (high powered money stock) which is backed by domestic credit, and that component which is backed by foreign exchange reserves (recalling that, over the period considered by the Committee, the Australian exchange rate was either fixed or only moderately flexible). In other words, the Committee argued that R.C.D. funding contributed to the volatility of the aggregate liquidity base, and not just to the domestic credit component of the liquidity base. This would, in turn, imply that R.C.D. funding

was seen to contribute to the volatility of the money supply in aggregate.

It seems probable that the approach and line of analysis adopted by the Committee were influenced by the submission put to the Committee by the Bureau of Agricultural Economics (1979). That submission was directed largely towards an analysis of the role and implications of R.C.D. seasonal financing.

The B.A.E. argued that, where R.C.D. financing was used for an exportable farm commodity, the main implication of that form of financing relative to commercial financing lay in the time profile of monetary growth. However, it was also argued that, if R.C.D. finance was used for a largely non-traded agricultural commodity, then the implications for monetary growth would be more pervasive:

> "The actual effects the R.C.D. loans have on the money supply is dependent on whether or not the industry receiving the finance is selling on the export or domestic markets. Where output is exported, the returns from export sales lead, ceteris paribus, to an increase in the money supply. If R.C.D. loans are used to 'pay' for this output before it is sold then the main effect on the money supply is one of timing. In the absence of a system for making 'advance payment', export proceeds and the resulting increases in the money supply would be spread over an extended period. The R.C.D. seasonal financing arrangements concentrate this increase in the money supply over a relatively short period. If the R.C.D. loans are repaid as export proceeds are received, there is no net contraction of the reserve base.
>
> When R.C.D. loans are made for the seasonal financing of commodities sold on the domestic market, there will be an expansion of the reserve base when the loans are made, as is the case with exports, but a contractionary effect when they are repaid". (p. 9)

The B.A.E. also emphasised the uncertainty which it felt that R.C.D. funding could impart to the money supply:

> "If the size of the R.C.D. loans were known in advance with reasonable certainty, then offsetting monetary policies could be planned and undertaken before the loans are made.... Difficulties arise when the actual requirements by the A.W.B. are very different from the

expected figure; in other words, when there are large forecast errors". (p.11).

Having argued that R.C.D. financing affects the size of the money supply or its rate of growth and/or the time profile of monetary growth, the B.A.E. then suggested that there is no clear consensus as to the consequences of these monetary effects:

> "The proposition that an unanticipated increase in the rate of growth of the volume of money above some target rate is a problem is based on two implicit assumptions. First, it is implicitly assumed that there is some economic cost as a result of departing from the target rate of growth, or of having an unstable volume of money. Secondly, it is implicitly assumed that the monetary authorities cannot offset the monetary expansion in a cost effective way.
>
> The economic costs from an unanticipated increase in the volume of money are by no means clear cut. The consensus among Australian economists ... seems to be that the rate of growth of the volume of money should be broadly in line with the sum of the target growth rates in real G.D.P. and in the general price level less the contribution due to the expected growth in velocity.... Much of the discussion of the costs of departures from money growth targets stems from a lack of resulution at a theoretical level about the influence of expectations and their quantitative importance in the economy". (p.16).

With respect to offsetting actions by the monetary authorities, the B.A.E. noted that:

> "... bond sales, at least in any quantity, could be made only at a lower price, ie. a higher yield. These higher yields would impart upward pressures on the structure of interest rates. There is thus a trade-off between having a more stable volume of money or a more stable interest rate pattern. If a particular interest rate policy is being followed, the scope for controlling the money supply is limited, and vice versa". (p. 24).

It is evident from this passage that the B.A.E. saw pure R.C.D. financing on the one hand, and R.C.D. financing accompanied by off-setting sales of government bonds on the other, as carrying quite different implications for both the growth of the money supply and for interest rates. The B.A.E. also noted that a comparison between pure

R.C.D. financing and commercial funding by the A.W.B. would lead to a similar conclusion, ie. these two alternative methods of financing would carry different implications for the money supply and for interest rates. For example, the B.A.E. argued that:

> "... what can be said is that commercial financing would in all probability result in a smaller addition to the money supply than that resulting from the current R.C.D. financing arrangements because some portion (and possibly the major proportion) would most likely be funded through existing deposits." (p.24).

Further -

> " ... if greater emphasis is to be placed on the stability of the volume of money, then funding of at least part of the A.W.B. requirements on the commercial market would be more likely to achieve this objective at a lower cost.... If greater emphasis is to be placed on the stability of the interest rate structure, then the uncertainty in the seasonal demand for funds would be better met by a corresponding increase in the seasonal supply of money from the R.C.D." (p.24-25).

As a final point on the B.A.E. analysis, it is interesting to note the following comments by the B.A.E.:

> "... an unexpectedly large wheat crop means that growth in real output in the community, that is, real income, is greater than anticipated. Some increase in the volume of money to finance this increase in real activity may therefore be justified." (p.15).

and:

> "... an unexpectedly good or bad harvest represents a change in real output and may warrant some change in the volume of money". (p.28).

While this issue was not expanded upon, there would seem to be an implication that if such 'justified' or 'warranted' changes in the money supply are not brought about through the operations of the R.C.D., or via other domestic monetary policies, then they would not occur at all.

The general view that R.C.D. financing has a direct impact on the money supply is also evident in the relevant submission put to the Campbell Committee by the Treasury (1980). When referring to the role of the R.C.D., the Treasury argued that:

> "What is clear is that the function is not a normal central bank function and can, in fact, run counter to the broad policy objectives of the Reserve Bank's other operations due to the sharp seasonal movements in liquidity and monetary aggregates that can arise from Rural Credits financing." (para.67).

Further:

> "There is... the specific consideration relevant to Rural Credits financing that the provision of funds on a commercial basis would tend to reduce the demand for Rural Credits advances and thereby assist monetary management by reducing the heavy seasonal injections of liquidity from such advances." (para. 70).

In a similar vein, in a study commissioned by the Campbell Committee, and which concentrated on seasonal liquidity issues - see Australian Financial System Inquiry (1982) - it was argued that:

> "... the overall seasonality in the liquidity base is largely attributable to the pattern of the Commonwealth domestic budget outcome but has typically been reinforced by movements in Rural Credits Advances." (p.186, para.10).

Having noted a linkage between R.C.D. advances and the (overall) liquidity base, the study proceeded to argue that:

> "Seasonality in the liquidity base and its components reflects also in seasonal movements in various monetary aggregates and in the price of credit - interest rates". (p.195, para.23).

and again:

> "Seasonal swings in the liquidity base of the financial system carry over to seasonal movements in short term interest rates and to some extent also to the monetary aggregates." (p.197, para.43).

In other words, here again, R.C.D. financing is viewed as having

a direct bearing on the money supply or its rate of growth and on the interest rate.

In general then, if the above analyses are accepted as being indicative of the position adopted in policy circles, and taking into account the observed changes in policy which have occurred in recent years, several points would seem clear:

(1) R.C.D. funding and commercial funding are perceived to have different implications for a range of variables, including the money supply, or its rate of growth or the time profile of its growth, and the interest rate. These divergent implications for the interest rate would, in turn, carry over to variables such as consumption, investment and G.D.P.;

(2) within the context of commercial funding, some significant distinction has been perceived to exist between domestic borrowing and overseas borrowing;

(3) the nature and significance of the distinction between R.C.D. and commercial funding is perceived to depend, at least in part, on whether the commodity in question is traded or non-traded.

These issues are, in turn, of considerable significance for the analysis attempted in the present thesis. In particular, it has been argued that the analyses of the first, third and fourth paradigms, in Chapters III, V and VI respectively, are each of some relevance to the wheat industry in some periods. However, no attempt was made in those analyses to explicitly cater for the presence of an R.C.D. financed advance payment scheme in the wheat industry, or for the shift from R.C.D. finance to commercial finance in recent years.

In the light of the above, the analysis in the present chapter has two main objectives:

(1) to assess to what extent the analyses in those earlier chapters may need to be modified for the case of the wheat industry, once explicit allowance is made for an advance payment scheme financed either through R.C.D. loans, domestic commercial borrowing by the A.W.B., or overseas borrowing by the A.W.B. In particular, we will attempt to identify which variables are most likely to be affected by these alternative forms of finance;

(2) to assess to what extent the position adopted in policy circles, as outlined above, can be supported by the results obtained from the relatively large and consistent macroeconomic framework represented by Model V.

Model V is presented in Section II below. Then, in Section III, the model is used to analyse the seasonal production and sale of a farm commodity in the presence of an advance payment scheme (with various forms of financing), and with perfect international capital mobility. In Section IV, the analysis is extended to the case of imperfectly mobile international capital flows. Section V contains some concluding remarks.

Finally, it should be noted that, unlike the earlier models, balance of payments considerations are explicitly incorporated throughout the analysis with Model V. This reflects the fact that, firstly, explicit balance of payments considerations are crucial to the present analysis and, secondly, that the analysis of the fifth paradigm is largely an extension and a refinement of the analysis of the earlier

paradigms. The latter consideration also permits much of the detailed analysis to be relegated to appendices in the present case.

Section II Model V Notation and Structure

II(1) Notation

The notation used in Model V is identical to that used in earlier models, with the following additions:

W = financial wealth held by domestic residents

B^G = stock of government bonds held by domestic residents

B^P = stock of private bonds held by domestic residents

p_G^B = price of government bonds

p_P^B = price of private bonds

II(2) Model Specification

The specification of Model V is very similar to that of Model III, with the state of the balance of payments endogenously determined, as described in Chapter V. It will be recalled that Model III was used to undertake some analysis of the third paradigm ie the case of an exogenous shock to the volume of farm production in the presence of an effective constraint on the volume of farm exports and buffer stockholding of farm commodities. That same framework, with only slight modifications, lends itself readily to an analysis of the fifth paradigm.

Farm Sector

(1) $O_F = O_F\ (\overset{+}{K}_F,\ \overset{+}{L}_F\ ,\ \overset{+}{J},\ \overset{+}{\alpha}_F)$

(2) $L_F = L_F\left(\frac{\delta\ \overset{+}{O}_F}{\delta\ L_F}\ ,\ \frac{\overset{+}{p}_F}{p_{NT}}\ ,\ \frac{\overset{+}{p}_F}{p_{NFT}}\ ,\ \overset{-}{n}\ ,\ \overset{?}{v}\right)$

(3) $Y_F = O_F - J$

(4) $Y_F^F = \beta Y_F$

(5) $Y_F = Y_F^F + Y_F^{NF}$

(6) $C_P^F = C_P^F(\overset{+}{Y}_F^F,\ \overset{-}{r}\ )$

(7) $R = Y_F^F - C_P^F$

(8) $I_P^F = I_P^F\ (\overset{+}{R},\ \overset{-}{r})$

The eight variables which are treated as endogenous to the farm sector are:

(1) O_F (2) L_F (3) Y_F (4) Y_F^F (5) Y_F^{NF} (6) C_P^F (7) R

(8) I_P^F

The variables incorporated into the farm sector of the model which are exogenous to the model as a whole are:

(1) K_F (2) J (3) α_F (4) p_F (5) p_{NFT} (6) p_{NT} (7) v

In addition, the interest rate, r, is exogenous to the farm sector of the model but endogenous to the non-farm sector.

Non-Farm Sector and Macroeconomic Aggregates

(9) $Y = Y_{NT} + Y_{NFT} + Y_F$

(10) $Y_{NFT} = Y_{NFT}(K_{NFT}^{+}, L_{NFT}^{+}, \alpha_{NFT}^{+})$

(11) $L_{NFT} = L_{NFT}\left(\frac{\delta Y_{NFT}^{+}}{\delta L_{NFT}}, \frac{p_{NFT}^{+}}{p_{NT}}, \frac{p_{NFT}^{+}}{p_F}, \bar{n}, \overset{?}{v}\right)$

(12) $Y_{NT} = Y_{NT}(K_{NT}^{+}, L_{NT}^{+}, \alpha_{NT}^{+})$

(13) $L_{NT} = \begin{cases} L_{NT}^{*}\left(\frac{\delta Y_{NT}^{+}}{\delta L_{NT}}, \frac{p_{NT}^{+}}{p_{NFT}}, \frac{p_{NT}^{+}}{p_F}, \bar{n}, \overset{?}{v}\right) \text{ for } Z_{NT} = Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) \\ L_{NT}^{D}(K_{NT}^{-}, \alpha_{NT}^{-}, Z_{NT}^{+}) \text{ for } Z_{NT} \neq Y_{NT}(K_{NT}, L_{NT}^{*}, \alpha_{NT}) \end{cases}$

(14) $C_p^{NF} = C_p^{NF}(Y_{NT}^{+}, Y_F^{+\,NF}, Y_{NFT}^{+}, \bar{r})$

(15) $C_p = C_p^{F} + C_p^{NF}$

(16) $I_p^{NF} = I_p^{NF}(\Delta Y_{NT}^{+}, \bar{r}) + I_p^{FS}$

(17) $I_p = I_p^{F} + I_p^{NF}$

(18) $Z = C_p + C_G + I_p + I_G$

(19) $Z_{NFT} = Z_{NFT}\left(Z - I_p^{+FS}, \frac{p_{NFT}^{-}}{p_{NT}}, \frac{p_{NFT}^{-}}{p_F}, \overset{?}{\varepsilon}\right)$

(20) $Z_{NT} = Z_{NT-J}\left(Z - I_p^{+FS}, \frac{p_{NT}^{-}}{p_{NFT}}, \frac{p_{NT}^{-}}{p_F}, \overset{?}{\varepsilon}\right) + J$

(21) $Z_F = Z - Z_{NFT} - (Z_{NT} - J)$

(22) $Z_F = O_F - \bar{O}_F$

(23) $n = \dfrac{w}{a\ p_{NT} + b\ p_{NFT} + c\ p_F}$

(24) $L = L_{NFT} + L_{NT} + L_F$

(25) $L^S = \bar{L}$

(26) $E = L$

(27) $m^d = m^d\ (\overset{+}{Y} \text{ or } \overset{+}{Z},\ \overset{-}{r},\ \overset{+}{W})$

(28) $m^d = m^s$

(29) $W = p_P^B . B^P + p_G^B . B^G + m^s$

ie. wealth, W, is defined as the sum of the value of private and government bonds held by domestic residents, and the nominal money stock.

(30) $\dot{m}^s = \dot{d} + BP$

(31) $k = k\ (\overset{+}{r},\ \overset{-}{r^w},\ \overset{+}{\dot{e}^E},\ \overset{?}{\dot{\mu}})$

(32) $BP = p_{NFT}\ Y_{NFT} + p_F\ \bar{O}_F - p_{NFT}\ Z_{NFT} + k$

Hence, the only differences in the algebraic specification of Models V and III are that: (1) wealth, W, is included as an argument in the demand for money function in Model V (equation 27); and (2) wealth is defined by the identity, equation (29), in Model V.

The variables which are treated as endogenous to the non-farm sector of the model are:

(1)Y (2)Y_{NFT} (3)Y_{NT} (4)L_{NFT} (5)L_{NT} (6)C_p^{NF} (7)C_p
(8)I_p^{NF} (9)I_p (10)Z (11)Z_{NFT} (12)Z_{NT} (13)Z_F
(14)I_p^{NF} (15)n (16)L (17)L^S (18)E (19)m^d (20)r (21)W
(22)m^s (23)k (24)BP

The variables which are exogenous to the non-farm sector of the model but are endogenous to the farm sector are:

(1)Y_F (2)Y_F^{NF} (3)C_p^F (4)I_p^F (5)L_F

The variables which appear in the non-farm sector of the model and which are exogenous to the model as a whole are:

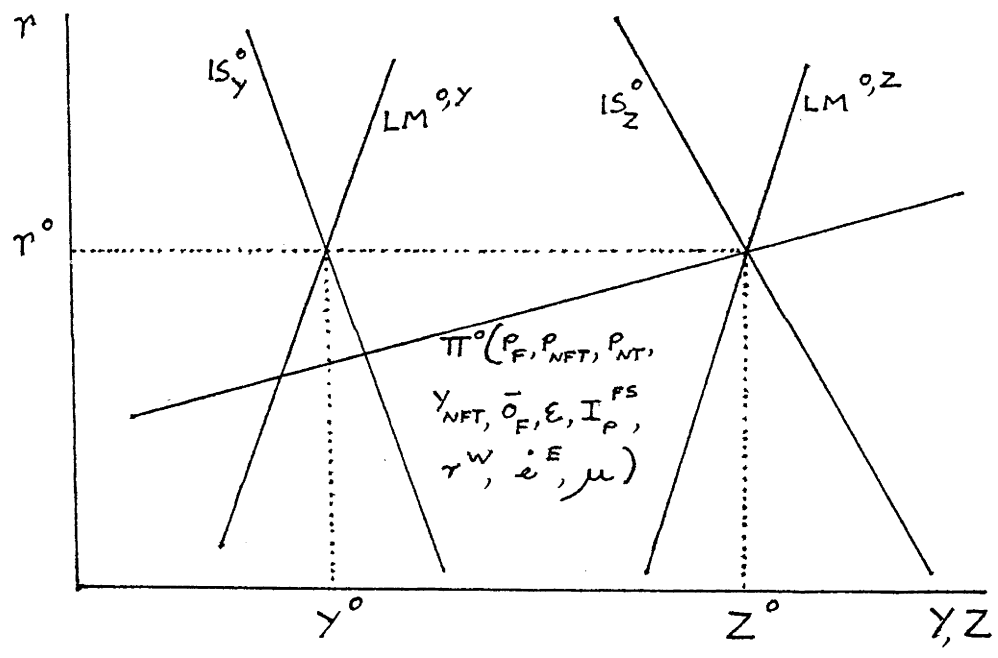
(1)K_{NFT} (2)α_{NFT} (3)p_{NT} (4)p_{NFT} (5)p_F (6)v (7)w
(8)K_{NT} (9)α_{NT} (10)C_G (11)I_G (12)ε (13)J (14)$\bar{L}$
(15)$\bar{O}_F$ (16)r^W (17)$\dot{e}^E$ (18)μ (19)$\dot{d}$ (20)B^P (21)B^G
(22)p_p^B (23)p_G^B

II(3) Geometric Characterisation of Model V

The geometric characterisation of Model V is identical to that of Model III, as set out at length in Chapter V. For convenience, Sectors I, II and III of this geometric construct are set out again briefly below.

FIG. VII(1)

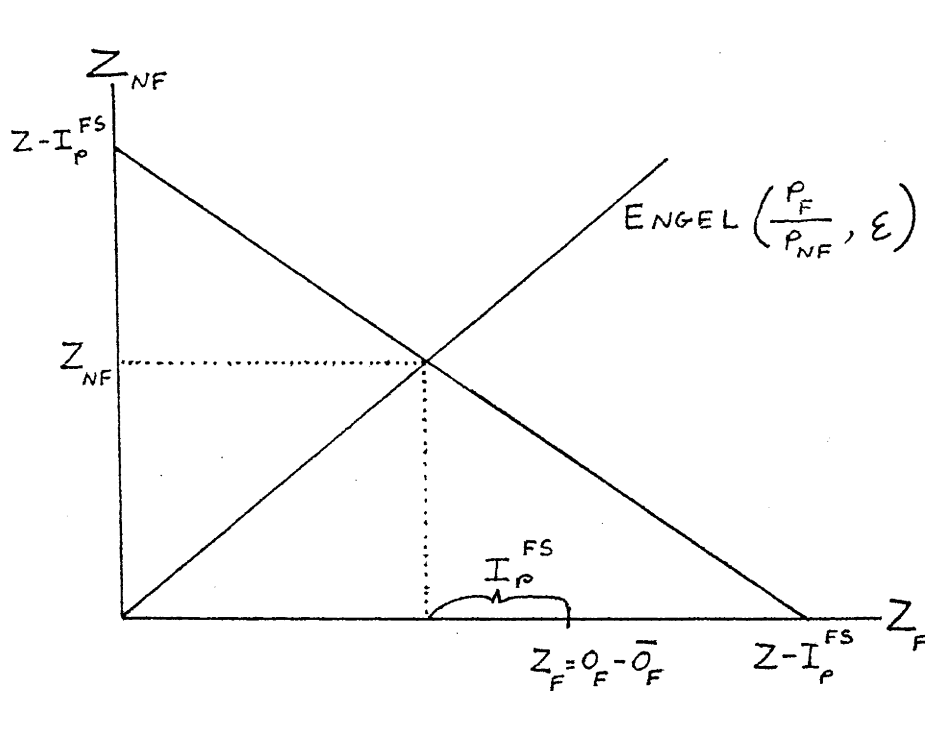
SECTOR I



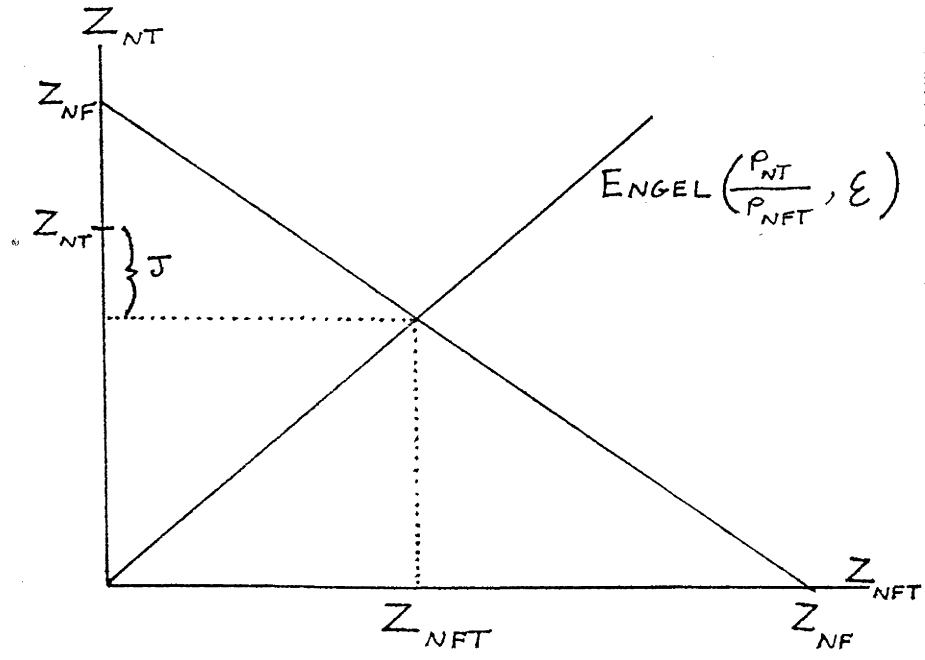
In Fig VII(1), in the presence of imperfectly mobile capital flows, the TT schedule is positively sloped. As argued in Chapter V, any given TT schedule, in the present model framework, is drawn on the assumption of given values for the variables p_F, p_{NFT}, p_{NT}, Y_{NFT}, $\bar{O}_F$, ε, I_p^{FS}, r^W, $\dot{e}^E$ and μ. Of course, in the case of perfect capital mobility, the TT schedule is horizontal at the world interest rate, r^W.

FIG. VII(2)

SECTOR II(1)



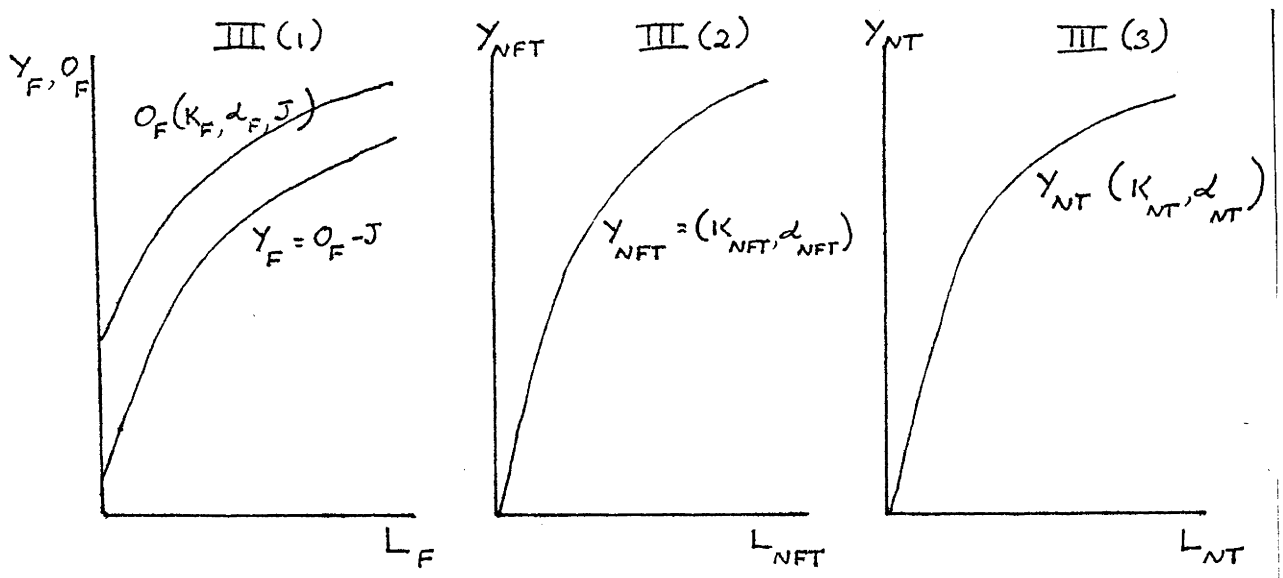
SECTOR II(2)



In Sector II(1), aggregate expenditure, net of investment in farm inventories, I_P^{FS}, is separated into its farm and non-farm components, with I_P^{FS} then being added directly to 'voluntary' expenditure on farm commodities in order to obtain aggregate expenditure on farm commodities, Z_F. In Sector II(2), Z_{NF} is separated into its non-traded and non-farm traded components. As usual, J is added directly onto the non-traded component of Z_{NF} in order to obtain total demand for non-traded goods.

FIG. VII(3)

SECTOR III



Given K_F, α_F and J, the gross volume of farm production is a function of farm employment, L_F. Farm value added, Y_F, is obtained by subtracting non-primary inputs, J, from the gross volume of farm production. Similarly, given K_{NFT} and α_{NFT}, Y_{NFT} can be represented as a function of L_{NFT}, while Y_{NT} can be represented as a function of L_{NT}.

As was also the case in Model III, Sector IV (the labour market sector) will not be explicitly considered in the analysis with Model V. In Section II(3) of Chapter V, the broad developments which would be expected to be occurring in Sector IV of Model III were described, and that discussion largely carries over to the present analysis.

Section III - Some Analysis of the Fifth Paradigm with Perfectly Mobile International Capital Flows

III(1) Assumptions

In Section III, some analysis of the issues raised by the fifth paradigm will be presented, based on the following assumptions:

(1) international capital flows are perfectly mobile ie. the TT schedule in Sector I of the model is horizontal at the level of the world interest rate;

(2) the production and sale of the relevant farm commodities are assumed to occur in two separate, conveniently defined stages within a given season:[1]

- stage 1, which could be interpreted as the harvest season. In this stage, output of the relevant farm commodity comes on stream and producers receive an advance payment which (for simplicity) is assumed to be equal to the value of output. It is also assumed that export sales proceed at a constant rate during both stage 1 and stage 2, those export sales being incorporated into $\bar{O}_F$. However, as stage 1 is likely

---

1 As the two stages are not assumed to be of equal duration, the flow variables must, of course, be normalised to a common unit of time in each stage.

For some recent examples of macroeconomic analyses within the context of models not dissimilar to Model V, and in which it also proved convenient to define several separate stages or periods, see Fane (1981a, 1981b) and Sieper and Fane (1981).

to be of only a relatively short duration, the actual volume of sales on the export and domestic markets during stage 1 is assumed to be negligible relative to the size of the harvest. Therefore, the build up in stocks during stage 1 is assumed to be (at least approximately) equal to the size of the harvest;

- stage 2, in turn, could be interpreted as the remainder of the season (ie. the non-harvest period). Output of the relevant farm commodity falls to zero, while sales of that commodity on the export and domestic markets are sufficient to allow a run down of stocks relative to their level in stage 1. Of course, as well as playing a buffering role between stage 1 and stage 2 of a given season, stocks may also play a buffering role between seasons. In other words, at the end of stage 2, the level of stocks could remain above, or have fallen below, their level at the start of stage 1, just prior to the harvest. This buffering role between seasons, of course, was the focus of attention in the analysis of the third paradigm, in the context of Model III, in Chapter V;

(3) it is assumed that the level of consumption and investment expenditure originating from farm households, and consumption expenditure originating from non-farm households in receipt of Y_F^{NF}, are the same in both stage 1 and

stage 2. In other words, the 'lumpy' nature of income receipts within a given season are ignored by the relevant economic agents in making their expenditure decisions. Of course, changes in the level of income between seasons would, in general, be expected to cause some change in the level of consumption and investment expenditure between seasons, as has been assumed in earlier paradigms;

(4) in the analysis, no distinction is drawn between R.C.D. funding immediately offset by sales of government bonds on the one hand, and sales of bonds by the A.W.B. on the domestic market. In both cases, there is no change in the domestic credit component of the money supply, and both policies will thus be referred to as domestic commercial financing. This, of course, ignores the fact that, in reality, government bonds and bonds issued by the A.W.B. may not be regarded by investors as being identical, so that there may be some requirement for a yield discount or premium.

III(2) Analysis

STAGE I

A. An Exportable Commodity

The detailed analysis of this case is presented in Appendix I.

The main implications of that analysis might be summarised as follows:

(1) in stage 1, variables such as the money supply (or its rate of growth), the interest rate, the volume of production and the volume of expenditure are identical under the three alternative forms of financing the advance payment (ie. R.C.D. financing, domestic commercial financing and overseas commercial financing);

(2) the main variable likely to be affected by the choice of financing arrangements would be the state of the balance of payments. In particular, during a period of adjustment to a new balance of payments equilibrium, the state of the balance of payments would tend to be relatively weaker under R.C.D. financing than under either domestic commercial financing or overseas commercial financing, the latter two having an identical impact on the balance of payments.

B. The Case of a Non-Traded Commodity.

In the analysis presented in A above, it was assumed that, in stage 1, sales of the farm commodity on both the export and domestic markets were negligible relative to the size of the harvest. Therefore, the entire harvest needed to be drawn into stocks. It is clear that, in that sense, that analysis would apply equally to either an exportable farm commodity and a non-traded farm commodity - in either case, the farm output comes on stream and is drawn entirely into stocks. In other words, at least in stage 1, the

implications of the alternative forms of financing the advance payment does not hinge crucially on whether the commodity in question is exportable or non-traded.

C. The Case of an Above Average Harvest

The preceding analysis was based on the assumption that the size of the harvest in stage 1 was equal to that of the previous season. This was consistent with the assumption that, with given prices, Y_F and hence Y_F^F and Y_F^{NF} were unchanged relative to the previous season, so that the level of consumption and investment expenditure originating from farm households and consumption expenditure by non-farm households in receipt of Y_F^{NF}, would also be unchanged relative to the previous season.

It is obviously also of interest to briefly consider the case of a harvest which differs substantially to that of the previous season. For example, in the introductory section, it was noted that a major stimulus to the move towards commercial funding of the 1978-79 wheat harvest was the recognition that that harvest was likely to be of a record size.

The detailed analysis of this case is presented in Appendix II. The main results are that:

(1) the advent of a larger harvest in the current stage 1 than in the preceding stage 1 makes it inevitable that the money supply would grow more significantly in the current stage 1. This is true regardless of the method of financing the advance payment to wheat growers. In other words, it would not be prevented by switching from R.C.D. funding to commercial funding;

(2) as before, the method of funding is significant for the state of the balance of payments during the adjustment to the new Keynesian and balance of payments equilibrium in stage 1. In particular, the balance of payments would tend to be relatively weaker under R.C.D. funding than under commercial funding.

D. The Case of a Non-Zero Wealth Elasticity of Demand for Nominal Money Balances.

Unlike the earlier versions of the model, in Model V wealth is explicitly included as an argument in the demand for money function (equation (27)). However, the analysis undertaken to date with Model V has been based on an implicit assumption that the wealth elasticity of demand for nominal money balances is zero. It is interesting to now briefly consider the case where that assumption is relaxed ie. where the wealth elasticity of demand for nominal money balances is positive.

The analysis is presented in Appendix III. In general, in the presence of a positive wealth elasticity of demand for money balances:

(1) the size of the equilibrium money stock and hence the size of any balance of payments deficits or surpluses during stage 1 are likely to be different to those which would occur in the presence of a zero wealth elasticity of demand for money balances;

(2) it remains true that, as in A, B and C above, the method of funding the advance payment is irrelevant for variables such as real output, real expenditure, the interest rate and the money supply, but relevant for the state of the balance of payments during the adjustment to a new balance of payments equilibrium.

STAGE II

A. An exportable Commodity

In Appendix IV, it is demonstrated that:

(1) the method of financing the advance payment in stage 1, and hence the nature of the repayment process during stage 2, is irrelevant for variables such as Y, Z, r and m^s. This result, of course, is identical to that established in stage 1;

(2) the method of financing the advance payment in stage 1 is relevant for the state of the balance of payments during the adjustment to a balance of payments equilibrium in stage 2. In particular, the balance of payments is relatively stronger under R.C.D. financing than under commercial financing, reversing the outcome in stage 1.

B. The Case of a Non-Traded Commodity

From the analysis presented in Appendix V, it follows that:

(1) in the case of a non-traded farm commodity, the method of financing the advance payment in stage 1, and hence the nature of the repayment process in stage 2, is irrelevant for variables such as Y, Z, r and m^s, but relevant for the state of the balance of payments during the adjustment to a balance of payments equilibrium in stage 2. This conclusion is qualitatively identical to that reached in A above for the exportable case;

(2) further, provided that Y is the scale argument in the demand for money function[2], the outcome for the state of the balance of payments in stage 2 is identical in both the exportable and non-traded goods case;

(3) while the overall state of the balance of payments in stage 2 is identical for both the exportable case and the non-traded goods case, that conclusion would not necessarily carry over to the current and capital accounts of the balance of payments.

C. The Case of an Above Average Harvest

From the analysis in Appendix VI, it is clear that the larger harvest in the present season:

(1) causes the money stock, in both stage 1 and stage 2, to be larger than otherwise; and

(2) the larger money stock in both stages is not 'caused' by the use of R.C.D. funding of the advance payment, nor is it preventable by a switch from R.C.D. funding to commercial funding. Further

---

2 If the IS_Y curves, IS_Y^0, and IS_Y^1, in Fig. VII(8) were assumed to be common to both the exportable and the non-traded good case in stage 2, then it is clear that the IS_Z curves, IS_Z^0 and IS_Z^1, could not be. More of any given level of Z must be directed onto farm commodities in the present case where the relevant farm commodity is assumed to be non-traded. Hence, expenditure on non-farm commodities would be correspondingly less, which would not be consistent with an equilibrium in the non-traded goods sector.

(3) variables such as Y, Z, and r, in addition to m^s, are determined independently of the method of funding the advance payment. However, the size of any transitory balance of payments deficit or surplus during stage 2 is not independent of the method of funding the advance payment.

D. The Case of a Non-Zero Wealth Elasticity of Demand for Nominal Money Balances

In general, the main significance of the positive wealth elasticity of demand for money in stage 2 is for the values taken by the variables m^s and BP, relative to the values taken by those variables in analyses in which it was assumed that the wealth elasticity of demand for money was zero - see Appendix VII. The major conclusion that the variables Y, Z, r and m^s are independent of the method of financing the advance payment to wheat growers, while BP is not, remains intact. These conclusions, of course, parallel those obtained in the corresponding analysis of stage 1.

III(3) Concluding Comments on the Analysis with Perfectly Mobile International Capital Flows

The main conclusions reached in the analysis with perfectly mobile international capital flows were that, in both stage 1 and stage 2 of a given season:

(1) the important variables Y, Z, r and m^s are determined independently of the method of financing the advance payment;

(2) the main variable affected by the choice of the method of financing the advance payment is the state of the balance of payments during the period of adjustment to a new balance of payments equilibrium:

- in particular, the implications of R.C.D. funding for the balance of payments differ to those of domestic and overseas commercial funding (the balance of payments implications of the latter two being identical);

- there is a strong presumption that, in stage 1, the period of adjustment to a new balance of payments equilibrium would be associated with a relatively weaker balance of payments under R.C.D. funding than under commercial funding, with the converse outcome likely to hold in stage 2;

(3) conclusions (1) and (2) hold regardless of whether the farm commodity in question is traded or non-traded. However, for a given level of production of the farm commodity:

- the distinction between a traded and a non-traded commodity is likely to be of some significance for the current and capital account components of the balance of payments;

- the actual size of any temporary balance of payments deficit or surplus, particularly in stage 2, may be influenced by the distinction between a traded and non-traded commodity if Z is the scale argument in the demand for money function;

(4) conclusions (1) and (2) also hold in the presence of a harvest in the current season which is larger than that of the previous season and which, in consequence, induces a rise in consumption and investment expenditure relative to that of the previous season. The actual values taken by variables such as m^s and BP, of course, are not independent of the advent of the larger crop size;

(5) similarly, conclusions (1) and (2) hold regardless of whether the wealth elasticity of demand for money balances is zero or positive although, again, the actual values taken by variables such as m^s and BP are not independent of the size of that wealth elasticity.

Section IV Some Analysis of the Fifth Paradigm with Imperfectly Mobile International Capital Flows

IV(1) The TT Schedule

The assumptions used in the analysis in Section IV are identical to those set out in Section III(1), except, of course, that in the present case it is assumed that international capital flows are imperfectly mobile ie. that the TT schedule is positively sloped.

As noted in the introductory section, Model V is very similar to Model III. From our analysis of Model III (see particularly Section III(2) of Chapter V) we know that:

(1) any given TT schedule is drawn on the assumption of given values for the variables p_F, p_{NFT}, p_{NT}, Y_{NFT}, $\bar{O}_F$, ε, I_p^{FS}, r^W, $\dot{e}^E$ and μ;

(2) a change in I_p^{FS}, which results directly from the need to absorb a change in the level of O_F at given prices and in the presence of a given level of $\bar{O}_F$, would leave the term $Z-I_p^{FS}$ unchanged, and hence have no effect on the current account. We saw that such a development needed to be reflected in an appropriate horizontal movement of the TT schedule. In Chapter V, this concept was used in the context of variations in farm output between seasons, but is also readily applicable in the present context of variations in farm output between stage 1 and stage 2 of a given season.

IV(2) Analysis

A. The Case of an Exportable Commodity

It is clear, from the analysis presented in Appendix VIII, that the change from an assumption of perfectly mobile international capital flows to one of imperfect mobility does not necessarily invalidate the main conclusions reached under perfect capital mobility. In particular, it remains possible that the levels of Y, Z, r and m^S in stage 1 are determined largely independently of the method of financing the advance payment, with the main variable affected by the method of financing being the state of the balance of payments. In other words, the crucial issue is not the existence of imperfect capital mobility. Rather, the crucial issue is the degree of capital mobility (and hence the magnitude of any balance of payments deficits or surpluses) relative to the magnitude of the change in the equilibrium money stock (some of the literature in this area was reviewed in Chapter III).

B. The Case of a Non-Traded Commodity

With the slight modification noted in Appendix IX, the analysis of the present case follows along similar lines to that presented in A above and leads to an identical set of conclusions.

C. The Case of an Above Average Harvest

From Appendix X, the analysis of the above average harvest might be summarised as follows:

(1) the advent of the larger harvest would, in general, influence the size of the equilibrium money stock and the equilibrium level of the interest rate in stage 1 and stage 2;

(2) the issue of whether or not the extra farm output is reflected in a rise in $\bar{O}_F$ is also relevant for the determination of the equilibrium levels of the money stock and the interest rate;

(3) as was the case in the presence of perfectly mobile international capital flows, it is possible that the method used to finance the advance payment on the larger crop is largely irrelevant for variables other than the state of the balance of payments. However;

(4) it is also possible that the method used to finance the advance payment is, in fact, of some relevance for the actual values taken by the variables m^s, r, Y, Z and BP.

D. The Case of a Non-Zero Wealth Elasticity of Demand for Nominal Money Balances

From the analysis presented in Appendix XI, it follows that:

(1) the assumption of a positive wealth elasticity of demand for money carries implications for the size of the equilibrium money stock in each stage;

(2) it remains true that, if the equilibrium money stock is approximately established in each stage, then the method of financing the advance payment would be largely irrelevant for all variables other than BP;

(3) conversely, if a significant divergence exists between the actual and the equilibrium money stock in each stage, then the method of financing the advance payment could be of some relevance not only for BP, but also for m^S, r, Y and Z.

IV(3) Concluding Comments on the Analysis with Imperfectly Mobile International Capital Flows

In the present section, the various analyses which were undertaken in Section III, in the presence of perfect international capital mobility, were repeated under the assumption of imperfect international capital mobility:

- the main conclusion reached was that the assumption of imperfect capital mobility does not <u>necessarily</u> invalidate some of the more important qualitative conclusions reached under perfect capital mobility;

  . in particular, it remains possible that variables such as m^S, r, Y and Z are determined largely independently of the method of financing the advance payment, with the main variable affected by the method of financing being BP;

- however, the possibility is also raised that m^S, r, Y, Z and BP could, in fact, all be influenced, at least to some extent, by the method of financing;

- the central empirical issue which discriminates between these two possible sets of outcomes is not the existence of imperfect capital mobility per se, but rather the <u>degree of any such immobility relative to the size of the change in the equilibrium money stock in stage 1 and stage 2</u>.

Section V Concluding Comments on Chapter VII

In Chapter VII, various aspects of the fifth paradigm have been examined, using the Model V framework. The fifth paradigm focusses on the macroeconomic implications of advance payment schemes which have operated in some farm industries (most notably the wheat industry), and the significance or otherwise of changes in the method of financing those schemes.

In the light of existing analyses and commentary on the supposed macroeconomic implications of advance payment schemes, as outlined in Section I, it was considered useful to examine several cases: (a) the case where the farm commodity in question was exportable; (b) the case where the farm commodity was non-traded; and (c) the case of an above average harvest. In addition, several alternative assumptions were made with respect to the wealth elasticity of demand for money balances, in recognition of the fact that variations in the level of farm output within a given season tends to be reflected in variations in the stock of wealth within a season. The analysis was conducted, firstly, in the presence of perfectly mobile international capital flows, and subsequently in the presence of a degree of capital immobility.

In the presence of perfect capital mobility, it was concluded that:

(1) the money supply, the interest rate, aggregate production and aggregate expenditure are determined independently of the method of financing the advance payment;

(2) the main macroeconomic variable to be significantly affected by the choice of the method of financing the advance payment is the state of the balance of payments; and

(3) these results hold regardless of whether the relevant farm commodity is exportable or non-traded, and regardless of whether output of the farm commodity in a given season is comparable to, or larger than, that of previous seasons.

These results, in the presence of perfect capital mobility, carry several important implications:

(a) the earlier analyses of the first, third and fourth paradigms, (each of which were argued to be of at least some relevance for the wheat industry in some periods), were unlikely to have been seriously in error as a result of the neglect of the existence of an advance payment scheme for wheat, and the change which has occurred in recent years in the method of financing that advance payment. The main exception to this, if any, would be in some of the conclusions reached with respect to the state of the balance of payments;

(b) in attempting to quantify the impact of output and price fluctuations in the farm sector on G.D.P. (such as is attempted in Chapter IX), it may be permissible to abstract from the presence of an advance payment scheme in the

wheat industry. Such an abstraction would be much less permissible if the macroeconomic variable of concern was the state of the balance of payments;

(c) the commentary, in official circles, that the method of financing the advance payment influences the money supply, its rate of growth, (or the time profile of monetary growth), and the interest rate, receives little support from the analysis;

(d) the suggestion that R.C.D. funding of the record 1978-79 wheat crop would have caused an increase in the rate of growth of the money supply, and that this was at least partly avoided by the switch to partial commercial funding in that year, is not supported by the analysis;

(e) the initial restriction on overseas borrowing by the A.W.B. and the more recent relaxation of that restriction, would be largely irrelevant for the determination of all macroeconomic variables, including the state of the balance of payments;

(f) the suggestion that the implications of the various methods of funding the advance payment hinge importantly on whether the relevant farm commodity is exportable or non-traded, is not supported by the analysis.

In the presence of imperfectly mobile international capital flows:

(1) it is possible that the results obtained under perfect capital mobility, and the associated implications, as outlined above, would continue to hold, at least approximately. Hence, the citing of a degree of capital immobility is not sufficient, in itself, to substantially negate those conclusions;

(2) it is also possible, however, that, in addition to the state of the balance of payments, variables such as the money supply, the interest rate, aggregate production and aggregate expenditure could be significantly affected by the method of financing the advance payment;

(3) the central empirical issue raised is the degree of capital immobility relative to the size of the change in the equilibrium money stock in stage 1 and stage 2 of a given season.

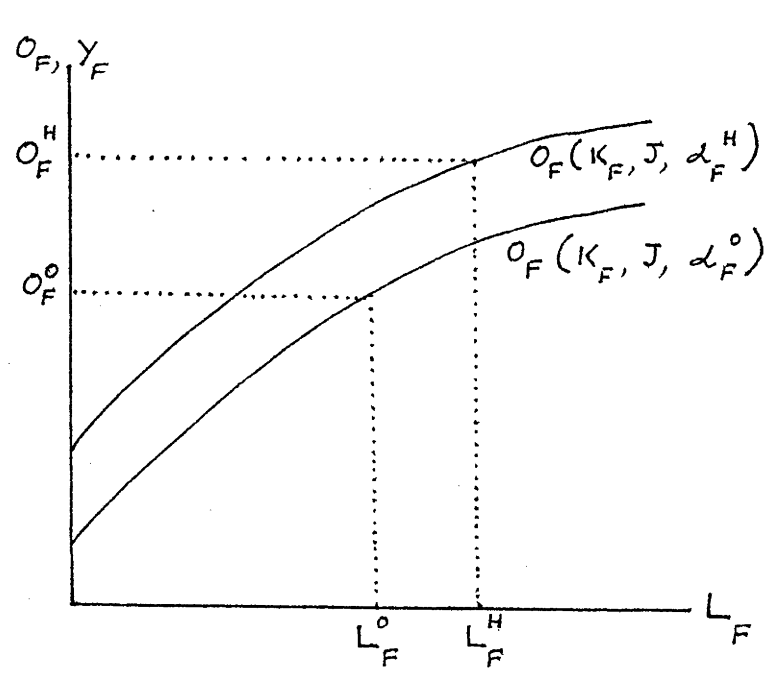
Finally, there are various interesting extensions to the analysis which could be taken up as part of a future research exercise. For example, little attention has so far been directed to the case where aggregate expenditure is the scale argument in the demand for money function. Also, it could be postulated that the demand for money was influenced by seasonally adjusted, rather than the actual, changes in income or expenditure, and the analysis repeated accordingly.

Appendix I

The analysis can commence in Sector III(1) of the model.

FIG. VII(4)

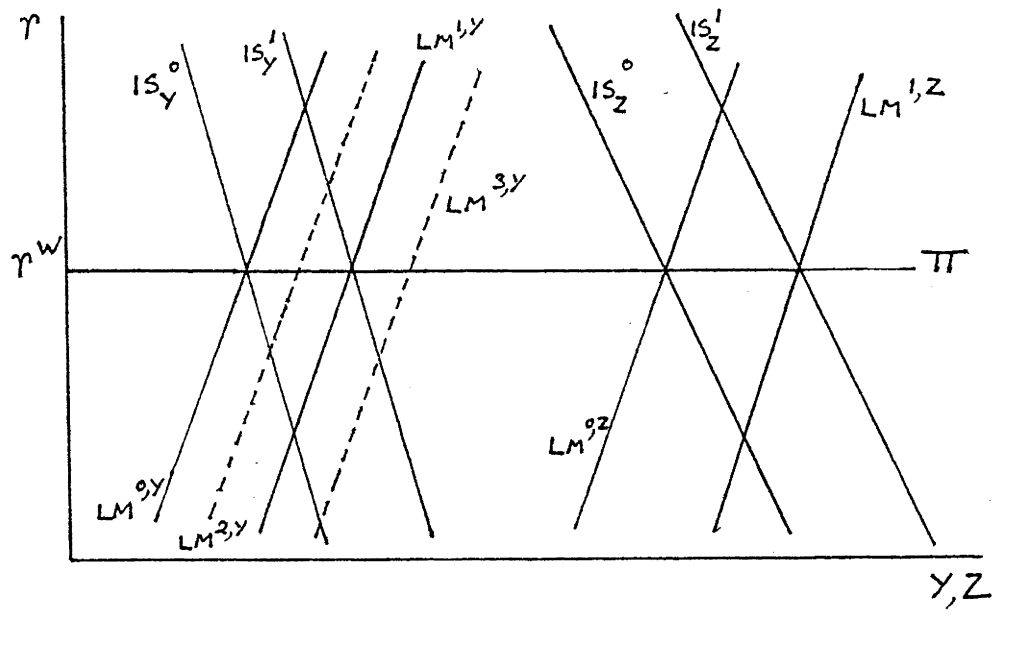
SECTOR III(1)



In Sector III(1), the farm sector production function in the preceding stage 2 is represented by O_F (K_F, J, α_F^o). Given the real wage (in Sector IV), farm employment is thus L_F^o, with gross farm output being O_F^o. Suppose that the seasonality of wheat production is incorporated into the 'technology' variable, α_F, so that, in the present stage 1, it rises from α_F^o to α_F^H. The resulting increase in the marginal productivity of labour in the farm sector during stage 1 causes farm employment to rise from L_F^o to L_F^H at the ruling real wage, and gross farm output rises from its non-harvest level of O_F^o to its harvest level of O_F^H.

FIG. VII(5)

SECTOR I



In Sector I, at the start of stage 1, just prior to the coming on stream of the wheat harvest, the IS curves are represented by IS_Y^o and IS_Z^o. If Y is the scale argument in the demand for money function, then the LM curve $LM^{o,Y}$ would be consistent with an initial balance of payments equilibrium. Alternatively, if Z is the scale argument, then $LM^{o,Z}$ would be consistent with an initial equilibrium.

As the wheat harvest comes on stream, the IS_Y curve moves to the right from IS_Y^o to IS_Y^1 ie. Y_F increases. As, by assumption, the entire harvest is drawn into stocks in stage 1, the IS_Z curve also moves to the right, from IS_Z^o to IS_Z^1, reflecting the increase in the I_P^{FS} component of aggregate expenditure.

Assuming that IS_Y^o and IS_Z^o were consistent with a Keynesian equilibrium in the non-traded goods sector, it is clear that the rightward movement of the IS curves to IS_Y^1 and

IS_Z^1 would not disturb that Keynesian equilibrium. (In other words, the rightward movement in the IS_Y curve simply reflects the wheat harvest, and the rightward movement of IS_Z reflects the drawing of the wheat harvest into stocks). It is also assumed that the size of the harvest is identical to that of the previous season, so that (with given prices), Y_F^F and Y_F^{NF} are unchanged relative to the previous season. Therefore, there is no change in consumption and investment expenditure by farm households, or in consumption expenditure by non farm households in receipt of Y_F^{NF}, relative to the levels of the previous season, as implicit in IS_Z^1.

Suppose that the advance payment made to wheat growers in stage 1 was financed by an advance from the R.C.D. ie, by an increase in the domestic credit component of the money supply. Suppose, also, that the scale argument in the demand for money function was Y, and that the increase in the domestic credit component of the money supply was sufficient, in itself, to shift the LM curve from $LM^{o,Y}$ to $LM^{2,Y}$ in Fig VII(5). It is immediate that, given IS_Y^1, $LM^{2,Y}$ is not consistent with a balance of payments equilibrium. Rather, in the absence of any additional increases in the domestic credit component of the money supply, balance of payments surpluses would occur until the money supply had been increased sufficiently to shift LM from $LM^{2,Y}$ to $LM^{1,Y}$. Alternatively, if the R.C.D. advance had been sufficient, in itself, to shift the LM curve from $LM^{0,Y}$ to some position of the right of $LM^{1,Y}$ - such as, for example, $LM^{3,Y}$ - then balance of payments deficits would occur until the money supply had been reduced sufficiently to shift the LM curve from $LM^{3,Y}$ back to $LM^{1,Y}$.

Now suppose that the advance payment had been financed by domestic commercial borrowing (as defined in Section III(1)). In this case, by definition, the domestic credit component of the money supply is unchanged and hence there is no tendency, <u>from that source</u>, for the LM curve to move from $LM^{0,Y}$. However, given IS^{1}_{Y}, it is clear that $LM^{0,Y}$ is not consistent with balance of payments equilibrium. Rather, balance of payments surpluses would occur until the money supply had been increased sufficiently to shift the LM curve to the right from $LM^{0,Y}$ to $LM^{1,Y}$.

As the final alternative, suppose that the advance payment to wheat growers had been financed by commercial borrowing on overseas capital markets. Starting from a situation of balance of payments equilibrium, overseas borrowing by the A.W.B. would, <u>with other factors unchanged</u>, raise capital inflow, k, and hence produce a balance of payments surplus. The resulting increase in the money supply would push LM to the right from $LM^{0,Y}$. Suppose that this rightward movement of LM from $LM^{0,Y}$ carried the LM curve to (say) $LM^{2,Y}$. It is immediate that further balance of payments surpluses would occur until the money supply had been increased sufficiently to push LM from $LM^{2,Y}$ to $LM^{1,Y}$. Alternatively, had the balance of payments surplus on account of overseas borrowing by the A.W.B. been sufficient, in itself, to push LM from $LM^{0,Y}$ to some position to the right of $LM^{1,Y}$ - for example, $LM^{3,Y}$ - then balance of payments deficits would occur until the money supply had been reduced to a level consistent with $LM^{1,Y}$. In other words, in either case, a net surplus in the overall balance of payments would occur, sufficient to increase the nominal money stock from the level

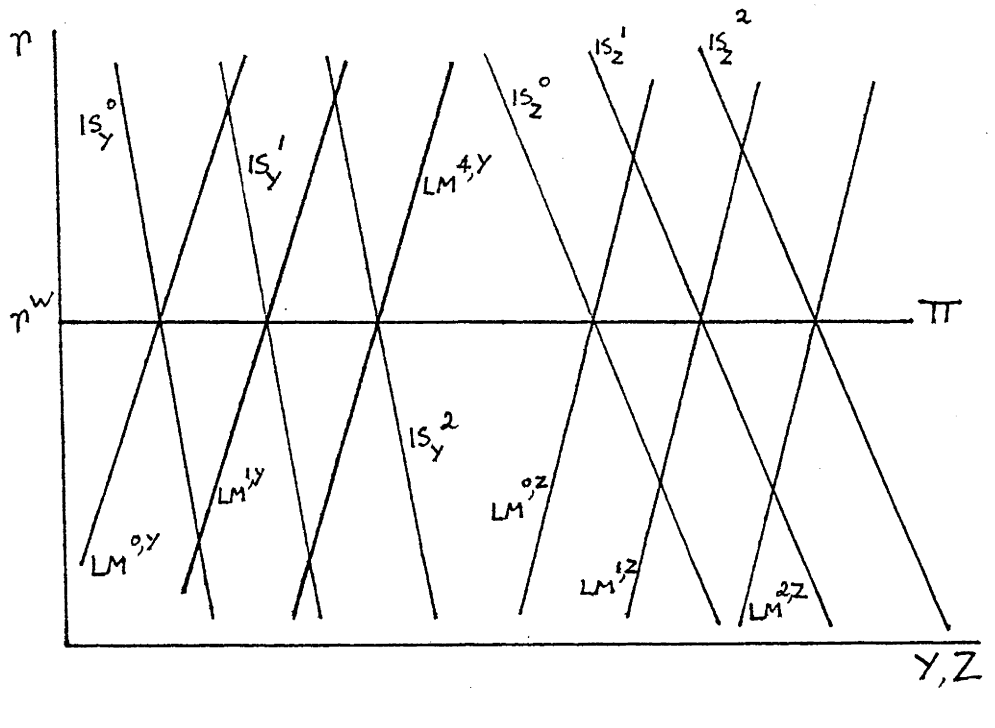
associated with $LM^{0,Y}$ to that associated with $LM^{1,Y}$. This outcome, of course, is identical to that outlined above for the case of domestic commercial borrowing by the A.W.B.

Finally, the above analysis was based on the assumption that Y was the scale argument in the demand for money function. An analogous line of argument could be mounted for the case where Z is the scale argument. Of course, the absolute magnitudes of, for example, the equilibrium money stock and balance of payments surplus would, in general, be different to those noted above for Y as the scale argument.

Appendix II

FIG. VII(6)

SECTOR I



In Fig VII(6), let the initial positions of the IS curves be represented by IS_Y^0 and IS_Z^0. Suppose that, in the presence of a harvest, in stage 1, of equal size to that of the previous season, the IS curves move to the right, to IS_Y^1 and IS_Z^1 (as assumed in A and B above). Then, with a larger crop, and hence a larger build up in stocks in stage 1, it is clear that the IS curves would move further to the right from IS_Y^1 and IS_Z^1. Also, to the extent that the larger crop stimulates a rise in consumption and investment expenditure relative to the levels which ruled in the previous season, that would also contribute to the rightward movement of the IS curves. Suppose, for simplicity, that sufficient time is available in stage 1 for the multiplier effects

of this rise in expenditure to work through, and that, when a new Keynesian equilibrium is established in the non-traded goods sector, the IS curves are given by IS_Y^2 and IS_Z^2.

It is immediate that, for balance of payments equilibrium to be re-established in stage 1, the money supply must increase sufficiently to shift the LM curve from $LM^{0,Y}$ to $LM^{4,Y}$ (or, in the case where Z is the scale argument, from $LM^{0,Z}$ to $LM^{2,Z}$). In either case, this represents a larger increase in the money supply than in A or B above.

With R.C.D. funding of the advance payment, the domestic credit component of the money supply would increase which, with other factors unchanged, would push the LM curve to the right from $LM^{0,Y}$. With a larger crop size and hence a larger advance payment, this increase in the domestic credit component of the money supply would be larger than that of the previous season. As before, however, if the increase in the money supply attributable to the R.C.D. advance leaves the money supply below its equilibrium level (ie. if the LM curve remains in some position to the left of $LM^{4,Y}$) then balance of payments surpluses would occur until $LM^{4,Y}$ had been reached. Alternatively, had the R.C.D. advance been sufficient to carry LM to some position to the right of $LM^{4,Y}$, then balance of payments deficits would occur until LM had been shifted to the left, to $LM^{4,Y}$.

In the presence of domestic commercial funding, the domestic credit component of the money supply is unaffected by the advance payment. Therefore, the movement in LM from $LM^{0,Y}$ to $LM^{4,Y}$ would be brought about entirely by balance of payments surpluses.

It is immediate that these surpluses would be larger than those required in A and B above (because $LM^{4,Y}$ lies to the right of $LM^{1,Y}$), and also larger than the surplus which would occur (if any) in the presence of R.C.D. funding in the present case.

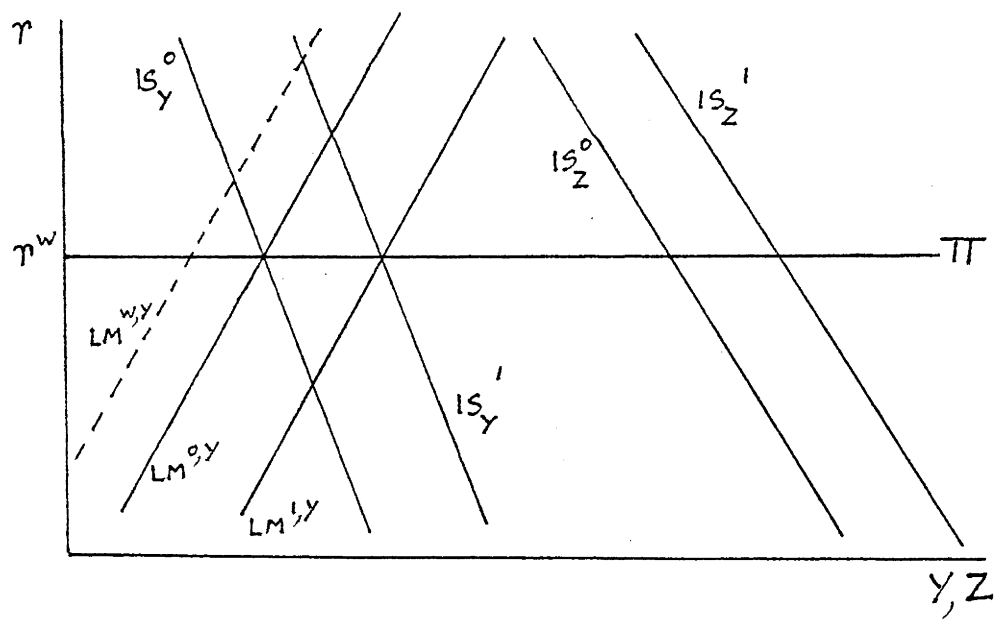
An analogous line of argument to that presented in A above could also be used to demonstrate that the implications of domestic and overseas commercial financing are identical for the money supply and the state of the balance of payments.

Appendix III

It is clear that, as farm output and incomes rise in stage 1 relative to the preceding stage 2, while consumption expenditure by farm households remains unchanged (by assumption), there is an increase in wealth relative to the preceding stage 2. If the wealth elasticity of demand for money balances is positive then, with other factors unchanged, the rise in wealth in stage 1 would, itself, result in some increase in the demand for money balances.

FIG. VII(7)

SECTOR I



In Fig. VII(7), IS_Y^0, IS_Y^1, IS_Z^0, IS_Z^1, $LM^{0,Y}$, $LM^{1,Y}$ and TT are as described in the context of A, B and C above. Suppose that, given the level of nominal money balances associated with $LM^{0,Y}$, the increase in wealth and hence in the demand for money in stage 1 had the effect of shifting LM to the

left from $LM^{0,Y}$ to $LM^{W,Y}$. It is immediate that, given IS^{1}_{Y}, LM must then shift to the right from $LM^{W,Y}$ to $LM^{1,Y}$ in order for balance of payments equilibrium to be re-established in stage 1. It is also clear that this would require a larger increase in the nominal money stock than did the rightward movement of LM from $LM^{0,Y}$ to $LM^{1,Y}$ as was required in A and B above.

As before, R.C.D. funding would increase the domestic credit component of the money supply which, with other factors unchanged, would push LM to the right from $LM^{W,Y}$. Suppose that, in the analysis outlined in A and B above, where wealth considerations were ignored, the rightward movement of LM from $LM^{0,Y}$ had left LM somewhere to the left of $LM^{1,Y}$, so that temporary balance of payments surpluses were required in order to produce the remaining movement of LM to $LM^{1,Y}$. It is clear that, in the present case, starting from $LM^{W,Y}$ rather than $LM^{0,Y}$, R.C.D. funding would leave a larger gap to be covered by temporary balance of payments surpluses ie. in the presence of a positive wealth elasticity of demand for money, the balance of payments surplus would be larger in D than in A or B above.

Alternatively, suppose that in A or B above, R.C.D. funding had, in itself, pushed LM to the right of $LM^{1,Y}$ so that temporary balance of payments deficits had been required to establish $LM^{1,Y}$. Following a similar line of reasoning, it is clear that, in the present case, with a positive wealth elasticity of demand for money, the extent of that balance of payments deficit would be reduced, or perhaps eliminated.

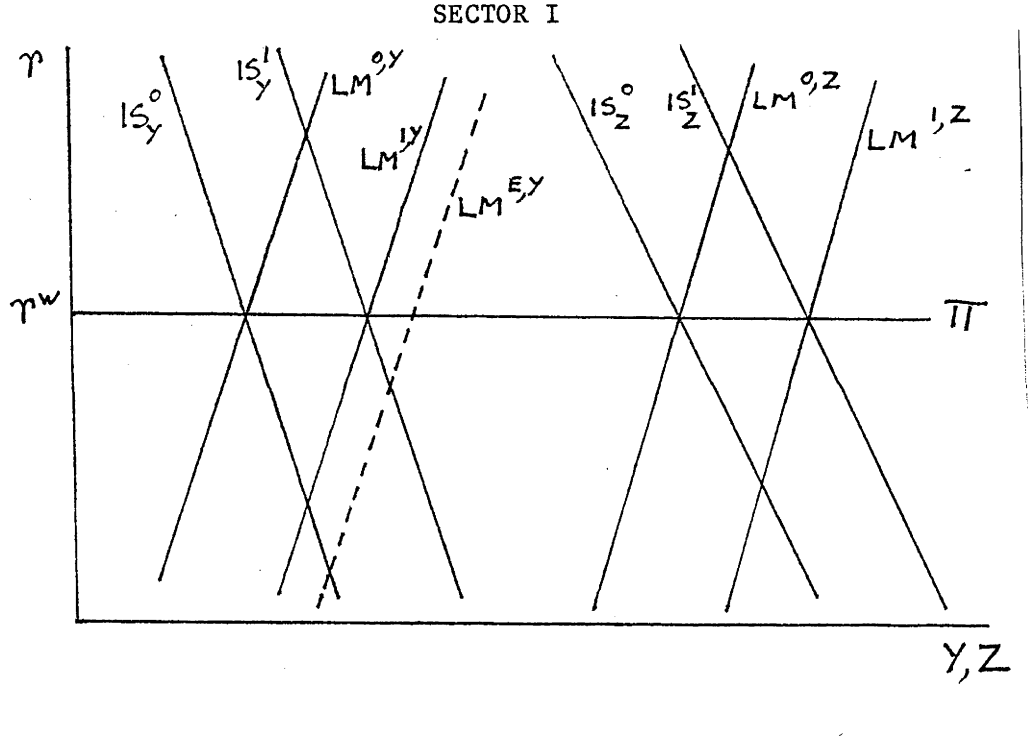
Now suppose that commercial funding had been used to finance the advance payment. As commercial funding has no impact on the domestic credit component of the money supply, it is clear that balance of payments surpluses would be required in order to shift LM to the right from $LM^{W,Y}$ to $LM^{1,Y}$. It is also clear that this surplus would be larger than that which would be required to shift LM from $LM^{0,Y}$ to $LM^{1,Y}$ as in A and B above.

Appendix IV

In stage 2, α_F in Fig. VII(4) returns to its non-harvest level of α_F^0. In consequence, the gross volume of farm production falls back to O_F^0, and farm employment falls from L_F^H to L_F^0 at the given level of the real wage.

FIG. VII(8)

SECTOR I



In Fig. VII(8), IS_Y^0, IS_Y^1, IS_Z^0, IS_Z^1, $LM^{0,Y}$, $LM^{1,Y}$, $LM^{0,Z}$, $LM^{1,Z}$ and TT are each as described in the context of Fig. VII(5). It is immediate that the fall in farm output in stage 2, relative to the preceding stage 1, would be reflected in a leftward movement of the IS_Y curve from its position in stage 1, IS_Y^1, back to its non-harvest position of IS_Y^0. Similarly, IS_Z would move to the left from IS_Z^1 as the ongoing sales of farm output on the export and domestic markets

result in a decumulation of stocks during stage 2, relative to their level in the preceding stage 1. It will be assumed, for simplicity, that these export and domestic sales during stage 2 are exactly sufficient to absorb the entire wheat harvest in the preceding stage 1, so that IS_Z returns to IS_Z^0 ie. there is no build up or run down of wheat stocks between seasons.

By assumption, sales of wheat on the export market were negligible in stage 1, but become significant during stage 2. It is clear that, with all other components of the current account and capital account of the balance of payments given, such export sales would result in an increase in the money supply. Suppose that Y is the scale argument in the demand for money function, and that this increase in the money stock on account of export sales of wheat pushed the LM curve to the right from $LM^{1,Y}$ to $LM^{E,Y}$. It is immediate that, even given IS_Y^1, such a money stock would not be consistent with balance of payments equilibrium. Rather, net capital inflow, k, would be reduced sufficiently to offset the impact of the wheat export sales on the overall balance of payments, hence preventing this rightward movement of LM from $LM^{1,Y}$.

It is also clear that, given IS_Y^0, the LM curve $LM^{1,Y}$ is not consistent with balance of payments equilibrium during stage 2. Rather, the LM curve would need to return to $LM^{0,Y}$ in order for balance of payments equilibrium to be re-established in stage 2. Suppose that the advance payment to wheat growers in stage 1 had been financed by an advance from the R.C.D., so that the domestic credit component of the money supply was increased in stage 1. The repayment of the advance in stage 2 would reduce the domestic credit component of the money supply, pushing the LM curve to the left from

$LM^{1,Y}$. If this decline in the domestic credit component of the money supply was sufficient to shift LM to some position to the left of $LM^{0,Y}$, then balance of payments surpluses would occur until LM was set at $LM^{0,Y}$. Conversely, if the decline in the domestic credit component of the money supply left the LM curve in some position between $LM^{0,Y}$ and $LM^{1,Y}$, then balance of payments deficits would occur until $LM^{0,Y}$ had been established.

Now suppose that the advance payment to growers in stage 1 had been financed by commercial borrowing. In this case, the repayment of those borrowings in stage 2 would, of course, leave the domestic credit component of the money supply unaffected. Therefore, the entire burden of shifting LM to the left from $LM^{1,Y}$ to $LM^{0,Y}$ would fall onto balance of payments deficits. In other words, during the period of adjustment to a balance of payments equilibrium in stage 2, the balance of payments is relatively weaker under commercial funding than under R.C.D. funding, which is the converse of the corresponding result in stage 1.

Finally, of course, a similar line of argument could be adopted for the case where the scale argument in the demand for money function is Z.

Appendix V

In A above, it was argued that, with other factors unchanged, the commencement of significant exports of the relevant farm commodity in stage 2 would product a balance of payments surplus, pushing LM to the right from $LM^{1,Y}$ to $LM^{E,Y}$ in Fig. VII(8). However, it was also noted that, even given $IS^{1,Y}$, $LM^{E,Y}$ would not be consistent with balance of payments equilibrium. Rather, net capital inflow would fall sufficiently to offset the farm export receipts, so that the overall balance of payments is unaffected, and hence LM would remain at $LM^{1,Y}$.

Now suppose that Fig. VII(8) had been drawn for a non-traded, rather than an exportable, farm commodity. As exports of the farm commodity remain at zero in stage 2 in this case, then, with other factors unchanged, there would be no tendency for the LM curve to move to the right from $LM^{1,Y}$, and hence no requirement for an offsetting fall in net capital inflow.

It remains true, however, that, as in A above, $LM^{1,Y}$ is not consistent with balance of payments equilibrium in stage 2, given the leftward movement of IS_Y from IS_Y^1 to IS_Y^0 in stage 2. Rather, in order for balance of payments equilibrium to be re-established in stage 2, LM must move to the left from $LM^{1,Y}$ to $LM^{0,Y}$. Following a line of argument analogous to that in A above, it is immediate that:

(a) if R.C.D. funding had been used in stage 1, then the repayment in stage 2 would reduce the domestic credit component of the money supply, shifting LM to the left from $LM^{1,Y}$. If this

leftward movement was sufficient to carry LM to the left of $LM^{0,Y}$, then balance of payments surpluses would occur until $LM^{0,Y}$ had been established. Conversely, had the decline in the domestic credit component of the money supply left LM in some position between $LM^{1,Y}$ and $LM^{0,Y}$, then balance of payments deficits would occur until $LM^{0,Y}$ had been established;

(b) if commercial funding had been used in stage 1, then the repayment of these borrowings in stage 2 would leave the domestic credit component of the money supply unaffected. Therefore, the entire burden of shifting LM to the left from $LM^{1,Y}$ to $LM^{0,Y}$ would fall on balance of payments deficits.

Appendix VI

The implications of this case, in stage 2, can be readily seen in the context of Fig. VII(6), which was originally used to present the corresponding case in stage 1. It will be recalled that IS_Y^2 is the position of the IS_Y curve in stage 1 in the presence of a crop larger in size than that of the previous season, with IS_Y^1 the position the IS_Y curve would have taken in the presence of a crop of the same size as the previous season. It was argued that the greater rightward movement of IS_Y in the presence of the larger crop reflected not only the larger volume of farm production, but also the multiplier effects in the non-traded goods sector following the rise in consumption and investment expenditure induced by the rise in Y_F. Similarly, it was argued that IS_Z^2 would lie to the right of IS_Z^1 because of the larger build up of farm stocks in the present case, and also because of the rise in consumption and investment expenditure induced by the rise in Y_F.

In stage 2, IS_Y moves to the left from IS_Y^2 as farm output returns to its non-harvest level, and IS_Z moves to the left from IS_Z^2 as farm stocks, which were accumulated in stage 1, are run down. It will be recalled that, by assumption, the higher level of consumption and investment expenditure, induced by the rise in Y_F in the present season, is evident in both stage 1 and stage 2. Therefore, IS_Y would remain in some position to the right of IS_Y^0, and to the left of IS_Y^2.

It is immediate that, given the leftward movement of IS_Y from IS_Y^2, the LM curve $LM^{4,Y}$ is not consistent with the maintenance of balance of payments equilibrium in stage 2. Rather, the LM curve

would need to move to the left from $LM^{4,Y}$. However, as IS_Y would remain in some position to the right of IS_Y^0, the equilibrium LM curve would also lie to the right of $LM^{0,Y}$. In other words, just as the equilibrium money stock in stage 1 is larger in the presence of the larger crop size (ie. $LM^{4,Y}$ lies to the right of $LM^{1,Y}$), so too is the money stock in stage 2. Following the now familiar line of argument, that money stock would be established by some combination of changes in the domestic credit component of the money supply (if any) and balance of payments deficits or surpluses, depending on the method of financing the advance payment in stage 1, and hence the nature of the repayment process in stage 2.

Finally, a similar analysis could, of course, be undertaken for the case where Z is the scale argument in the demand for money function. However, there is an additional complication in this case. In particular, as well as playing a buffering role between stage 1 and stage 2 of a given season, stocks of farm commodities may also play a buffering role between seasons (as examined in the context of Model III). For example, if the rundown in farm stocks during stage 2 is less than the build up of stocks in stage 1, then that would represent an additional factor holding IS_Z to the right of IS_Z^0 in stage 2. Conversely, if the run down in stocks in stage 2 is greater than the build up of stocks in stage 1, then IS_Z may return to, or even more to the left of IS_Z^0 in stage 2.

Appendix VII

In the corresponding case in stage 1, it was argued that the seasonal rise in farm production, coupled with the assumption of an unchanged flow of consumption expenditure, implied a rise (or a faster rate of increase) in wealth relative to the preceding stage 2. It was also argued that, if the wealth elasticity of demand for money was positive, then the demand for nominal balances in stage 1 would be relatively greater than implied by the earlier analyses in which it has been assumed that the wealth elasticity of demand for nominal balances was zero. It was concluded that it remained true that variables such as Y,Z,r and m^S were independent of the method of financing the advance payment to wheat growers, and that the state of the balance of payments was not independent of that method of financing. It was also concluded that m^S and the state of the balance of payments, in the presence of a positive wealth elasticity of demand for money balances, would, in general, be different to their values in the presence of a zero wealth elasticity of demand for money.

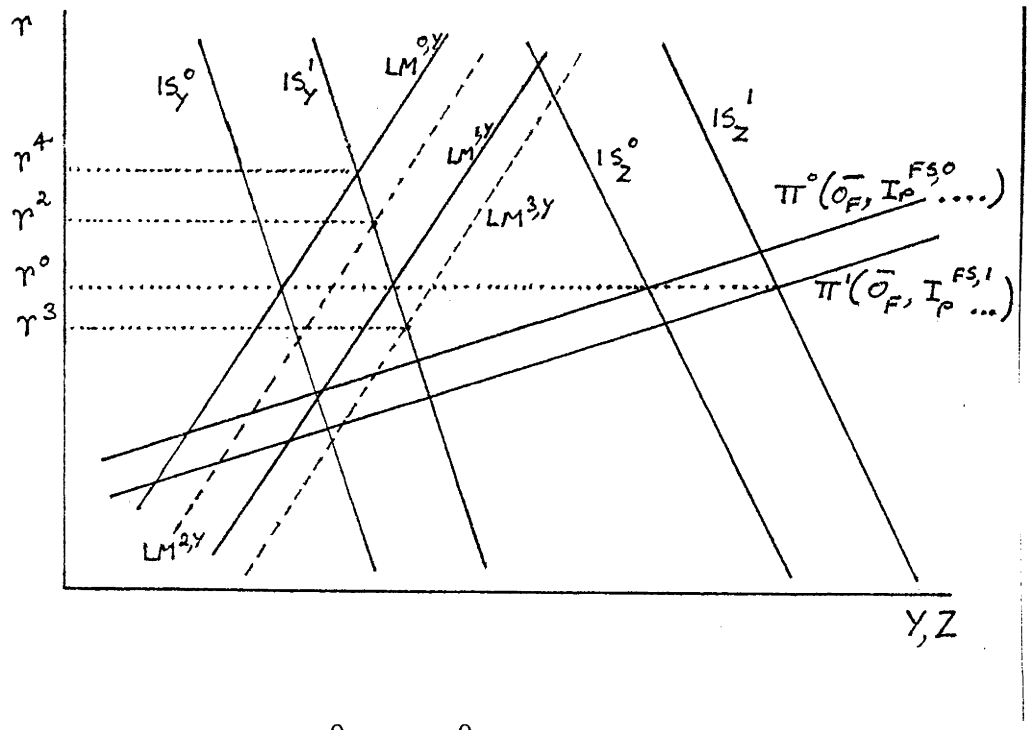
In stage 2, the fall in farm output to its non-harvest level, coupled with an unchanged flow of consumption expenditure, implies a fall in wealth relative to stage 1 (or a slower rate of increase). In Fig. VII(7), the wealth induced fall in the demand for money balances, given the level of nominal balances implied by $LM^{1,Y}$, would push LM to the right from $LM^{1,Y}$. However, even given IS^1_Y, such a rightward movement of the LM curve would not be consistent with balance of payments equilibrium. Rather, balance of payments deficits would occur until the money supply had been reduced

sufficiently to return LM to $LM^{1,Y}$. Then, of course, the leftward movement of IS_Y from IS_Y^1 to IS_Y^0 during stage 2 would also require a leftward movement of LM from $LM^{1,Y}$ to $LM^{0,Y}$ in order for balance of payments equilibrium to be re-established in stage 2. Following the familiar line of argument, that leftward movement of LM would be brought about by some combination of a decline in the domestic credit component of the money supply (if any), and balance of payments deficits or surpluses, depending on the method of financing the advance payment which had been used in stage 1.

Appendix VIII

FIG. VII(9)

SECTOR I



In Fig. VII(9), IS_Y^0 and IS_Z^0 represent the positions of the IS curves at the start of stage 1 in the current season. As output of the relevant farm commodity comes on stream during stage 1, and is drawn entirely into stocks, the IS curves move to the right, to IS_Y^1 and IS_Z^1, as described at length above. It is assumed that the harvest is of comparable size to that of the previous season, so that there is no change in the level of consumption and investment expenditure by farm households, or in consumption expenditure by non-farm households in receipt of Y_F^{NF}, relative to the levels of the previous season ie. there is no tendency for a further movement in the IS curves from IS_Y^1 and IS_Z^1.

Suppose that the volume of exports of farm commodities, including the commodity in question, during the previous season had been $\bar{O}_F$. Also suppose that the flow of farm exports during stage 1 and stage 2 of the current season is consistent with a volume of farm exports, $\bar{O}_F$, again being achieved in the current season. Then, if the position of the TT schedule in stage 2 of the preceding season is represented by TT^o, it follows that the position of TT in stage 1 of the current season must be TT^1. The horizontal distance between TT^o and TT^1 is equal to the horizontal distance between IS_Z^0 and IS_Z^1, reflecting the fact that the rise in aggregate expenditure in stage 1, associated with the drawing of farm output into stocks, does not imply any deterioration in the current account, and hence does not require an increase in the rate of net capital inflow.

If Y is the scale argument in the demand for money function, it is clear that the maintenance of balance of payments equilibrium in stage 1 would require a rightward movement of LM from $LM^{0,Y}$ to $LM^{1,Y}$. If R.C.D. funding of the advance payment had been used, then the resulting increase in the domestic credit component of the money supply would, itself, push LM to the right from $LM^{0,Y}$. Suppose that this rightward movement carried LM to $LM^{2,Y}$ in Fig. VII(9). Given IS_Y^1, the interest rate required to clear the money market, given $LM^{2,Y}$, would be $r^2 > r^0$. It is immediate that such an interest rate would produce a balance of payments surplus, pushing LM further to the right from $LM^{2,Y}$ and so on. It is largely an empirical question whether $LM^{1,Y}$ would be approximately reached within stage 1 - depending on the size of the balance of payments surpluses (engendered by a level of r in excess of r^0) relative to the required increase in the money supply.

Alternatively, suppose that the increase in the domestic credit component of the money supply had been sufficient to shift LM to the right from $LM^{0,Y}$ to $LM^{3,Y}$. Given $LM^{3,Y}$, the interest rate required to clear the money market would be $r^3 < r^0$. The resulting balance of payments deficits would shift LM to the left from $LM^{3,Y}$ and towards $LM^{1,Y}$. Again, it is an empirical question whether $LM^{1,Y}$ would be approximately established within stage 1.

Now suppose that the advance payment had been financed by domestic commercial borrowing. In this case, the domestic credit component of the money supply is unchanged. Given IS^1_Y and $LM^{0,Y}$ the interest rate required to clear the money market would be $r^4 > r^0$. The resulting balance of payments surpluses would shift LM to the right from $LM^{0,Y}$, but it remains an empirical question whether that rightward movement would be sufficient to approximately establish $LM^{1,Y}$ in stage 1.

It is also interesting the consider the case of overseas commercial financing of the advance payment. In particular, suppose that in the current season, overseas borrowing was permitted for the <u>first time</u>. Such a restriction on net capital inflow, and its subsequent relaxation, would be captured in the vector μ ie. the vector of arguments influencing the rate of net capital inflow other than r, r^W and $\dot{e}^E$. The relaxation of the restriction on overseas borrowing to finance the advance payment would in general, be expected to shift the TT schedule downwards and to reduce its slope, as net capital inflow becomes more responsive to interest rate differentials. The extent of the impact on the slope and position of the TT curve is an empirical question. In general, however:

(a) if the impact on the TT schedule was significant, and if, prior to the relaxation of the restriction on overseas borrowing to finance the advance payment, the movement towards an equilibrium money stock had been relatively slow, then the admission of overseas borrowing could produce a significantly different outcome for r (and hence Y and Z) and m^s in stage 1; Conversely

(b) if the impact on the TT schedule was negligible, and if the equilibrium money stock had been established rapidly in stage 1 even in the absence of such overseas borrowing, then the admission of overseas borrowings would be of litle consequence for Y, Z, r and m^s.

The analysis of the reverse adjustments which occur during stage 2 parallels that presented above, and leads to a comparable set of conclusions. Hence, it will not be presented in detail.

Appendix IX

Suppose that Fig.VII(9) represented the case of a non-traded, rather than an exportable, agricultural commodity. Also assume that $\bar{O}_F$ is again common to both stage 1 and stage 2 of the current season, and equivalent to its level in the previous season. In the present case, of course, the contribution made to $\bar{O}_F$ by the farm commodity in question would be constant at zero, rather than constant at some positive level, as in A above, (with a corresponding increase in the contribution to $\bar{O}_F$ made by the remaining farm commodities).

The analysis of the present case then follows along identical lines to that presented in A above, and leads to an identical set of conclusions.

Appendix X

We will now revert to the assumption that the farm commodity in question is exportable, and consider the case of a harvest in the current season which is larger in size than that of the previous season. It will be assumed, in the first instance, that the larger harvest is not reflected in an increase in $\bar{O}_F$ relative to its level in the previous season. In other words, that assumption implies that there is some constraint on the volume of exports of the relevant farm commodity, so that the additional output in the current season must be absorbed via a rise in the average level of stocks relative to the previous season. This, of course, is the central assumption underlying the third paradigm, as analysed in Chapter V.

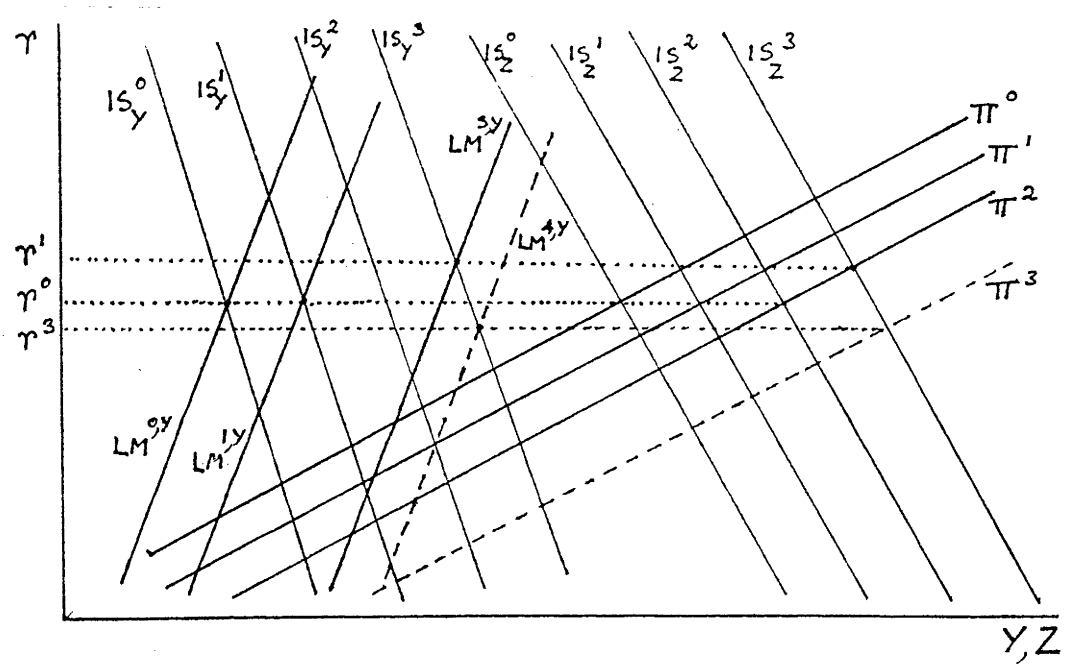
Subsequently, we will consider the case where no such export constraint exists. In other words, the advent of the larger harvest in the current season is reflected in an increase in the volume of farm exports, $\bar{O}_F$, so that all of the additional output of the relevant farm commodity is absorbed via exports by the end of stage 2. Such an assumption is identical, in spirit, to that adopted in the first paradigm, as analysed in Chapter III.

In Fig. VII(10), let the positions of the curves at the start of stage 1, just prior to the harvest, be represented, as usual, by IS_Y^0, IS_Z^0, TT^0 and $LM^{0,Y}$. In the presence of a crop equal in size to that of the previous season, the IS and TT curves move to IS_Y^1, IS_Z^1 and TT^1, as in A above. Suppose that the additional output of the relevant farm commodity in the current stage 1 is reflected in an additional movement of IS_Y from

IS_Y^1 to IS_Y^2. The drawing of this additional farm output into stocks during stage 1 is also reflected in an additional rightward movement of the IS_Z curve from IS_Z^1 to IS_Z^2. Similarly, the TT curve must move further to the right, from TT^1 to TT^2 to reflect the fact that, with $\bar{O}_F$ given, the additional expenditure on farm inventories does not imply any deterioriation in the current account ie. IS_Z^2 and TT^2 must intersect at the same level of the interest rate - r^0 - as the intersection between IS_Z^1 and TT^1. The rise in Y_F in the current season would induce an increase in consumption and investment expenditure by farm households, and by non-farm households in receipt of Y_F^{NF}. This

FIG. VII(10)

SECTOR I



increase in expenditure would push IS_Z further to the right from IS_Z^2, and the resulting increase in the demand for, and hence production of, non-traded goods would shift IS_Y to the right from IS_Y^2. It will be assumed, for simplicity, that sufficient time is available in stage 1 for a new Keynesian equilibrium to be established in the non-traded goods sector, and that, in that new equilibrium, the IS curves are represented by IS_Y^3 and IS_Z^3.

It is immediate that, in order for balance of payments equilibrium to be re-established in stage 1, the money supply must increase sufficiently to shift the LM curve to the right from $LM^{0,Y}$ to $LM^{3,Y}$. It is also clear that this increase in the equilibrium money stock is larger than that which was required in A above, in the presence of a harvest equal in size to that of the previous season ie. $LM^{3,Y}$ lies to the right of $LM^{1,Y}$.

Suppose that R.C.D. funding of the advance payment is used in stage 1. The resulting increase in the domestic credit component of the money supply would shift the LM curve to the right from $LM^{0,Y}$. If this movement left LM in some position to the left of $LM^{3,Y}$ then, given IS_Y^3, there would be upward pressure on the interest rate relative to r^1, creating a balance of payments surplus. This surplus would, in turn, push LM further to the right towards $LM^{3,Y}$. As the rate of net capital inflow remains finite across a range of differentials between the domestic and the world interest rate, it is an empirical question whether the surplus would be sufficiently large to ensure that $LM^{3,Y}$ was approximately established within stage 1. Conversely, if the increase in the domestic credit component of the money supply had been sufficient to push LM from $LM^{0,Y}$ to some position to the right of $LM^{3,Y}$ then,

given IS^3_Y, there would be downward pressure on the interest rate relative to r^1, and hence a balance of payments deficit. This balance of payments deficit would shift the LM curve back to the left, toward $LM^{3,Y}$. Again, it is an empirical issue whether the deficit would be of sufficient size to ensure that $LM^{3,Y}$ was approximately established during stage 1.

If domestic commercial borrowing had been used to finance the advance payment then the domestic credit component of the money supply would be unchanged. The entire burden of shifting the LM curve to the right from $LM^{0,Y}$ towards $LM^{3,Y}$ would fall on balance of payments surpluses. Again, with finite capital flows, $LM^{3,Y}$ may or may not be approximately established during stage 1. If $LM^{3,Y}$ was approximately established during stage 1 under both domestic commercial funding and R.C.D. funding, then these two alternative forms of funding would carry approximately identical implications for m^s, r and hence Y and Z, with the main variable affected being the state of the balance of payments. Conversely, if $LM^{3,Y}$ was not approximately established during stage 1 under one or other form of financing then it is clear that, in general, the <u>actual</u> level of m^s (and hence r, Y and Z) <u>may</u> be significantly influenced by the choice between R.C.D. and domestic commercial funding.

In the analysis in A above, some attention was devoted to the case of overseas commercial funding of the advance payment. In particular, it was supposed that overseas commercial funding was permitted for the first time during the current season. The conclusions reached in that earlier analysis carry over to the present case of an above average harvest, and hence will not be repeated in detail.

In stage 2, farm output returns to its non-harvest level, which is reflected, as usual, in a leftward movement of IS_Y from IS_Y^3. Similarly, investment expenditure on inventories of the relevant farm commodity declines from its abnormally high level in stage 1 to a negative level in stage 2 as stocks are run down. Note that the level of this negative inventory investment in stage 2 is equivalent to that of the previous season because, by assumption, the volume of farm exports, $\bar{O}_F$, is identical to that of the previous season. The decline in I_P^{FS} in stage 2 is, of course, matched by a leftward movement of TT from TT^2 to TT^0.

While IS_Y would move to the left from IS_Y^3 in stage 2, and IS_Z would move to the left from IS_Z^3, the IS curves would remain in some position to the right of IS_Y^0 and IS_Z^0 respectively. This is the case because, by assumption, the induced increase in expenditure which emerged in stage 1 of the current season, and the associated multiplier effects in the non-traded goods sector, remain present in stage 2. It follows that, in general, the equilibrium position of the LM curve in stage 2 would lie in some position between $LM^{3,Y}$ and $LM^{0,Y}$. Following the familiar line of argument, it is possible that this equilibrium LM curve would be approximately established within stage 2, by some combination of a decline in the domestic credit component of the money supply (if any) and balance of payments deficits or surpluses, depending on the method of financing the advance payment. In such a case, variables such as m^S, r, Y and Z in stage 2 would be determined largely independently of the method of financing the advance payment. The main variable affected would again be the state of the balance of payments. Conversely, if the equilibrium LM

curve is not approximately established within stage 2, then m^s, r, Y, Z and BP would all be influenced, at least to some extent, by the method of financing the advance payment.

So far, this analysis of an above average harvest has proceeded on the assumption that the additional output of the relevant farm commodity is not reflected in an increase in the level of farm exports, $\bar{O}_F$, relative to that of the previous season. In other words, it has been assumed that the larger harvest simply results in the level of stocks of the farm commodity being higher at the end of stage 2 than at the start of stage 1. Now suppose that, in contrast, there is no significant constraint on the volume of exports of the farm commodity, so that the additional output in the current season is absorbed via a corresponding increase in the level of O_F.

From equation (32), the total partial derivative of the current account elements of the balance of payments with respect to $\bar{O}_F$ is:

$$(33) \quad \left[\frac{\delta BP}{\delta \bar{O}_F}\right]_{\text{current account}} = \frac{\delta(p_{NFT} \quad Y_{NFT})}{\delta \bar{O}_F} \cdot \frac{\delta BP}{\delta(p_{NFT} \quad Y_{NFT})} + \frac{\delta(p_{NFT} \quad Z_{NFT})}{\delta \bar{O}_F} \cdot \frac{\delta BP}{\delta(p_{NFT} \quad Z_{NFT})} + \frac{\delta BP}{\delta(p_F \quad \bar{O}_F)}$$

The first term on the R.H.S. is zero because p_{NFT} is exogenous and Y_{NFT}, while endogenous, is a function only of a set of exogenous variables which excludes $\bar{O}_F$.

From equation (20), and noting that p_{NFT}, p_{NT}, p_F and $\mathcal{E}$ are exogenous variables, it follows that:

$$\frac{\delta\,(p_{NFT}\;\;Z_{NFT})}{\delta\;\;\bar{O}_F} = \frac{\delta\;Z_{NFT}}{\delta(Z-I_p^{FS})} \cdot \frac{\delta\,(Z-I_p^{FS})}{\delta\;\;\bar{O}_F}$$

As the impact on the TT schedule of a change in $\bar{O}_F$ is determined for given levels of Z and I_P^{FS}, this term can be ignored. Therefore, as the term

$$\frac{\delta\,BP}{\delta\,(p_F\;\;\bar{O}_F)}$$ is clearly positive, then it

follows that a rise in $\bar{O}_F$ in the current season would shift the TT schedule to the right. In other words, for any given level of Z, a rise in $\bar{O}_F$ improves the state of the current account, so that a lower level of r would now be consistent with a level of net capital inflow, k, just sufficient to clear the overall balance of payments.

In Fig.VII(10), it will be recalled that, in stage 1 and in the absence of any change in the level of $\bar{O}_F$, the TT schedule was shifted to the right from TT^0 to TT^2 to match the increase in I_P^{FS}. Suppose that the additional rightward movement of TT which occurs in response to the assumed increase in $\bar{O}_F$ pushes the TT schedule from TT^2 to TT^3. It is immediate that:

(a) given IS_Z^3, the equilibrium level of r in stage 1, r^3, lies below r^1. (As drawn, r^3 is also less than r^0, but, of course, the converse could also apply);

(b) given IS_Y^3 and $r^3 < r^1$, the equilibrium position of the LM curve in stage 1 would be represented by $LM^{4,Y}$ rather than $LM^{3,Y}$.

Following the familiar line of reasoning, $LM^{4,Y}$ and r^3 may or may not be approximately established in stage 1 under each of the various forms of financing the advance payment:

- if $LM^{4,Y}$ and r^3 are approximately established, then the issue of whether or not $\bar{O}_F$ rises in response to the rise in farm output is relevant for the variables m^s and $\dot{r}$ (and hence Y and Z), but the method of financing the larger advance payment remains relevant only for the state of the balance of payments;

- if $LM^{4,Y}$ and r^3 are not approximately established in stage 1, then the method of financing the advance payment becomes relevant not only for BP, but also for m^s, r, Y and Z.

In stage 2, IS_Y moves to the left from IS_Y^3 as farm output returns to its non-harvest level. Similarly, IS_Z moves to the left from IS_Z^3 as I_P^{FS} declines from its positive level in stage 1 to a negative level in stage 2. It is clear that the higher level of $\bar{O}_F$ implies that farm stocks are run down more quickly in stage 2 of the current season than in stage 2 of the previous season. In other words, I_P^{FS} is more negative in stage 2 of the current season than in the previous season. It follows

that, in stage 2, IS_Z would move to the left from IS_Z^3 by a horizontal distance greater than the horizontal distance between IS_Z^0 and IS_Z^2. This, of course, would be matched by an equivalent leftward movement of TT from TT^3, so that IS_Z and TT would continue to intersect at interest rate r^3. With these modifications incorporated, the analysis of stage 2 then follows along identical lines to that presented above for an unchanged level of $\bar{O}_F$.

Appendix XI

We will now return to the assumption that the harvest in stage 1 of the current season is identical in size to that of the previous season, and hence that consumption and investment expenditure by farm households, consumption expenditure by non-farm households in receipt of Y_F^{NF}, and farm exports are all unchanged relative to the previous season. As noted in Case D with perfectly mobile capital flows, the developments which occur in stage 1 imply a rise in wealth (or a faster rate of wealth accumulation) relative to stage 2. In other words, as farm output is higher in stage 1 than in stage 2, while, by assumption, consumption expenditure is identical in both stages, then wealth accumulation must be relatively greater in stage 1. If the wealth elasticity of demand for money balances is positive (rather than zero, as has been assumed so far in Section IV), then these divergent rates of wealth accumulation would be reflected in the monetary adjustments which occur in each stage.

In Fig. VII(9), given the nominal money stock associated with $LM^{0,Y}$, the increase in wealth in stage 1, and hence the wealth induced increase in demand for money balances, would push the LM curve to the left from $LM^{0,Y}$. Therefore, in order for the equilibrium LM curve in stage 1, $LM^{1,Y}$, to be established, the increase in the nominal money stock would need to be greater than was the case in A above, where it had been assumed that the wealth elasticity of demand for money was zero. With this additional complication incorporated, the issue of whether or not $LM^{1,Y}$ is actually established within stage 1, and hence the significance or

otherwise of the method of financing the advance payment, can be analysed along identical lines to the analysis presented in A above.

Similarly, in stage 2, given the nominal money stock associated with $LM^{1,Y}$ (assuming, for simplicity, that $LM^{1,Y}$ was, in fact, established in stage 1), the fall in wealth would reduce the demand for money, pushing LM to the right from $LM^{1,Y}$. Hence, in order for $LM^{0,Y}$ to be established in stage 2, a greater fall in the nominal money stock would be required than was the case in A above, where it had been assumed that the wealth elasticity of demand for money was zero. Again, the significance of the method of financing the advance payment, for variables other than BP, hinges largely on whether or not $LM^{0,Y}$ is approximately established in stage 2.

PART C

Some Empirical Issues and Preliminary Results

CHAPTER VIII

A REVIEW AND CRITIQUE OF SOME EMPIRICAL LITERATURE

Introduction

In preceding chapters, we have examined various theoretical aspects of the linkages from the farm sector to the macroeconomy. The analysis was undertaken in the context of five separate paradigms, which differed in either the nature of the shock which was assumed to occur in the farm sector, or in the structure of the marketing and institutional arrangements in which the farm sector was assumed to operate. In Chapter II, each of these paradigms were identified as being of relevance to one or more of the major Austraian farm industries.

One of the more fundamental linkages from the farm sector to the macroeconomy, incorporated into this earlier theoretical analysis, was the change in expenditure by farmers in response to a change in farm incomes. It was assumed that this expenditure response from the farm sector consisted of both a consumption and an investment response - the latter via a 'residual funds' effect. In the present chapter, the existing empirical literature on farm consumption and investment responses will be critically reviewed. The three major objectives of the exercise are:

(1) to provide some feel for the possible quantitative significance of this linkage from the farm sector to the macroeconomy which, to date, has been discussed only from a theoretical viewpoint;

(2) to establish a resume of the empirical literature in this area which can be subsequently drawn upon in the development of the simple quantitative model in Chapter IX; and

(3) to facilitate, in conjunction with the theoretical analysis presented in earlier chapters, an assessment of the adequacy of the treatment of the farm sector in the major Australian macroeconomic models.

In Section II, a review is presented of various time series and cross sectional studies which have investigated, or have provided some evidence on, the consumption response by farm households to a change in income. Then, in Section III, a similar exercise is undertaken for farm investment expenditure, with a particular emphasis on the residual funds hypothesis. In Section IV, the threatment of the farm sector in the N.I.F., R.B.A., Nevile, ORANI, and I.M.P models are discussed briefly. Finally, Section V contains some concluding remarks.

Section II A Review of the Empirical Literature on Farm Consumption Expenditure

II (1) Background

Several major limitations in the available time series data have precluded the direct estimation of the farm sector consumption function in an Australian context:

(1) there is no published data on consumption expenditure by farm households (or, more correctly, consumption by farm unincorporated enterprises);

(2) there is no readily available data on the disposable income of farm households. While data on the pre-tax incomes of farm and non-farm households is readily available, data on disposable incomes is available only for farm and non-farm households combined. Further, while some data is available on the assessed tax liability of farm households in a given year, the existence of provisional tax debits and credits would indicate that such data may be an inaccurate guide to the actual level of tax payments by farm households in that year.

In view of these data limitations, two alternative approaches to the empirical analysis of farm consumption behaviour have been adopted in the literature:

(a) economy wide consumption functions have been estimated, using time series data, with farm and non-farm pre-tax household income (or some proxy for farm and non-farm household disposable income) included as separate explanatory variables. This approach provides an estimate of the marginal propensity to consume by farm households;

(b) farm household consumption functions have been estimated using predominantly cross sectional data drawn from privately

commissioned surveys - typically involving only a relatively small number of farm households in a specific region.

Some of the more important of the studies based on time series data are reviewed below, followed by a review of some of the cross sectional studies.

II (2) Analyses Based on Time Series Data

In an early study, Arndt and Cameron (1957) observed that in simple linear consumption functions, non-farm disposable income seemed to serve as a more satisfactory explanatory variable than total disposable income. This, of course, implied that variations in farm disposable incomes had little, if any, impact on aggregate consumption expenditure, ie that the farm marginal propensity to consume was approximately zero. Arndt and Cameron handled the problem created by the absence of published data on farm and non-farm disposable incomes essentially by assuming that the ratio between those two variables would be identical to the known ratio between farm and non-farm pre-tax incomes. The validity or otherwise of such an assumption is not clear, and this issue was not addressed in detail in the paper.

Arndt and Cameron rationalised the above result as follows:

> 'It is not unreasonable to suppose that farmers' consumption levels are in various ways (such as direct personal contacts, availability of goods and services, advertising), influenced by consumption levels in the rest of the community. If farm consumption is a function of non-farm consumption, which in turn is a function of non-farm disposable incomes, total consumption will be a function of non-farm disposable incomes' (p.109).

Zerby (1969) was amongst the first to publish a small econometric model of the Australian economy - noteworthy earlier attempts being made by Nevile (1962) and Kmenta (1966). Zerby's model is of interest in that he explicitly allowed an independent role for farm income in the consumption functions in his model. In particular, he specified

expenditure on consumer durables to be a function of non-farm household income, farm household income, total personal tax payments, a short term interest rate and a lagged dependent variable. The specification for consumption expenditure on non-durables was similar except for the exclusion of the interest rate variable. It is interesting to note that Zerby handled the problem created by the lack of published data on the disposable incomes of farm and non-farm households by using pre-tax household incomes and including a variable for total personal tax payments. The model was estimated using annual data over the period 1948-49 to 1965-66. Zerby reported parameter estimates obtained using O.L.S., 2.S.L.S. and 3.S.L.S.

Unfortunately, the specification of these consumption equations does not permit the direct derivation of the annual marginal propensity to consume by farm households out of disposable income. However, if it is assumed, arbitrarily but not implausibly, that the marginal rate of personal tax paid by farm and non-farm households over the observation period was around 0.2, then some feel can be obtained for the implied value of the marginal propensity to consume out of disposable income. In particular, assume that:

$$(1)\quad \frac{\delta C}{\delta Y_D} = \frac{\frac{\delta C_N}{\delta Y} + \frac{\delta C_N}{\delta TP} \cdot \frac{\delta TP}{\delta Y} + \frac{\delta C_D}{\delta Y} + \frac{\delta C_D}{\delta TP} \cdot \frac{\delta TP}{\delta Y}}{1 - \frac{\delta TP}{\delta Y}}$$

where: C = consumption expenditure on non-durables and durables combined by either farm or non-farm households, as appropriate

Y_D = disposable income of either farm or non-farm households, as appropriate

Y = pre-tax income of either farm or non-farm households, as appropriate

C_N = consumption expenditure on non-durables by either farm or non-farm households, as appropriate

C_D = consumption expenditure on durables by either farm or non-farm households as appropriate

TP = total personal taxation

Values for the terms $\frac{\delta C_N}{\delta Y}$, $\frac{\delta C_N}{\delta TP}$, $\frac{\delta C_D}{\delta Y}$ and $\frac{\delta C_D}{\delta TP}$ can be obtained directly from Zerby's published parameter estimates, for both farm and non-farm households. Then, given the assumed value of 0.2 for the term $\frac{\delta TP}{\delta Y}$, numerical values can be obtained for the term $\frac{\delta C}{\delta Y_D}$ from (1).

TABLE VIII (1)

Approximate Marginal Propensities to Consume Implied by Zerby's Estimates, Given $\frac{\delta TP}{\delta Y} = 0.2$

	O.L.S.	2.S.L.S.	3.S.L.S.
$\frac{\delta C}{\delta Y_D}$ (farm households)	.04	.29	.57
$\frac{\delta C}{\delta Y_D}$ (non-farm households)	.98	.96	1.04

It is clear that the implied value for the marginal propensity to consume by non-farm households is reasonably insensitive to the choice of estimation technique. In contrast, the implied value for the farm marginal propensity to consume is highly sensitive to the choice of estimation technique - ranging from approximately zero under O.L.S., to a level more than half of its non-farm counterpart under 3.S.L.S.

Of course, the numerical values obtained for the marginal propensity to consume is not invariant to the value assumed for the

marginal rate of personal taxation. It seems improbable that, over the period considered by Zerby, the marginal rate of personal income tax would have significantly exceeded 0.2. To assess the implications of a marginal rate significantly below 0.2, the above exercise was repeated for an assumed marginal tax rate of 0.1.

TABLE VIII (2)

Approximate Marginal Propensities to Consume Implied by Zerby's Estimates, Given $\frac{\delta TP}{\delta Y} = 0.1$

	O.L.S.	2.S.L.S.	3.S.L.S.
$\frac{\delta C}{\delta Y_D}$ (farm households)	.17	.45	.75
$\frac{\delta C}{\delta Y_D}$ (non-farm households)	1.00	1.04	1.17

It is clear that the estimates presented in Table VIII (2) are suggestive of broadly similar conclusions to those reached from Table VIII (1).

Smyth and McMahon (1972) assumed that the consumption function had the following structure:

$$(2) \quad C_t = a + b_n \sum_{i=0}^{\infty} (1-\lambda)\lambda^i Y_{n,t-i} + b_f \sum_{i=0}^{\infty} (1-\lambda)\lambda^i Y_{f,t-i}$$

where C is private consumption expenditure and Y_n and Y_f are the disposable incomes of non-farm and farm households respectively. Contrary to the interpretation suggested by Smyth and McMahon, it is clear that, in such a formulation, b_n and b_f can be interpreted as the long run marginal propensities to consume by non-farm and farm households respectively (or, equivalently, the marginal propensities

to consume out of permanent income). The short run marginal propensity to consume by non-farm households is represented by $(1-\lambda)b_n$, and for farm households by $(1-\lambda)b_f$.

After the usual transformations, equation (2) yields the following estimating equation:

$$(3)\quad C_t=a(1-\lambda)+b_n(1-\lambda)Y_{n,t}+b_f(1-\lambda)Y_{f,t}+\lambda C_{t-1}$$

or equivalently

$$(4)\quad C_t=a(1-\lambda)+b_n(1-\lambda)(Y_{n,t}+Y_{f,t})-(b_n-b_f)(1-\lambda)Y_{f,t}+\lambda C_{t-1}$$

Equation (4) was estimated using quarterly data over the period 1958(IV) to 1968(III). Smyth and McMahon handled the problem created by the lack of published data on the disposable income of farm households by using a procedure similar to that adopted by Arndt and Cameron (1957), as outlined above.

The estimated values of the coefficients $b_n(1-\lambda)$ and $(b_n-b_f)(1-\lambda)$ were not significantly different in absolute value, and this was interpreted by Smyth and McMahon as implying that b_f was not significantly greater than zero. There would seem to be several difficulties raised by such a result:

(1) it seems hardly plausible that a change in the <u>permanent</u> income of farm households would induce no consumption response;

(2) it implies that the relationship between consumption and permanent income in farm households is significantly different to that in non-farm households. This implicaton cannot be readily rationalised in terms of the permanent income hypothesis - see Friedman (1957). Indeed, that hypothesis tends to suggest the converse - that the relatonship between consumption and permanent

income should be relatively stable over time and across income groups[1];

(3) the result is dependent upon an assumption that the value of the lag parameter, λ, is common to both farm and non-farm households. However, Smyth and McMahon note, correctly, that as farm incomes tend to be more volatile than non-farm incomes, it is possible that the value of the lag parameter would differ between the two groups. In particular, they suggest that the value of λ in the farm sector could be <u>less</u> than that in the non-farm sector, in which case their empirical results would be consistent with a value for b_f greater than zero. The latter step of reasoning, however, would seem incorrect. Rather, it would be expected that the value of λ in the farm sector would be <u>larger</u> than that in the non-farm sector (so that the weighting given by farm households to the current period's income would be relatively less than for non-farm households, given the geometrically declining lag structure specified in equation (2)). Of course, if it was accepted that the value of λ in the farm sector would be larger than in the non-farm sector, then the Smyth and McMahon results would imply that, if anything, $b_f < 0$;

(4) finally, as noted by Smyth and McMahon, if the procedure which they adopted in order to obtain a series for the disposable income of farm households was invalid, then their results would be biassed.

---

1 It is interesting to note that Friedman analysed some survey based US data which also implied that the average and marginal propensities to consume by farm households out of permanent income were less than for non-farm households. This was rationalised, rather vaguely, in terms of risk aversion and the access of farm households to highly profitable on farm investment opportunities - see Friedman (1957), pp 58-69.

In a later paper, Rutledge and Madden (1974) took up the issue raised by Smyth and McMahon that the value of the lag parameter could be expected to differ between farm and non-farm households, as noted above. They examined the following form of the consumption function:

$$(5)\quad C_t = a + b_n(1-\lambda)\sum_{i=0}^{\infty}\lambda^i Y_{n,t-i} + b_f(1-\mu)\sum_{i=0}^{\infty}\mu^i Y_{f,t-i} + u_t$$

where Y_n and Y_f are as described in the Smyth and McMahon paper, λ is the lag parameter for non-farm households, μ is the lag parameter for farm households and u_t is a random disturbance term. As before, it is clear that b_n and b_f can be interpreted as the long run marginal propensities to consume by non-farm and farm households respectively, with the corresponding short run marginal propensities being given by $b_n(1-\lambda)$ and $b_f(1-\mu)$.

Maximum likelihood estimates were obtained for the parameters λ, μ, $b_n(1-\lambda)$ and $b_f(1-\mu)$, using quarterly data over a comparable time period to that used by Smyth and McMahon. The reported estimates are:

$$\lambda = 0.432$$

$$\mu = 0.598$$

$$b_n(1-\lambda) = 0.414 \longrightarrow b_n = .729$$

$$b_f(1-\mu) = 0.0748 \longrightarrow b_f = .186$$

As would be expected (and contrary to the suggestion made by Smyth and McMahon), the estimated lag parameter for the farm sector is larger than that for the non-farm sector, implying that farm households' perception of their permanent income adjusts more slowly to a change in current income than is the case for non-farm households. The estimated short run (quarterly) marginal propensity to consume by farm households is positive but relatively small at 0.07 - substantially smaller than its non-farm counterpart at 0.41. A similar conclusion

also holds for the estimated long run marginal propensities to consume. The latter result, of course, again implies that the relationship between consumption and permanent income in the farm sector is substantially different to that in the non farm sector.

Freebairn (1977) investigated the relationship between inflation and consumption-savings decisions by households in Australia. In so doing, he provided some further evidence on the marginal propensity to consume by farm households. Using annual data over the period 1948-49 to 1974-75, Freebairn estimated a number of consumption functions, the structures of which were based on various popular theories of the consumption function. The dependent variable in each case was the average propensity to consume out of household disposable income, with no distinction being drawn, in the equations, between farm and non-farm households. Freebairn reported, however, that he had tested alternative specifications in which the ratio of farm and non-farm household incomes had been included as an explanatory variable, but which, in most cases, had proved to be statistically insignificant.

It is clear that this evidence, as reported by Freebairn, could be interpreted as implying that the marginal propensity to consume by farm households is not significantly different to that of non-farm households. In particular, if the marginal propensity to consume by farm households was significantly less than that of non-farm households, then it would be expected that the ratio of farm and non-farm household income would have entered Freebairn's equations with a significant negative sign. In his preferred equations, the short run (annual) marginal propensity to consume (by farm and non-farm households alike) ranged between about 0.4 to 0.6, with the corresponding long run marginal propensity to consume around 0.9.

Freebairn noted that his results with respect to the consumption behaviour of farm households were at variance to those reported by Smyth and McMahon (1972) and Rutledge and Madden (1974), as outlined above. He also reported, however, that the ratio of farm and non-farm household income tended to become less statistically significant as observations from the 1970s were added to the data set. It is possible, therefore, that, had Freebairn's analysis been undertaken over a time period more comparable to that used in those earlier studies, (ie. terminating in 1968), he may have found that the estimated parameter on the ratio of farm and non-farm household income was negative and statistically significant.

II(3) Analyses Based on Cross-Sectional Data

In an early study, Friedman (1957) analysed the consumption behaviour of farm and non-farm households in the US, using cross-sectional data obtained from separate sources for 1935-36 and 1941. The marginal propensity to consume by farm households was estimated to be about 0.6, compared to about 0.7-0.8 for non-farm households - see Friedman (1957), Table 3, p.62. Unfortunately, the use of cross-sectional data drawn from a single time period precluded a distinction being drawn between the short run and the long run marginal propensity to consume.

More recently, MacMillan and Loyns (1969) analysed survey data obtained for 226 farms in Manitoba, Canada, in 1964. Their estimating equation was based on a variant of the life cycle hypothesis of consumption behaviour. The estimated marginal propensity to consume was 0.24. Again, the use of data drawn from a single time period precluded a distinction being drawn between the short run and the long run marginal propensity to consume. It was noted, however, that the

estimated marginal propensity to consume was substantially less than the average propensity to consume by the surveyed households at around 0.6.

Girao, Tomek and Mount (1974) analysed data drawn from a survey of 50 farms in the US over the period from 1963 to 1969. The 50 farms were divided into two groups, depending on their relative income stability. A number of consumption functions were estimated for each group, using structural forms based on various popular theories of the consumption function, with the preferred equation being based on a variant of the life cycle hypothesis. The estimated short run (annual) marginal propensity to consume was 0.16 for the unstable income group, rising to 0.24 for the stable income group. The estimated long run marginal propensities to consume were 0.47 and 0.49 respecively, which accorded closely with the observed average propensity to consume of slightly in excess of 0.5 in both cases.

In a recent study, Mullen, Powell and Reece (1980) examined survey data obtained for 16 farm families in the NSW wheat-sheep zone over the period 1968-69 to 1975-76. Following Girao, Tomek and Mount (1974), they experimented with a range of structural forms for the consumption function. In their preferred models, the short run (annual) marginal propensity to consume ranged between 0.13-0.16, with the long run marginal propensity to consume lying between 0.19-0.25.

This latter study is potentially of more relevance than the previously cited cross sectional studies in that it was based on relatively recent Australian data. However, the extremely small sample size used to obtain the data may limit the applicability of the results to the overall farm sector. Further, a number of important qualifications about the data were noted by the authors. For example, it was noted that the data needed to be adjusted to cater for on-farm

consumption of farm commodities and for depreciation of farm capital. These adjustments were reported to be only very approximate, and were large relative to the absolute size of the observations on the consumption and income variables. Hence, the potential for bias in the results would seem to be substantial.

II(4) Concluding Comments on Section II

While the above review of the empirical literature on farm consumption behaviour is not necessarily exhaustive, it is felt that it provides some appreciation of the various approaches which have been adopted in the literature, and of the range of values obtained for the marginal propensity to consume by farm households. For convenience, the essential elements of this literature are summarised in Table VIII(3).

TABLE VIII(3)

Empirical Estimates of the Marginal Propensity to Consume by Farm Households

Study	Observation Period	Marginal Propensity to Consume by Farm Households	Comments
Arndt & Cameron (1957)	1946-47 to 1955-56	0 (annual)	Marginal propensity to consume out of non-farm disposable incomes approximately unity
Zerby (1969)	1948-49 to 1965-66	.04 to .75 (annual)	A wide range of values implied by Zerby's estimates, depending on the choice of estimation technique and the assumed value for the marginal rate of taxation. In each case, however, the value implied is lower than that for non-farm households
Smyth & McMahon (1972)	1958 (IV) to 1968 (III)	0 (quarterly) 0 (long run)	Positive short run and long run marginal propensities to consume out of non-farm disposable income were obtained
Rutledge & Madden (1974)	1958 (IV) to 1968 (III)	.07 (quarterly) .19 (long-run)	Both the short run and long run estimates were significantly lower than for non-farm households
Freebairn (1977)	1948-49 to 1974-75	0.4 to 0.6 (annual) 0.9 (long-run)	Estimates were not significantly different to those for non-farm households. However, there is some suggestion that the estimates may fall significantly below those for non-farm households if observations from the 1970s are removed

Study	Observation Period	Marginal Propensity to Consume by Farm Households	Comments
Friedman (1957)	1935-36 and 1941	0.6	Study used US cross-sectional data. The estimate was significantly less than that for non-farm households. No distinction between short-run and long-run was possible
MacMillan & Loyns (1969)	1964	0.24	Study used Canadian cross sectional data. No distinction between short-run and long-run was possible
Girao, Tomek & Mount (1974)	1963 to 1969	0.16 to 0.24 (annual) 0.47 to 0.49 (long run)	Study used US cross sectional data
Mullen, Powell & Reece (1980)	1968-69 to 1975-76	0.13 to 0.16 (annual) 0.19 to 0.25 (long run)	Study used Australian cross sectional data with an extremely small sample size

Several broad conclusions would seem to follow from this review of the empirical literature:

(1) there is no clear consensus in the literature as to the 'true' value of the marginal propensity to consume by farm households, either in the short or the long run;

(2) there is, however, a reasonable consensus that these parameters are significantly greater than zero. Only Arndt and Cameron (1957) and Smyth and McMahon (1972) provide evidence to the contrary;

(3) there is also a reasonable consensus that these parameters are significantly less than their counterparts in the non-farm sector. Amongst the studies in which such a comparison was possible, only Freebairn (1977) provides evidence to the contrary.

The result that the short run marginal propensity to consume by farm households is positive but less than its non-farm counterpart accords with the spirit of the widely accepted permanent income and life cycle hypotheses of consumption behaviour, given that farm incomes have traditionally been substantially more volatile than non-farm incomes. However, the result that the long run marginal propensity to consume by farm households is also less than its non-farm counterpart is less readily rationalised in terms of these popular hypotheses, and no fully convincing explanation has been offered in the literature. Finally, given the substantial data problems which confront researchers attempting to model farm consumption behaviour, it seems improbable that a consensus will emerge in the foreseeable future as to a <u>specific</u> value, or a tight range of values, for the marginal propensity to consume by farm households.

Section III Farm Investment Expenditure: Theory and Empirical Evidence

III (1) Background

To adequately assess the impact of fluctuations in farm income on the level of expenditure originating from the farm sector, it is necessary to recognise that farm income fluctuations may affect more than just farm consumption expenditure. In particular, it has been commonly argued in the literature that farm income, via a 'residual funds' effect, is also a major factor influencing farm investment decisions in the short to medium term. Such an effect, of course, was explicitly incorporated into the structure of the theoretical models developed and explored in earlier chapters.

The first detailed statement of the residual funds hypothesis has been attributed to Campbell (1958). He argued that:

> 'The most promising clues to the nature of the investment process in agriculture have come from empirical studies. These seem to point unequivocally to the prime importance of internal liquidity in capital formation. The most plausible formulation would treat investment outlay as a residual, defined as the net income realised from current operations, less tax commitments and some conventional allowance for farm family living expenses'. (p.98)

This view of farm investment expenditure has been echoed more recently in several important documents - see, for example, Harris et al (1974, Para 2.22, p.17), Bureau of Agricultural Economics (1977, p.30) and Industries Assistance Commission (1978, p.23).

It is clear that the residual funds hypothesis, as proposed by Campbell, can be expressed algebraically as follows:

$$(6)\quad R = Y_F^F - T^F - C_P^F$$

and $$(7)\quad \frac{\delta I_P^F}{\delta R} \simeq 1$$

where R = farm residual funds

Y_F^F = that part of gross farm product which accrues to farm households

C_P^F = private consumption expenditure originating from farm households

T^F = tax payments by farm households

I_P^F = investment expenditure by farm households

Hence

$$(8) \quad \frac{\delta I_P^F}{\delta Y_F^F} = \frac{\delta I_P^F}{\delta R} \cdot \frac{\delta R}{\delta Y_F^F}$$

and from (6)

$$(9) \quad \frac{\delta R}{\delta Y_F^F} = 1 - \frac{\delta T^F}{\delta Y_F^F} - \frac{\delta C_P^F}{\delta Y_F^F}$$

Therefore, assuming that $\frac{\delta I_P^F}{\delta R} = 1$, then

$$(10) \quad \frac{\delta I_P^F}{\delta Y_F^F} = 1 - \frac{\delta C_P^F}{\delta Y_F^F} - \frac{\delta T^F}{\delta Y_F^F}$$

or equivalently

$$(11) \quad \frac{\delta I_P^F}{\delta Y_F^F} + \frac{\delta C_P^F}{\delta Y_F^F} = 1 - \frac{\delta T^F}{\delta Y_F^F}$$

Equation (11) says that the sum of the changes in farm consumption and farm investment expenditure, in response to a change in farm income, is equal to the change in farm disposable income. It is clear, therefore, that if the marginal propensity to invest by farm households out of residual funds, as defined by Campbell, is unity, then the size of the marginal propensity to consume by farm households is of little consequence in determining the aggregate expenditure response by farm households to a change in income. Conversely, if the marginal propensity to invest out of residual funds is either less

than, or greater than, unity then the actual size of the marginal propensity to consume by farm households continues to be important from a macroeconomic viewpoint.

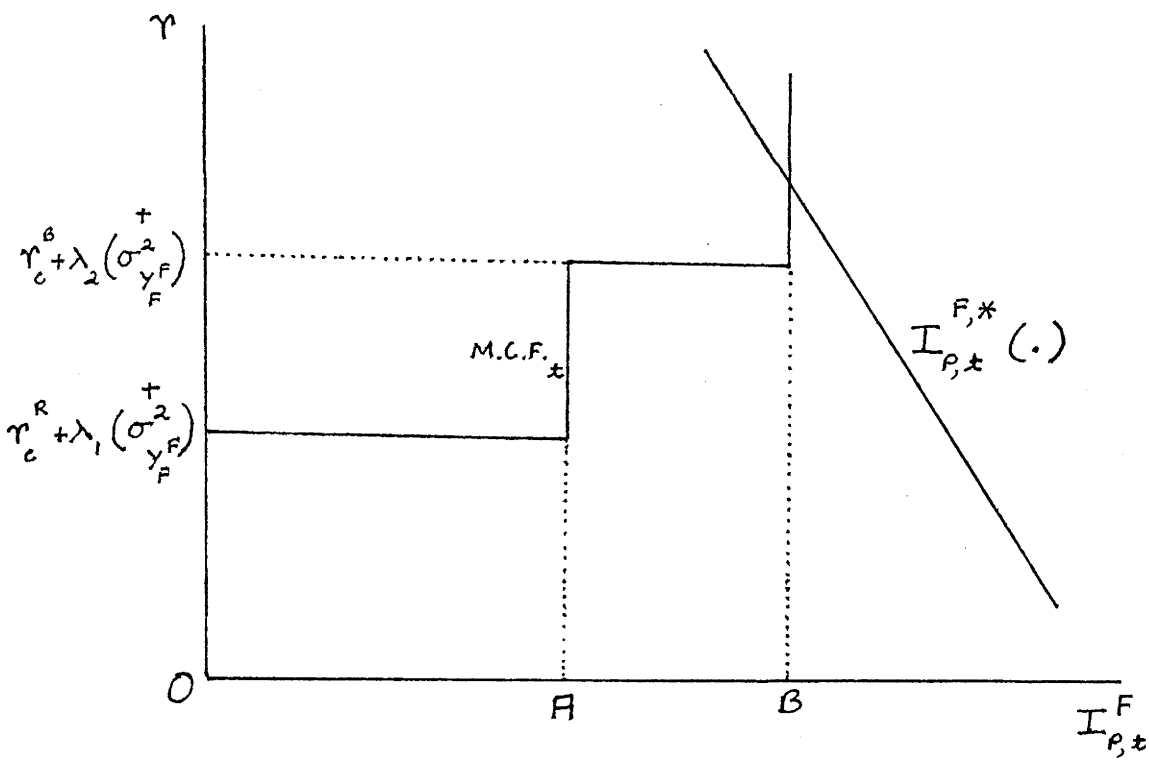
In Section III (2), some discussion of the theoretical underpinnings of the residual funds hypothesis is presented. Then, in Section III (3), some empirical evidence on the size of the marginal propensity to invest out of residual funds is reviewed. In Section III (4), it is argued that the existing empirical models are misspecified in such a way as to bias downwards the estimate of the marginal propensity to invest. Finally, some concluding comments on Section III are presented in Section III (5).

III (2) Some Theoretical Underpinnings for the Residual Funds Hypothesis of Farm Investment

In the Australian literature, little attempt has been made to provide the residual funds hypothesis with a rigorous theoretical foundation. In an early paper in the US literature, Hesser (1960) provided a simple conceptual framework which explicitly allowed for external rationing of credit, and which allowed an analysis of the conditions under which internal and external credit rationing would be present. His analysis, however, was largely oriented to longer term issues such as the patterns of investment and farm equity over the life span of farm operators. More recently, Waugh (1977a) provided a brief restatement of Duesenberry's (1958) bifurcation hypothesis, but did not proceed to draw out the implications of that hypothesis under external credit rationing. Young (1973) made some attempt to model credit rationing in the farm sector, while Ockwell and Batterham (1982) undertook some analysis of the longer term role of credit in the growth of farm firms.

In the present sub-section, a relatively simple conceptual framework is presented which permits an examination of some aspects of farm investment decisions in the presence of interest rate controls and the associated credit rationing. It is shown that a residual funds effect on farm investment emerges readily from such a framework. The model also provides some insight into the extent to which the marginal propensity to invest might be expected to vary between industries, across regions and over time.

FIGURE VIII (1)



In Figure VIII (1), the level of farm investment expenditure, $I^F_{P,t}$, is measured along the horizontal axis, and the interest rate, r, along the vertical axis. The schedule labelled $I^{F,*}_{P,t}$ indicates the 'notional' level of farm investment expenditure at each level of the interest rate, ie the level of investment which would occur in the absence of effective credit rationing in the farm sector. It can be assumed that this notional investment schedule is derived from a neo-classical investment model, such as that outlined in Section III(4). As such, it would be drawn on the assumption that the expected levels of output and input prices (other than the interest rate) are given, as is the state of technology in the farm sector (ie. the farm production function). In other words, for simplicity, we will ignore the impact which changes in farm prices and/or seasonal conditions might have on the optimal farm capital stock and hence the position of the $I^{F,*}_{P,t}$ schedule. Broadly speaking, however, the factors which produce an increase in residual funds may also be expected to shift the $I^{F,*}_{P,t}$ schedule to the right and conversely.

The schedule labelled $M.C.F._t$ indicates the marginal cost of investment funds facing the farm sector. Horizontal distance OA is equal to farm residual funds. It is assumed that the opportunity cost of residual funds comprises two parts. The first part, r^R_C, is the interest rate available on off-farm financial investments. The second part, λ_1, is a subjective premium which farmers are assumed to add to the return from off-farm financial investments, and is assumed to be an increasing function of the variance of farm household income, $\sigma^2_{Y_F}$. In other words, farmers are assumed to gain utility from the

existence of relatively liquid off-farm assets, given the uncertainties created by an imperfect capital market and credit rationing, and this utility becomes more substantial as farm income becomes more volatile.[2]

The opportunity cost of borrowed funds is also assumed to be comprised of two parts. The first part r_c, indicates the interest rate payable by farmers on funds borrowed from commercial sources. To this is again added a subjective premium, λ_2, reflecting an assumption that farmers may obtain some negative utility from a commitment to fixed repayment terms in the presence of volatile farm incomes - the premium assumed to be an increasing function of $\sigma^2_{Y_F}$. Horizontal distance AB represents the rationed volume of capital available to the farm sector from commercial sources. While it is likely that various criteria would be used to ration credit to the farm sector in the presence of interest rate controls, it is assumed, not implausibly, that one such criterion would be the level of current farm income, $Y^F_{F,t}$, with the relevant ordinary partial derivative taking a positive sign.

Some of the implications of this simple framework can be drawn out by considering various cases distinguished by the initial location of the point of intersection between the $I^{F,*}_{P,t}$ schedule and the $M.C.F._t$ schedule. The analysis is presented in detail in the Appendix. The essential points might be summarised as follows:

---

2. Neither λ_1 nor λ_2 play a crucial role in the analysis, but have been included to illustrate that, if desired, such issues can be readily catered for within this simple model framework.

(1) a residual funds effect on farm investment emerges readily from a simple theoretical framework in which a neo-classical investment model is combined with an imperfect capital market and credit rationing;

(2) using this framework, various plausible scenarios can be identified in which a value of unity for the marginal propensity to invest would be expected. Such an outcome is consistent with Campbell's (1958) original statement of the residual funds hypothesis;

(3) however, other plausible scenarios can be identified in which a value of zero for the marginal propensity to invest would be expected, and yet others for which values between zero and unity would be expected;

(4) it is also suggested that a value for the marginal propensity to invest in excess of unity could be plausible under some circumstances;

(5) it is demonstrated that, from a given initial situation, an equivalent increase or decrease in residual funds would not necessarily result in a symmetrical investment response in the farm sector;

(6) combining points (2), (3), (4) and (5), therefore, it would seem that there are no strong grounds for expecting, a priori, that the marginal propensity to invest should take any specific value, or that it should be stable over time and across regions and industries.[3]

---

3 It should be reiterated that the analysis proceeded on the assumption that the position of the $I^{F,*}_{P,t}$ schedule was given. Of course, to the extent that the change in farm residual funds is caused by variations in farm prices or by seasonal variations in farm production, some movement in the position of the $I^{F,*}_{P,t}$ schedule would also be expected. In general, this would serve to reinforce the volatility of the marginal propensity to invest.

III(3) A Review of Some Empirical Evidence on the Marginal Propensity to Invest out of Residual Funds

Empirical testing of the residual funds hypothesis of farm investment has been hampered by a lack of published data on farm residual funds. As was noted in the review of the empirical literature on farm consumption behaviour, there is no published time series data in Australia for either the disposable income of farm households, or consumption expenditure by farm households. It is clear, from equation (6), that both of these variables enter the residual funds identity, as defined by Campbell (1958). Therefore, empirical researchers have typically needed to resort to various proxies for the residual funds variable - proxies which have often departed significantly from Campbell's original definition.

Gruen (1957) provided one of the earliest estimates of the impact of changes in farm income on farm investment expenditure. He argued that the results of a study of wheat-sheep farmers in Western Australia in the mid-1950s had indicated a marginal propensity to invest out of pre-tax farm income of 0.14. Taking what he regarded to be a reasonable measure of the marginal rate of taxation paid by farmers, Gruen suggested that this may have implied a marginal propensiy to invest out of post-tax farm income of about 0.25. However, he did not proceed to make a further adjustment for a (probable) non-zero marginal propensity to consume by farm households, and hence to obtain a measure of the marginal propensity to invest out of residual funds. Such an estimate would clearly lie above 0.25, depending on the size of the marginal propensity to consume.

Herr (1964) analysed Bureau of Agricultural Economics survey data for a limited number of sheep properties in the pastoral, wheat-sheep and high rainfall zones of N.S.W. over the period 1953-1961. He found

that changes in residual funds - proxied by changes in the pre-tax cash income of farm households - proved to be a significant explanatory variable for changes in investment expenditure on the surveyed farms in the pastoral and high rainfall zones, but not in the wheat-sheep zone. The marginal propensity to invest out of (proxied) residual funds was estimated to be 0.08 in the pastoral zone and 0.40 in the high rainfall zone. Of course, once some allowance is made for changes in taxation and consumption expenditure, the marginal propensity to invest out of true residual funds would be expected to be somewhat larger than these estimates presented by Herr.

Herr argued that, on the basis of his results, the residual funds hypothesis would need to be complemented by other more traditional investment theories if a complete model of farm investment behaviour was to be obtained. It is clear that the simple model presented in Section III(2) is consistent with such a proposition. It is also clear that Herr's finding that the marginal propensity to invest tended to differ substantially between agricultural zones can be readily rationalised in terms of that simple model.

Duloy and Nevile (1965) used a modified version of Nevile's (1962) model in order to examine some of the possible macroeconomic consequences of a hypothetical floor price scheme in the Australian wool industry. One of the modifications made to Nevile's model was to separate aggregate investment expenditure into its farm and non-farm components, and to treat each as endogenous variables. Farm investment expenditure was specified to be a simple linear function of the gross operating surplus of farm unincorporated enterprises - lagged one period and adjusted for direct taxes paid by the farm sector - and a time trend. Direct taxes paid by the farm sector, in turn, were estimated using an assumption that the marginal rate of taxation

facing the farm sector was 0.3. The model was estimated using annual data over the period 1948-49 to 1962-63.

The estimated marginal propensity to invest out of farm post-tax gross operating surplus was approximately 0.09. Again, as no allowance was made for a non-zero marginal propensity to consume by farm households, this estimate seems likely to understate the marginal propensity to invest out of farm residual funds. This would be reinforced by the fact that the post-tax gross operating surplus variable would overstate the level of disposable incomes of farm households - for example, the latter variable is adjusted for net rents and interest paid by farm households, whereas the former is not.

In an important study, Glau (1971) examined the impact of various forms of farm tax concessions on farm investment expenditure. He argued that tax concessions would influence farm investment via two main channels:

(1) they would reduce the use cost of capital, and hence, with other factors unchanged, would increase the optimal capital stock in the farm sector. The establishment and maintenance of this larger capital stock would, in turn, stimulate an increased level of investment expenditure;

(2) the tax concessions would also serve to reduce aggregate tax payments, and hence would increase farm residual funds, which would, in turn, influence the speed of adjustment of the actual capital stock to its optimal level.

Accordingly, Glau proposed the following model of farm investment:

$$(12)\quad I_t = b(K_t^* - K_{t-1}) + \sigma K_{t-1}$$

where (using Glau's notation)

I_t = gross investment

K_t = capital stock

K_t^* = optimal or desired capital stock

σ = rate of replacement investment

He suggested two alternative formulations for the partial adjustment parameter, b:

$$(13)\quad b = \bar{b}$$

or $(14)\quad b_t = f(L_{t-1})$ where L = farm internal liquidity.

Glau assumed that the function, f, took the following specific form:

$$(14^1)\quad b_t = b_1 + b_2\left[\frac{L_{t-1}}{K_t^* - (1-\sigma)K_{t-1}}\right]$$

Glau also assumed that the optimal capital stock, K_t^*, was determined as a function of neo-classical and accelerator type arguments:

$$(15)\quad K_t^* = a_0 + a_1 Q_t + a_2\left(\frac{C_t}{w_t}\right) + a_3\left(\frac{C_t}{p_t}\right)$$

where Q_t = expected volume of farm output

C_t = user cost of farm capital services

p_t = price of farm output

w_t = opportunity cost of farm labour

After the usual substitutions and transformations, the following estimating equations were obtained:

$$(16)\quad I_t = ba_0 + ba_1 \Delta Q_t + ba_2 \Delta\left(\frac{C_t}{w_t}\right) + ba_3 \Delta\left(\frac{C_t}{p_t}\right) + (1-b)I_{t-1} \quad \text{for fixed b}$$

$$(17)\quad I_t = b_1a_0 + b_1a_1 \Delta Q_t + b_1a_2 \Delta\left(\frac{C_t}{w_t}\right) + b_1a_3 \Delta\left(\frac{C_t}{w_t}\right) + b_2 \Delta L_{t-1} + (1-b_1)(1-\sigma)I_{t-1} \quad \text{for variable b}$$

where $\Delta Q_t = \left[Q_t - (1-\sigma)Q_{t-1}\right]$

$$\Delta\left(\frac{C_t}{w_t}\right) = \left[\left(\frac{C_t}{w_t}\right) - (1-\sigma)\left(\frac{C_{t-1}}{w_{t-1}}\right)\right]$$

$$\Delta\left(\frac{C_t}{p_t}\right) = \left[\left(\frac{C_t}{p_t}\right) - (1-\sigma)\left(\frac{C_{t-1}}{p_{t-1}}\right)\right]$$

$$\Delta L_{t-1} = \left[L_{t-1} - (1-\sigma)(L_{t-2})\right]$$

Equations (16) and (17) were estimated using annual data over the period 1949-50 to 1966-67. Expected farm output, Q_t, was defined to be a three year moving average of the volume of rural output. An index of the user cost of capital was constructed using various assumptions to incorporate the effects of farm tax policies. Several measures of internal liquidity, L, were tested, but the one chosen on the basis of statistical performance was defined to be equal to realised farm income, plus depreciation and the change in gross rural indebtedness, less estimated tax payments. Finally the variable $\Delta\left(\frac{C_t}{p_t}\right)$ proved insignificant in both equations and was discarded.

The estimated value of b_2, which can be interpreted as the marginal propensity to invest out of internal liquidity - as defined by Glau - was approximately .05. The failure to cater for a probable non-zero marginal propensity to consume would again seem to imply that b_2 would represent an understatement of the marginal propensity to invest out of residual funds, as defined by Campbell. Similarly, the inclusion of the change in gross indebtedness in the internal liquidity variable also represents a departure from Campbell's definition of residual funds, but its likely impact on the estimated value of b_2 is not clear.

Following on from Glau, Fisher (1974) undertook a further investigation of the role of the user cost of capital as a determinant of farm investment expenditure. He estimated an equation of the following form:

$$(18)\ I_t = bK_{t-1} + \sum_{i=0}^{n_1-1} f_i \Delta Y_{t-i} + \sum_{i=0}^{n_2-1} g_i \Delta c_{t-i}$$

where I_t = gross fixed capital expenditure in the farm sector

K_t = estimated farm capital stock

Y_t = volume of farm output

C_t = estimated user cost of capital in the farm sector

The model was estimated using quarterly data over the period 1964(4) to 1969(4). In Fisher's preferred equations, the lag length on farm output was four quarters, and on the user cost of capital was five quarters. Over these lag lengths, the coefficients were significant and took the expected sign, ie positive on output and negative on the user cost of capital.

Fisher's approach differed to that adopted by Campbell (1958), Gruen (1957), Herr (1964) and Glau (1971) in that no explicit role for internal liquidity or residual funds was allowed. However, the underlying structural basis for the inclusion of the ΔY terms in the equation is not made clear by Fisher. He commented only that 'The role of the output variable appears to be limited to one of causing seasonal shifts in investment' (p.29). It would seem, therefore, that to the extent that there is a substantial correlation between variations in output and variations in residual funds, it is possible that the output variable could, in fact, be partly capturing a residual funds effect. This issue will be taken up further in Section III(4).

Girao, Tomek and Mount (1974), in addition to their analysis of farm consumption expenditure, as noted in Section II(3), also analysed farm investment expenditure on the surveyed farms. They specified gross investment to be a function of the change in total sales, the actual level of the capital stock and a variable designed to capture 'financial conditions'. Their description of the structural basis for this formulation is not particularly clear. It would seem that an assumption was made that the optimal capital stock was determined largely by an accelerator effect on total sales, with the actual level of investment expenditure then being determined by the gap between the desired and the actual capital stock, and financial conditions.

A variety of variables were used to represent financial conditions in the estimating equations, including:

(1) farm savings - a variable closely resembling Campbell's (1958) definition of residual funds;

(2) surplus income - essentially the difference between disposable income and consumption expenditure on non-durables and services;

(3) transitory income - defined as $(\Delta Y_{t-1} - \Delta\overline{Y})$, where

Y = disposable income of farm households

$\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}$

$\Delta\overline{Y}$ = average change in Y over the observation period.

Each of these three variables, when used alternatively in the estimating equations, generally proved to be statistically significant, taking the expected positive sign. For those farms classified as having relatively unstable incomes, the estimated coefficients on these variables tended to fall in the range 0.13-0.15. For the farms with more stable incomes, the coefficients on savings and surplus income were around 0.4-0.5, and on transitory income around 0.2-0.25. The lower marginal propensity to invest out of

transitory income in the latter case probably reflects the fact that the short run marginal propensity to consume is substantial amongst the farm households with stable incomes, so that transitory income overstates farm savings.

Finally, Waugh (1977b) estimated an investment function based on survey data drawn from 23 farms in the N.S.W. wheat-sheep zone over the period 1966-67 to 1972-73. The general form of Waugh's estimating equation was:

$$(19)\ I_t = f(O_{t-1}, O_{t-2}, O_{t-3}, P_t, K_{t-1}, Y_{t-1}, \Delta D_t)$$

where

I_t = net investment expenditure

O_t = volume of farm output

P_t = relative input prices, defined alternatively as the user cost of capital deflated by the price of output and the wage rate relative to the user cost of capital

K_t = capital stock

Y_t = pre-tax cash income

ΔD = change in debt

The estimated coefficients on lagged output were, in general, positive and highly significant, with the coefficient on the lagged capital stock being negative and highly significant. However, both of the alternative measures for the variable P_t proved to be insignificant, and the coefficient on Y_{t-1}, while significant, took a perverse negative sign. Waugh thus replaced the variable Y_{t-1} with a measure of transitory income, $Y_{T,t}$, where

$$Y_{T,t} = Y_t - Y_{t-1} - \Delta\overline{Y}$$

and where $\Delta\overline{Y}$ is the average change in Y over the observation period.

The estimated coefficient on $Y_{T,t}$ was 0.23 and significant. Again, to the extent that Y and hence Y_T are not adjusted for the effects of taxation or for a positive marginal propensity to consume, it seems likely that this estimate would understate the marginal propensity to invest out of residual funds, as defined by Campbell (1958).

III(4) A Critical Comment on the Empirical Literature on Farm Investment

In discussing the empirical literature on farm investment in Section III(3), some emphasis was placed on the measure of residual funds or internal liquidity used in the various studies. It was noted that, in most cases, no allowance was made for changes in farm consumption expenditure and/or farm taxation payments in response to a change in farm income. It was suggested, therefore, that the estimated coefficients on the various proxies for residual funds may tend to understate the true value of the marginal propensity to invest out of residual funds, as defined in equation (6). There is, however, a further more fundamental feature, common to most of the estimated models, which would also seem to present some difficulties for the interpretation of the empirical results. This issue will be taken up in the present sub-section.

With some variations between the studies, the structural underpinning of the investment models reviewed in Section III(3) might be generalised as follows:

$$(20)\quad I_t = I_t(K_t^* - K_{t-1}, R)$$

$$(21)\quad K_t^* = K_t^*(O_F, p_F, c, w)$$

where I_t = net farm investment expenditure

K_t^* = optimal level of the farm capital stock

K_t = actual level of the farm capital stock

R = some measure of residual funds, internal liquidity or financial conditions

O_F = volume of farm output

p_F = price of farm commodities

c = user cost of capital in the farm sector

w = the wage rate

Of course, various lags are applied to the variables R, p_F, O_F, c and w, depending on the study being considered. Following the usual substitutions and transformations, the typical estimating equation would include the following variables:

$$(22)\ I_t = I_t(O_F, \frac{p_F}{c}, \frac{c}{w}, R, I_{t-1})$$

where, again, various lags are employed on O_F, $\frac{p_F}{c}$, $\frac{c}{w}$ and R.

Within this general formulation, the role of R is typically interpreted as influencing the adjustment of the actual capital stock to its optimal level - a role which, of course, is perfectly consistent with its role in the simple model explored in Section III(2). However, the role played by the output variable, O_F, in equation (21), and hence in equation (22), is much more problematical. There is some suggestion by the model builders that it is capturing an accelerator effect on farm investment. It is generally accepted, however, that individual farm firms, because of their relatively very small size, act as price takers in the market for final output, and this is true regardless of whether the commodity in question is traded or non-traded, or whether the industry in aggregate faces some form of export constraint. An environment in which individual farm firms perceive no demand side constraints on their volume of sales at given

prices seems likely to be conducive to neo-classical investment decision making, ie the optimal capital stock would be assessed using conventional profit maximising criterion.

A more neo-classical specification of equation (21) would be:

$$(21') \quad K_F^* = K_F^*(p_F, c, w, p_j, \alpha_F)$$

where p_j is the price of non-primary inputs used in the farm sector, and α_F is the state of technology in the farm sector. The price of non-primary inputs was largely ignored in the various empirical studies, but has been included in (21') for completeness, given that non-primary inputs have been incorporated into the theoretical models developed in earlier chapters. The explanatory variables in (21') may, of course, refer to the expected, rather than actual, values of the variables, and these expected values may, in turn, be based on various lag structures of the actual values. After substituting (21') into (20) and undertaking the usual transformations, a typical estimating equation would include the variables:

$$(22') \quad I_t = I_t(p_F, c, w, p_j, \alpha_F, R, I_{t-1})$$

From (6) $R = Y_F^F - T^F - C_p^F$

$= \beta (O_F - J) - T^F - C_p^F$, using the specification for Y_F^F employed in the theoretical models developed in earlier chapters, and where J is the volume of non-primary inputs used in the farm sector.[4]

Substituting (6) into (22'), we get:

$$(22'') \quad I_t = I_t(p_F, c, w, p_j, \alpha_F, (\beta (O_F - J) - T^F - c_p^F), I_{t-1})$$

---

4. Of course, equation (6) could also be specified in nominal terms, in order to cater for variations in p_F and p_j.

It is clear that the variable, O_F, appears in both equation (22) and equation (22''). However, the interpretation of its role in the two equations is quite different. In equation (22), its role is interpreted as an accelerator effect, while, in (22''), its role comes through its contribution to residual funds. If the neo-classical specification of farm investment was seen as being more acceptable from a theoretical viewpoint, then the inclusion of the separate O_F variable in most of the existing empirical models could be seen as capturing, not an accelerator effect, but rather as capturing at least part of the residual funds effect which would otherwise have been captured by the R variable. In other words, the size of the estimated coefficient on R, and its statistical significance, may understate the role of residual funds as a determinant of farm investment in such a case.

III(5) Concluding Comments on Section III

In Section III, the origins of the residual funds hypothesis of farm investment expenditure were briefly reviewed. It was noted that Campbell's (1958) statement of the hypothesis could be interpreted as implying that the marginal propensity to invest out of residual funds was around unity.

A simple theoretical model of farm investment behaviour was then developed, which incorporated credit rationing into an otherwise neo-classical investment framework. It was observed that a residual funds effect on farm investment emerged readily from such a framework, and that a unit marginal propensity to invest out of residual funds, as suggested by Campbell, was quite plausible in some circumstances.

However, it was noted that a value of zero was also quite plausible, as were values between zero and unity and values in excess of unity. These results also seemed to carry the corollary that there were no firm grounds for assuming that the marginal propensity to invest would necessarily be stable over time or across industries and regions, or would be invariant to the direction of the change in residual funds.

Some existing empirical literature on farm investment behaviour was then reviewed. For convenience, some of the main features of this literature are summarised in Table VIII(4).

TABLE VIII(4)

Empirical Estimates of the Marginal Propensity to Invest out of Farm 'Residual Funds'

Study	Observation Period	Estimated Marginal Propensity to Invest	Comments
Gruen (1957)	Western Australian survey data, mid 1950s	0.25	No allowance was made for a non-zero marginal propensity to consume by farm households
Herr (1964)	NSW survey data, 1953-61	0.08-0.40	No allowance was made for either a non-zero marginal rate of taxation or marginal propensity to consume by farm households. The estimates varied substantially, depending on the region
Duloy & Nevile (1965)	Australian time series data 1948-49 to 1962-63	0.09	No allowance was made for a non-zero marginal propensity to consume by farm households
Glau (1971)	Australian time series data 1949-50 to 1966-67	0.05	No allowance was made for a non-zero marginal propensity to consume by farm households
Fisher (1974)	Australian time series data 1964(4) to 1969(4)	-	No explicit allowance was made for a residual funds effect
Girao, Tomek & Mount (1974)	United States survey data 1963-69	0.13-0.5	Some allowance was made for a non-zero marginal rate of taxation and marginal propensity to consume by farm households. Estimates varied sharply between groups of farms classified in terms of relative income stability

Study	Observation Period	Estimated Marginal Propensity to Invest	Comments
Waugh (1977b)	NSW survey data, 1966-67 to 1972-73	0.23	No allowance was made for a non-zero marginal rate of taxation or marginal propensity to consume by farm households

It is clear from Table VIII(4) that:

(1) empirical estimates of the marginal propensity to invest out of 'residual funds' (somehow defined) range between about 0.05 to about 0.5;

(2) most of these studies fail to allow for a non-zero marginal rate of taxation and/or a non-zero marginal propensity to consume by farm households. This suggests that the estimates are likely to understate the marginal propensity to invest out of residual funds, as defined by Campbell (1958), and as specified in equation (6).

Finally, it was suggested that, from the viewpoint of neo-classical investment theory, the models used in most of these empirical studies may have been misspecified, and that the nature of this misspecification was such as to indicate a downward bias in the size and significance of the estimated residual funds effect.

Section IV The Treatment of the Farm Sector in the Major Australian Macroeconomic Models[5]

In the light of the theoretical models developed and explored in earlier chapters, and the preceding review of the empirical literature on consumption and investment behaviour in the farm sector, it is useful to now briefly consider the treatment of the farm sector in the major Australian macroeconomic models - in particular, the N.I.F. model, the R.B.A. model, the Nevile model, ORANI and the I.M.P. model. Space limitations permit only an overview of the treatment of the farm sector in these models, rather than a detailed analysis. Nevertheless, this should be sufficient to allow some assessment of the adequacy of these models as frameworks for analysing the contribution of the farm sector to short-term variations in the major macroeconomic variables.

In the current specification of the N.I.F. model - N.I.F. 10 (see Department of the Treasury (1981), Gray (1982), Johnston et al (1982), Fane (1982)) - the gross volume of farm production, farm value added, farm exports, farm employment, payments of wages, salaries and supplements in the farm sector, and farm prices are all exogenously determined. Further, only a limited proportion of farm value added is counted as household income for purposes of assessing household consumption expenditure. Farm wages, salaries and supplements are included in household income for this purpose, as are those parts of the interest and dividend payments by the farm sector which eventually accrue to non-farm households. However, the income of farm unincorporated enterprises (which can be broadly interpreted as the income of farm households) is not inluded. It is clear that this approach can be interpreted as an assumption that the marginal propensity to consume out of farm household income is zero.

5. Some of the material in this section has been presented earlier in O'Mara, Nguyen and Adams (1984) - particularly pp.2-6.

Several other features of N.I.F. 10 are worth noting. Firstly, the specification of the various investment equations in the model allows no role for farm 'residual funds' to influence the farm component of aggregate investment expenditure. Secondly, at least in the forecasting version of N.I.F. 10, the demand for money, interest rates, net capital inflow and the state of the balance of payments are either ignored or treated as exogenous variables.[6] Therefore, the model can provide little guidance as to the impact of a shock in the farm sector on any of these important macroeconomic variables - variables on which considerable emphasis was placed in the theoretical analyses presented in earlier chapters.

A markedly different approach to the treatment of the farm sector is adopted in R.B.A. 76/79 - see for example, Reserve Bank of Australia (1977), Jonson and Trevor (1981). In that model, rather than distinguishing between the farm and non-farm components of most major aggregates and treating the former exogenously (as is the case in N.I.F. 10), only the aggregates of the farm and non-farm components are considered. In that sense, there is much greater endogeneity of the farm sector in the R.B.A. model that in N.I.F. 10. However, it is also clear that this specification is not easily amenable to an examination of, for example, production or price shocks which are peculiar to the farm sector.

The absence of any distinction between farm and non-farm income in the consumption function can be interpreted as an assumption that the marginal propensity to consume by farm households is equal to that of non-farm households. This assumption lies at the opposite extreme to the corresponding assumption in N.I.F. 10. The treatment of aggregate

6. An attempt was made to close the model for some of these variables in a recent, largely experimental, simulation version of N.I.F. 10 - see, for example, Johnston, et al (1982).

investment expenditure in R.B.A. more closely parallels that in N.I.F. 10 in that it allows no role for farm residual funds to influence the farm component of aggregate investment.

The specification of the export equations in R.B.A. should also be noted. In R.B.A. 76, aggregate exports were specified to be influenced partly by demand and partly by supply factors. In R.B.A. 79, however, the specification was modified so that exports essentially became a function of demand factors alone, ie relative prices and the volume of world trade. The relevance of such a specification to at least some of the farm components of aggregate exports would seem to be open to question. For example, under the circumstances postulated under the first paradigm, as examined in Chapter III, a major cause of variations in the volume of farm exports would be variations in the volume of farm production, while, under the third paradigm, variations in stockholding of farm commodities would be important. In that sense, this specification for exports may be more restrictive than the exogeneity asumption adopted in N.I.F. 10.

Finally, variables such as the demand for money, interest rates, net capital inflow and the balance of payments are endogenised in the R.B.A. model. This may circumvent some of the limitations noted above with respect to N.I.F. 10.

The model developed by Nevile (1975) is broadly similar to N.I.F. 10 in its treatment of the farm sector. Farm income is given exogenously and plays no role in either household consumption expenditure or dwelling investment. Similarly, no allowance is made for farm residual funds to influence aggregate investment expenditure in the model. That part of farm value added which remains after farm income is subtracted is included as a component of non-farm income, and is therefore allowed to influence consumption expenditure and

dwelling investment. The model abstracts completely from the money market, interest rates, net capital inflow and the overall state of the balance of payments.

In its short-run mode, the ORANI model - see for example, Dixon et al (1977), Dixon et al (1979), Freebairn (1980), University of Melbourne (1983) - could be used to assess some of the implications of a production or price shock in the farm sector. For example, in the presence of a change in farm prices or an exogenous change in farm production, ORANI could be used to make some assessment of the likely changes in farm production and employment at an industry level, and changes in the volume of non-primary inputs used in the farm sector. However, the linkages between the farm sector and the macroeconomy, which are captured in ORANI, are relatively weak. This issue will be discussed in a little more detail in Chapter IX, in the context of a review of a study undertaken by Campbell, Crowley and Demura (1983) using the ORANI model. It is sufficient to note, at this stage, that ORANI simulations typically proceed on the assumption that the aggregate level of consumption and investment expenditure is given. Hence, while the first round effects of the relevant shock may be captured, subsequent multiplier effects typically are not.

Further, as is also the case with N.I.F. 10 and the Nevile model, ORANI abstracts from, or treats exogenously, variables such as the demand for money, interest rates, capital flows and the overall state of the balance of payments. The fact that ORANI is essentially a general equilibrium model, based predominantly on input-output tables obtained for a particular base year, also serves to limit its usefulness as a framework for analysing long series of historical data.

It may be possible to overcome some of these problems when ORANI is linked with the MACRO interface of the IMPACT Project - see, for

example, Cooper and McLaren (1983). It is important to note, however, that the MACRO interface is based on the R.B.A. model. Therefore, some of the limitations noted above with respect to the R.B.A. model, particularly the treatment of farm consumption, farm investment and farm exports in that model, would seem to carry over to any combined ORANI/MACRO analysis.

Finally, the I.M.P. model, developed by the Melbourne Institute of Applied Economic and Social Research - see, for example, Brain (1977) - contains a large and detailed module for the agricultural sector - see Smith and Smith (1976), University of Melbourne (1983). However, the formal linkages from the agricultural module to the remainder of the model are not well documented. Hence, the adequacy of such linkages in the model cannot be easily assessed. Further, it has been stressed by the model builders that the primary function of the model is to undertake medium to long-term projections and forecasts - typically over a period of 5-20 years - see University of Melbourne (1983 , p.55). Therefore, its usefulness for relatively short term analyses is unclear. The specification of the agricultural module would also seem to be more detailed at an industry and microeconomic level than is necessary, or convenient, for an analysis of macro/farm linkages.

In general, then, it would seem that the existing macroeconomic models in Australia are not well suited to analyses in which the central issue is the linkages between the farm sector and the macroeconomy, particularly in the short to medium term. For example, the specification of some of the models (N.I.F., Nevile and ORANI) does not capture the linkage between the farm sector and such macroeconomic variables as the demand for money, interest rates and the state of the balance of payments. Further, ORANI only captures the

direct, impact effect of a shock in the farm sector on G.D.P., rather than the total multiplier effect. In addition, some of the linkages which are incorporated into the models would seem to be empirically suspect - for example, the assumption in N.I.F. and Nevile that the marginal propensity to consume by farm households is zero, or in R.B.A. that the marginal propensity to consume by farm households is equal to its counterpart in the non-farm sector.

It is argued in Chapter IX that very few attempts have been made in Australia to analyse, either theoretically or empirically, the impact of developments in the farm sector on important macroeconomic variables in the short to medium term. This may well reflect the absence of a suitable macroeconomic framework for this purpose in Australia. It is interesting to observe, in this regard, that the most noteworthy attempt to date to assess the contribution of the farm sector to short run variations in G.D.P. - that presented by Gray and Gruen (1981, 1982) and extended and refined by Gray (1984) - was undertaken using a growth decomposition model developed by those authors quite independently of any of the existing models discussed above.

Finally, it might be noted that the Australian experience in this area is not necessarily shared by other countries. For example, numerous econometric models are available for the United States economy which either focus on the farm sector, or which incorporate a block of equations for the farm sector into a macroeconomic model. It is beyond the scope of the current chapter to review these models in detail. An extensive review and critique of many of the models was recently undertaken by Freebairn et al (1981). Perhaps the main implication to emerge from that review, for present purposes, is that a paucity of such models exists in Australia relative to the number, size and complexity of the models developed in the United States.

Section V Concluding Comments on Chapter VIII

In Chapter VIII, some empirical literature on farm consumption and investment behaviour was reviewed. Farm consumption and investment expenditure represented one of the more important of the linkages between the farm sector and the macroeconomy that were incorporated into the theoretical analyses undertaken in earlier chapters. It is also central to the simple quantitative model developed in Chapter IX.

It was argued that there was no consensus in the empirical literature as to the actual value of the marginal propensity to consume by farm households. However, it was noted that most estimates were consistent with the more general proposition that the short run marginal propensity to consume by farm households was greater than zero but less than its counterpart in non-farm households. Such a result seemed to be consistent with the spirit of the permanent income and life cycle hypotheses of consumption behaviour, given that farm incomes have traditionally been more unstable than non-farm incomes. However, it was also noted that there was some evidence that the long run marginal propensity to consume by farm households was less than that of non-farm households, and that such a result was less easily rationalised in terms of the popular consumption theories.

The empirical literature on farm investment behaviour was then reviewed. It was observed that most empirical studies explicitly allowed for a residual funds effect on farm investment, and found it to be statistically significant. A relatively wide range of estimated values for the marginal propensity to invest out of farm residual funds seemed to emerge from the literature. It was argued, on theoretical grounds, that it was probable that the marginal propensity to invest would, in fact, vary substantially over time and across

industries and regions. It was also argued that the value of the marginal propensity to invest, as estimated in these various studies, may have been understated because of the data and model specifications used.

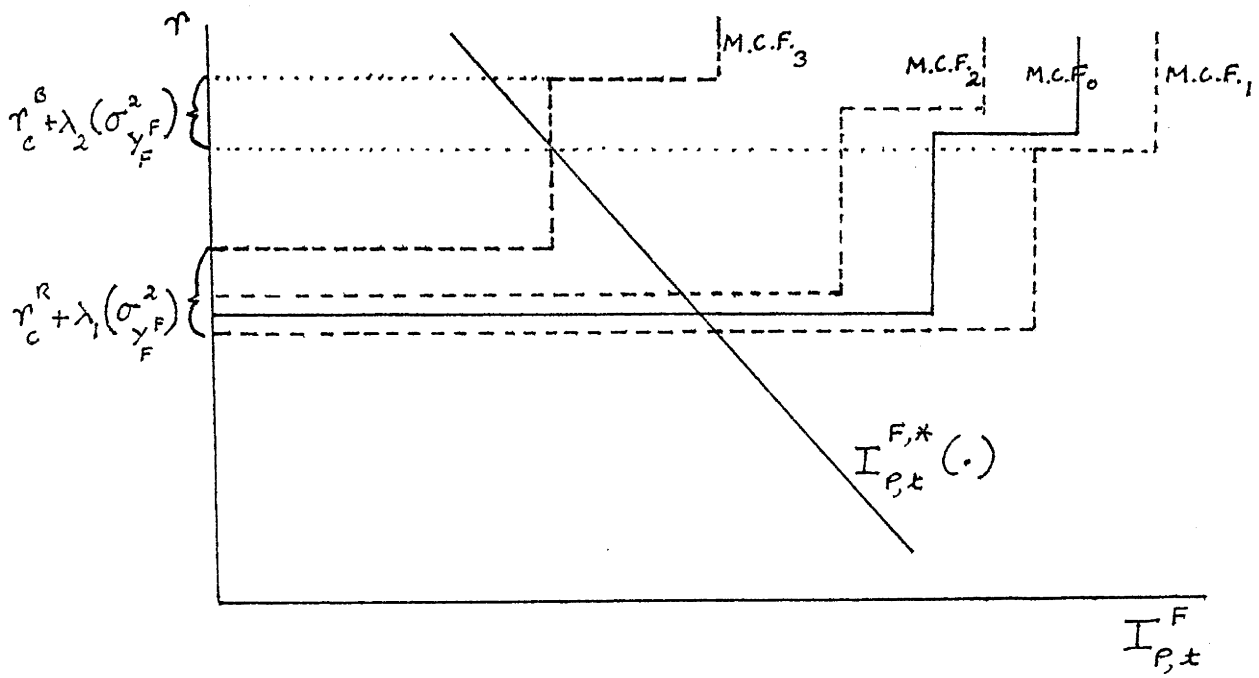
Finally, in the light of this review of the empirical literature on farm consumption and investment behaviour, and in the light of the theoretical analyses presented in earlier chapters, it was argued that the existing Australian macroeconomic models were not well suited to analyses in which the central issue is farm/macro linkages. It was noted that a number of the important linkages stressed in the earlier theoretical analyses were not captured at all in some of these models. It was also noted that, to the extent that the important linkage coming through farm consumption and investment behaviour was captured, it tended to be empirically unsatisfactory, given the literature in this area. It was common to assume that either the marginal propensity to consume by farm households was zero, or equal to its counterpart in the non-farm sector - neither of which receive strong empirical support. Similarly, the residual funds effect on farm investment expenditure tended to be largely ignored.

Looking ahead to Chapter IX, a simple quantitative model is developed there which is consistent with the spirit of the theoretical models presented in earlier chapters. It captures some of the more important linkages from the farm sector to the macroeconomy identified in those models and draws heavily on the existing empirical literature on farm consumption and investment behaviour reviewed in the present chapter. It is used to make some, albeit tentative and preliminary, assessment of the short run impact of developments in the farm sector on non-farm and total G.D.P. in Australia over the period since the early 1950s.

Appendix

CASE A

FIGURE VIII(2)



In Figure VIII(2), the horizontal regions of the four M.C.F. schedules, M.C.F.$_0$, M.C.F.$_1$, M.C.F.$_2$ and M.C.F.$_3$, should of course, be coincident, but have been drawn parallel for ease of exposition. Suppose that, in some initial situation, the notional investment schedule is given by $I^{F,*}_{P,t}$ and the marginal cost of funds schedule is given by M.C.F.$_0$. It is clear that, in such a situation, the notional level of investment is, in fact, realised, and is financed entirely out of residual funds. Now suppose that a short term beneficial price or weather shock occurred in the farm sector, so that residual funds increased, and the M.C.F. schedule shifted to the right to M.C.F.^{1}. Also suppose that these short term developments were ignored by farmers in ascertaining their optimal capital stock, so

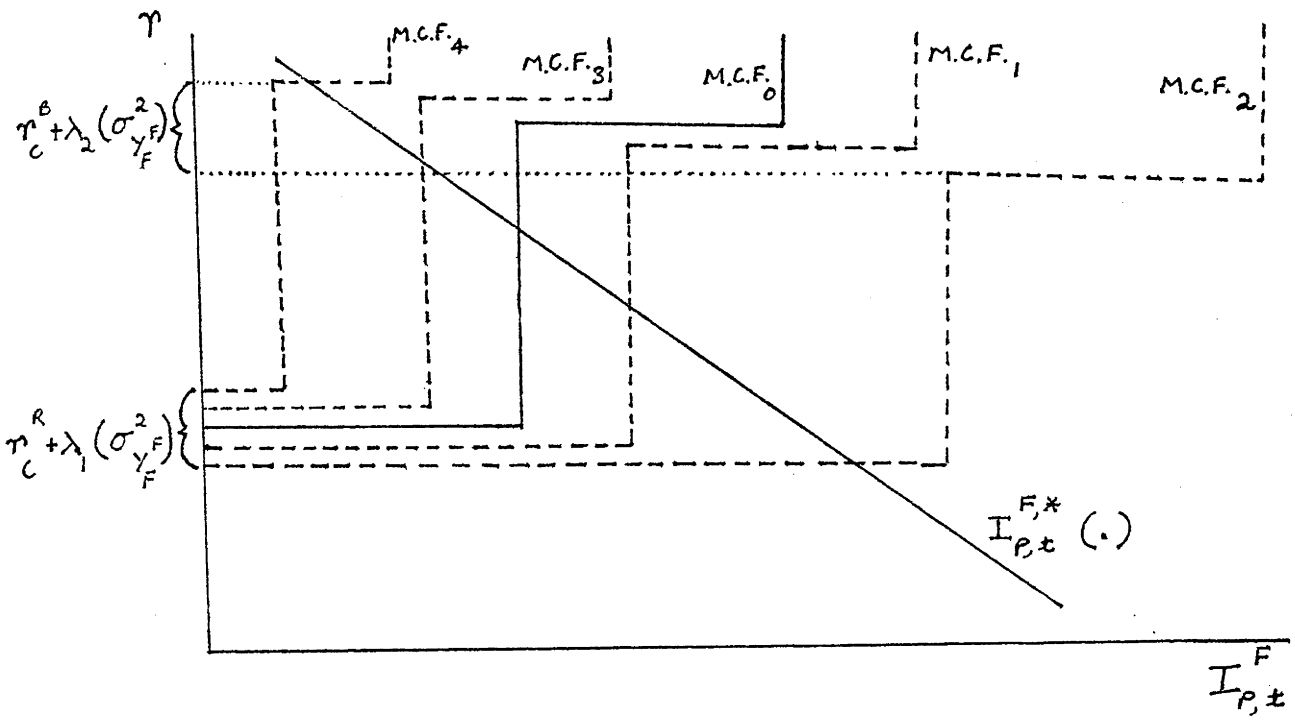
that the $I^{F,*}_{P,t}$ schedule remained unchanged. It is immediate that the rise in residual funds would have no impact on the actual level of investment expenditure. In other words, the marginal propensity to invest out of residual funds is zero.

Now suppose that the short term shock in the farm sector had been adverse, ie that residual funds had fallen. Two scenarios can be readily identified. Firstly, if the M.C.F. schedule had moved to the left to some position such as $M.C.F._2$, then the notional level of investment would continue to be realised and, again, the marginal propensity to invest out of residual funds is zero. Alternatively, if the M.C.F. schedule moved to a position such as $M.C.F._3$, then the actual level of investment would fall below its notional level, and the marginal propensity to invest out of residual funds would be greater than zero.

In Case A, therefore, the marginal propensity to invest would be zero if residual funds increased, and could take any value between zero and unity if residual funds declined.

CASE B

FIGURE VIII(3)



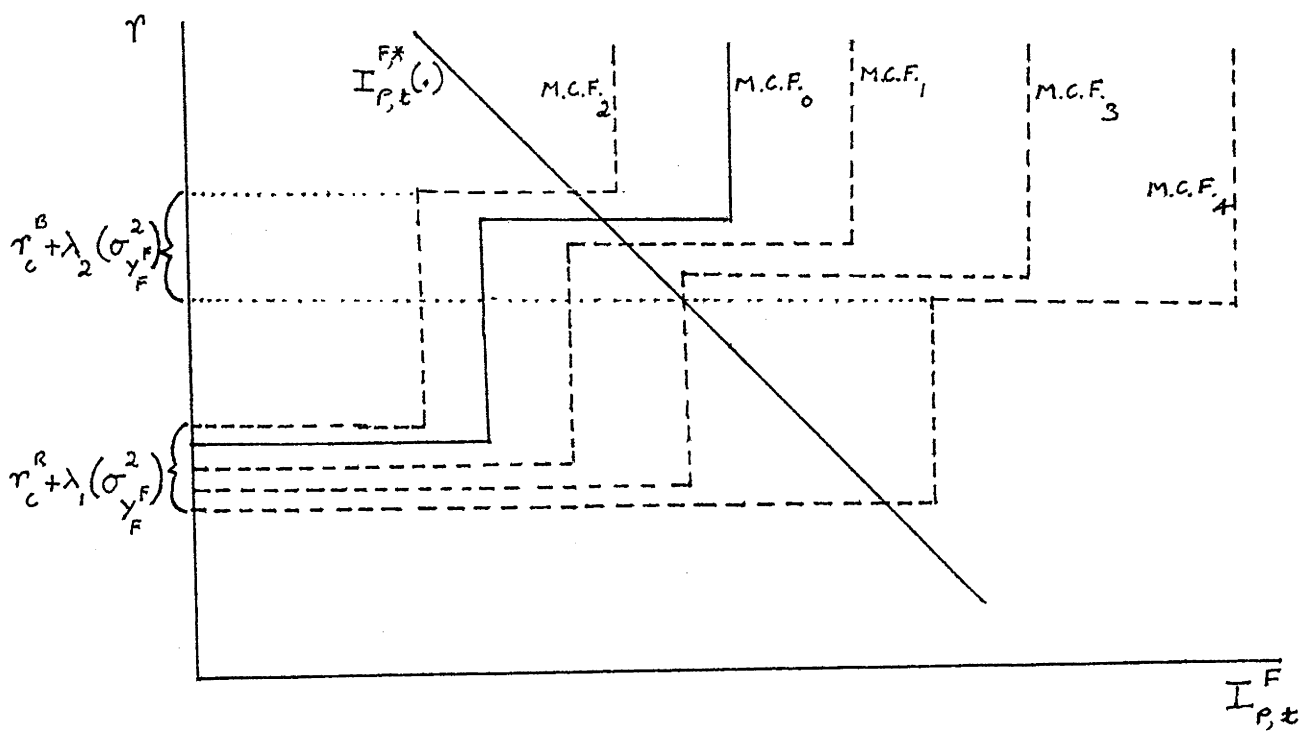
In Figure VIII(3), assume that the initial position of the M.C.F. schedule is represented by M.C.F.$_0$, with the investment schedule fixed at $I^{F,*}_{P,t}$. In this case, the notional level of investment is realised, and financed entirely from residual funds. It is clear that, in the presence of a short term shock which increased residual funds sufficiently to shift M.C.F. from M.C.F.$_0$ to M.C.F.$_1$, investment expenditure would rise by the full amount of the increase in residual funds, ie the marginal propensity to invest out of residual funds would be unity. However, if M.C.F. had moved from M.C.F.$_0$ to M.C.F.$_2$, then investment would have increased by less than the rise in residual funds, ie. the marginal propensity to invest would be greater than zero but less than unity. Similarly, if an adverse short

term shock reduced residual funds sufficiently to shift M.C.F. to the left from $M.C.F._0$ to $M.C.F._3$, then investment would fall by the full amount of the fall in residual funds. Alternatively, if M.C.F. had moved to $M.C.F._4$, then investment would have fallen by less than the fall in residual funds.

In Case B, then, a marginal propensity to invest greater than zero would be expected, regardless of whether residual funds increased or declined. Further, a marginal propensity to invest equal to unity is a plausible outcome, for both an increase and a decline in residual funds.

CASE C

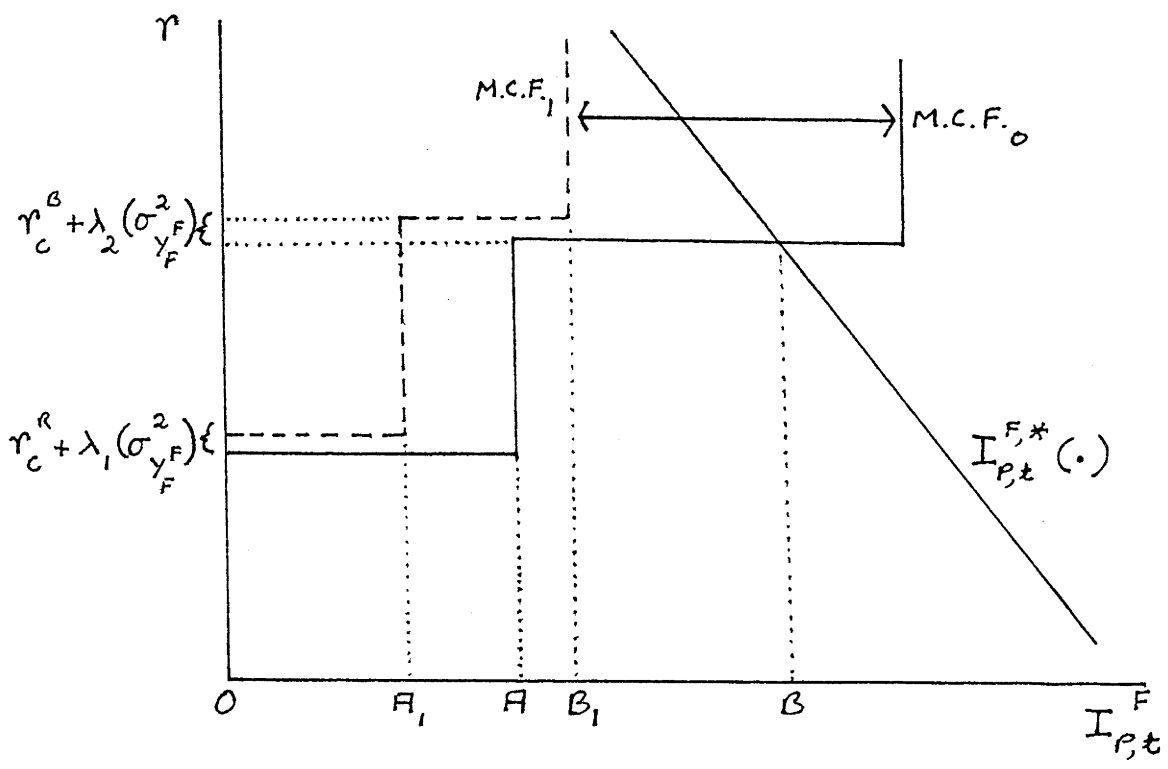
FIGURE VIII(4)



In Figure VIII(4), if the initial M.C.F. schedule is $M.C.F._0$, then the notional level of investment expenditure is being realised, financed partly by residual funds and partly by borrowed funds. If a short term increase in residual funds occurred, sufficient to shift M.C.F. from $M.C.F._0$ to $M.C.F._1$, then no change in investment expenditure would occur. A similar conclusion would hold for a decline in residual funds sufficient to shift M.C.F. from $M.C.F._0$ to $M.C.F._2$. In either case, therefore, the marginal propensity to invest is zero. Alternatively, if residual funds increased sufficiently to shift M.C.F. from $M.C.F._0$ to some position such as $M.C.F._3$ or $M.C.F._4$, then some increase in investment expenditure would occur, but by less than the increase in residual funds.

CASE D

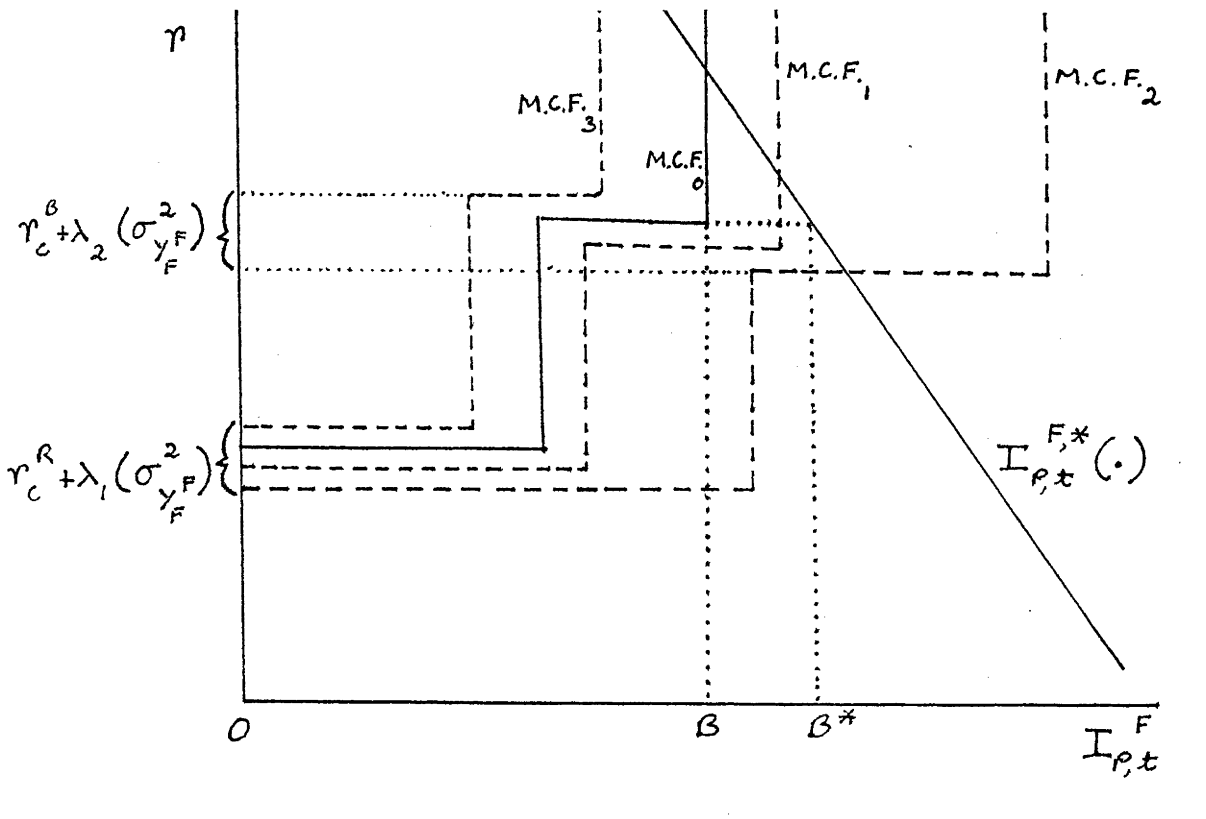
FIGURE VIII(5)



Case D is similar to Case C in that, in the initial situation, with M.C.F. represented by $M.C.F._0$, the notional level of investment is realised, financed partly by residual funds, and partly by commercial borrowing. Suppose that residual funds decline sufficiently to shift M.C.F. to the left from $M.C.F._0$ to $M.C.F._1$. It is clear that the level of investment would decline from OB to OB_1 and that OB_1 does not represent the notional level of investment, ie the rationing of credit from commercial sources is effective in this new situation. It will be recalled that, by assumption, the rationed volume of credit available from commercial sources is an increasing function of $Y^F_{F,t}$. Therefore, the horizontal distance between the second vertical region of $M.C.F._0$ and the second vertical region of $M.C.F._1$ (as indicated by the arrows in Figure VIII(5)) is greater than the decline in residual funds. Hence, it is <u>possible</u> that (as drawn), the decline in investment expenditure from OB to OB_1 could exceed the decline in residual funds, from OA to OA_1. In other words, it is possible that the marginal propensity to invest out of residual funds could exceed unity in this situation.

CASE E

FIGURE VIII(6)



In Case E, in the initial situation, with M.C.F. represented by M.C.F.$_0$, rationing of credit from commercial sources is effective so that the notional level of investment is not realised. In other words, given $r_c^B + \lambda_2(\sigma^2_{Y_F})$, the notional level of investment expenditure is OB*, but the actual level of investment is restricted to OB.

Suppose that residual funds increased sufficiently to shift M.C.F. to the right from M.C.F.$_0$ to M.C.F.$_1$, so that credit rationing remained effective. Recalling that the horizontal distance between the second vertical region of M.C.F.$_0$ and the second vertical region of M.C.F.$_1$ is greater than the increase in residual funds, then it is clear that the rise in investment expenditure would exceed the increase in residual funds, ie the marginal propensity to invest out

of residual funds would exceed unity. Alternatively, if the increase in residual funds shifted M.C.F. from $M.C.F._0$ to $M.C.F._2$ then credit rationing would become ineffective, and the marginal propensity to invest could be greater than, equal to or less than unity.

Finally, if residual funds fell, then M.C.F. would shift to the left from $M.C.F._0$ to some position such as $M.C.F._3$. In this case, credit rationing would remain effective, and the marginal propensity to invest would exceed unity.

CHAPTER IX

THE CONTRIBUTION OF THE FARM SECTOR TO ANNUAL VARIATIONS IN NON-FARM AND TOTAL G.D.P. - SOME RESULTS FROM A SIMPLE EMPIRICAL VERSION OF THE MODEL

Introduction

In Chapter VIII, it was argued that the existing macroeconomic models in Australia represent largely unsatisfactory frameworks for assessing such issues as the contribution of the farm sector to short term variations in important macroeconomic variables. It was also suggested that the relative paucity of published studies in this area reflected, at least in part, this lack of a suitable analytical and quantitative framework. While a major objective of the line of research commenced in this thesis is to develop a model capable of filling this gap, it has not proved possible to develop a fully operational, quantitative version of the complete model within the confines of the thesis. Some further, post thesis, research will be required to bring the project fully to fruition. Therefore, as an interim measure, it was considered desirable to use a simplified version of the theoretical model developed in earlier chapters in order to obtain some tentative and preliminary quantitative results relevant to the Australian economy. This simple quantitative version of the model, and the results obtained, are presented in the current chapter.

It was felt that the most useful variables to focus on in this exercise were non-farm and total G.D.P. These are obviously major policy variables (and carry with them reasonably direct, intuitive, implications for another major policy variable - unemployment). The time period considered in the study is 1953-54 to 1982-83 - a period

in which a wide range of short term shocks occurred in the volume of farm production and/or farm prices in the context of ongoing structural change in the farm and macroeconomies. As we shall see, some of the results obtained would seem to be not strictly in accord with conventional wisdom, and hence may stimulate some further analysis and discussion during the period leading up to the development of the empirical version of the complete model. The results are also suggestive of some important hypotheses which should be subsequently tested within the context of the empirical version of the complete model.

In Section II, the simple quantitative version of the model is presented and discussed. In Section III, the various sets of parameter combinations used in the simulations are presented. This section draws extensively on the review of the literature on farm consumption and investment behaviour presented in Chapter VIII. Some data considerations are outlined in Section IV (all of the data used in the model is documented in detail in an Appendix). Then, in Section V, the empirical results are summarised and discussed. In Section VI, some results obtained from two other relevant studies - firstly, that undertaken by Gray and Gruen (1981, 1982) and subsequently revised and refined by Gray (1984), and, secondly, that undertaken by Campbell, Crowley and Demura (1983) - are presented and compared and contrasted with the relevant results from the present analysis. Finally, some of the main results and conclusions are drawn together in Section VII.

Section II. The Simple Quantitative Model

II(1). Notation

As far as possible, the notation is identical to that used in the original theoretical model developed in earlier chapters:

O_F - the volume of farm production

J - the volume of non-primary inputs used in the farm sector

J_{NT} - that part of J produced in the non-traded goods sector

Y_F - real gross farm product

p_F - the implicit deflator for farm production

p_j - the implicit deflator for non-primary inputs

y_F - nominal gross farm product

$y_F{}^F$ - farm household income

$y_F{}^{NF}$ - that part of y_F which accrues to non-farm households

Y_{NF} - real gross non-farm product

Y - real gross domestic product

p - the deflator for nominal expenditure originating from farm households

p_c - the implicit consumption deflator

II(2). Model Specification

(1) $Y_F = O_F - J$ - real gross farm product is equal to the volume of farm production less the volume of non-primary inputs used.

(2) $y_F = p_F O_F - p_j J$ - nominal gross farm product is obtained by reversing the double deflation procedure.

(3) $y_F = y_F^F + y_F^{NF}$ - it is assumed that nominal gross farm product accrues either to farm or to non-farm households. Then:

(4) $$p_F O_F = y_F^F + y_F^{NF} + p_j J$$
$$= y_F^F + y_F^{NF} + p_j J_{NT} + (p_j J - p_j J_{NT})$$

ie. the nominal gross value of farm production is assumed to be equal to the nominal income accruing to farm households, plus that part of farm value added which accrues to non-farm households, plus the nominal value of non-primary inputs used in the farm sector and produced in the non-traded goods sector, plus the nominal value of non-primary inputs used in the farm sector and produced either in the farm sector, or in the non-farm traded goods sector.

It is assumed that:

(5) $$\Delta Y_{NF}/\Delta p_F O_F = \Delta Y_{NF}/\Delta y_F^F + \Delta Y_{NF}/\Delta y_F^{NF} + \Delta Y_{NF}/\Delta p_j J_{NT} + \Delta Y_{NF}/\Delta(p_j J - p_j J_{NT})$$

where $\Delta y/\Delta x$ is to be interpreted as the discrete change in y which can be attributed to a discrete change in x.

It is further assumed that:

$$(6) \quad \Delta Y_{NF}/\Delta y_F^{\ F} = \Delta\left(\frac{y_F^{\ F}}{p}\right) \left(\sigma_F\right) \left(k\right)$$

In (6), σ_F is a conversion factor to transform $\Delta\left(\frac{y_F^{\ F}}{p}\right)$ into an appropriate multiplicand. This multiplicand will be defined as the initial change in expenditure on (and therefore production of) non-farm output as a direct result of the change in $\frac{y_F^{\ F}}{p}$. The term, k, represents the <u>induced</u> non-farm multiplier over the relevant period - in this case, one year, ie. the extent to which the multiplicand, as defned above, is multiplied over that period. It should be noted that the induced multiplier is a concept quite distinct from the more common concept of a total multiplier. In terms of equation (6), the total multiplier could be defined as:

$$(6') \quad k_T = \frac{\Delta\left(\frac{y_F^{\ F}}{p}\right) \left(\sigma_F\right) \left(k\right)}{\Delta\left(\frac{y_F^{\ F}}{p}\right)} = \sigma_F k$$

Following a similar line of reasoning as used to obtain (6):

$$(7) \quad \Delta Y_{NF}/\ \Delta y_F^{\ NF} = \Delta\left(\frac{y_F^{\ NF}}{p_c}\right) \left(\sigma_{NF}^{\ F}\right) \left(k\right)$$

It is assumed that the most appropriate deflator for $y_F^{\ NF}$ is the implicit consumption deflator, p_c. The term $\sigma_{NF}^{\ F}$ has a similar interpretation to that outlined above for σ_F, but will not, in general, be assumed to take the same numerical value as σ_F. As before, k represents the induced non-farm multiplier.

$$(8) \quad \Delta Y_{NF}/\Delta p_j\ J_{NT} = \Delta J_{NT} + \Delta\left(\frac{p_j J_{NT}}{p_c}\right) \left(\sigma_j^{\ NT}\right) \left(k\right)$$

In the first instance, ΔJ_{NT} impacts directly on non-farm output, by

definition. Then, to the extent that this change in production and income in the non-farm sector induces a change in expenditure and hence subsequent multiplier effects in the non-farm sector, this is captured in the second term on the R.H.S. of (8). This, of course, is quite consistent with the treatment of J in the theoretical analyses presented in earlier chapters. There, it was assumed, for simplicity, that J was drawn entirely from the non-traded goods sector, and changes in J were explicitly fed directly into the total demand for, and hence production of, non-traded goods. In (8), σ_j^{NT} has a similar interpretation to σ_F and σ_{NF}^{F}, and k is again the induced non-farm multiplier.

$$(9) \quad \Delta Y_{NF} / \Delta(p_j J - p_j J_{NT}) = 0$$

Equation (9) says that a change in the usage of non-primary inputs in the farm sector which are drawn either from the farm sector itself, or from the non-farm traded goods sector, has no impact on non-farm production. In other words, it is assumed that, as in Models I, II, III, IV and V in earlier chapters, the non-farm traded goods sector operates along 'classical' lines, so that a change in the demand for non-farm traded goods has no effect on production in that sector - rather, it is absorbed via a change in the balance of trade.

From (5), (6), (7), (8) and (9)

$$(10) \quad \Delta Y_{NF} / \Delta p_F 0_F = \left[\Delta\left(\frac{y_F^F}{p}\right)\left(\sigma_F\right)\left(k\right) + \Delta\left(\frac{y_F^{NF}}{p_c}\right)\left(\sigma_{NF}^{F}\right)\left(k\right) + \Delta J_{NT} + \Delta\left(\frac{p_j J_{NT}}{p_c}\right)\left(\sigma_j^{NT}\right)\left(k\right)\right]$$

and

$$(11) \quad \Delta Y / \Delta p_F 0_F = \Delta Y_{NF} / \Delta p_F 0_F + \Delta Y_F$$

In their present form, equations (10) and (11) would only be strictly relevant to those cases where (a) the shock was a pure volume shock; and (b) the change in output was absorbed entirely by exports of farm commodities at unchanged prices. Suppose, however, that the change in the volume of farm output needed to be absorbed on the domestic market, with no change in buffer stockholding, thus requiring a change in the relative price of farm and non-farm commodities. The various farm industries whose marketing and institutional arrangements might be consistent with such an outcome were identified and discussed in Chapter II, and this case was examined at some length in the theoretical analysis in Chapter IV. In addition to the various impacts on non-farm and total output captured in equations (10) and (11), the changed volume, and hence price, of farm output, would impinge directly on the market for non-farm commodities by creating an expenditure switching effect. The resulting simultaneity problem was discussed at length in Chapter IV. For present purposes, it is sufficient to recall that the farm commodity market needed to clear within the context of a given level of aggregate nominal expenditure. If nominal expenditure on farm output were to rise, nominal expenditure on non-farm output would fall, and conversely. In other words, the own price elasticity of demand for farm commodities is crucial. In particular:

$$(12) \qquad \frac{\Delta z^F}{z^F} \doteqdot \left(\frac{\Delta O_F}{\frac{Z^F}{\varepsilon}} + \frac{\Delta O_F}{Z^F} \right)$$

where z^F is domestic nominal expenditure on farm output, Z^F is the volume of domestic expenditure on farm output, and ε is the own price elasticity of demand for farm output. The two components on the R.H.S. of (12) will be opposite in sign (defining ε as negative), so that the sign of the term on the L.H.S. would depend

crucially on the value of ε.

From (12)

$$(13) \quad \Delta z^F \doteqdot \left(\frac{\Delta 0_F}{\frac{Z^F}{\varepsilon}} + \frac{\Delta 0_F}{Z^F} \right) z^F$$

Then

$$(14) \quad \Delta Y_{NF}/\Delta z^F = -\Delta\left(\frac{z^F}{p_c}\right) \left(\sigma\right) \left(k\right)$$

ie. the change in nominal expenditure on non-farm commodities is equal in magnitude but opposite in sign to the change in nominal expenditure on farm commodities. It is assumed that most of the expenditure switching effect falls on consumer goods, so that p_c can be used as the relevant deflator. The conversion factor, σ, will, in general, take a different numerical value to σ_F, σ_{NF}^F and σ_j^{NT}.

Therefore, for analyses of endogenous price changes, equations (10) and (11) would need to be modified by the inclusion of (14).

$$(10') \quad \Delta Y_{NF}/\Delta p_F 0_F = \Bigg[\Delta\left(\frac{y_F^F}{p}\right) \left(\sigma_F\right) \left(k\right) + \Delta \left(\frac{y_F^{NF}}{p_c}\right)\left(\sigma_{NF}^F\right) \left(k\right)$$
$$+ \Delta J_{NT} + \Delta\left(\frac{p_j J_{NT}}{p_c}\right) \left(\sigma_j^{NT}\right) \left(k\right) - \Delta\left(\frac{z^F}{p_c}\right) \left(\sigma\right) \left(k\right) \Bigg]$$

$$(11') \quad \Delta Y/\Delta p_F 0_F = \Delta Y_{NF}/ \Delta p_F 0_F + \Delta Y_F$$

It needs to be recognised, of course, that the value used for p_F in (2) and hence in (3), to obtain values for y_F^F and y_F^{NF}, should be consistent with the p_F implied by $\dfrac{\Delta 0_F}{\frac{Z^F}{\varepsilon}}$ in (12) and (13).

In Chapter II, it was argued that, despite the complexity of the marketing and institutional arrangments for many of Australia's farm commodities, it would still be expected that, for most of those

commodities, an exogenous price change on overseas markets would filter through to the prices received by producers and paid by local consumers, at least to some degree. On that basis, the case of an exogenous price change was examined in some detail in the theoretical analysis presented in Chapter VI. It is clear that, in this case too, the impact on the non-farm sector of any expenditure switching effect produced by such an exogenous price change for farm commodities should be considered. Following a similar line of reasoning to that used above, it follows that:

$$(15) \qquad \Delta z^F \doteq \left[\frac{\frac{\Delta p_F}{p_F}}{\frac{1}{\varepsilon}} + \frac{\Delta p_F}{p_F} \right] z^F$$

where Δp_F is the exogenous price change, and ε is, as before, the own price elasticity of demand for farm commodities. Then:

$$(16) \qquad \Delta Y_{NF}/\Delta z^F = -\Delta\left(\frac{z^F}{p_c}\right) \left(\sigma \right) \left(k \right)$$

As before, equations (10) and (11) would need to be modified to (say) (10") and (11") by the inclusion of (16).

Finally, it should be noted that the distinction between (13) and (15) and hence between (14) and (16), would only be of consequence where the model was being used to examine hypothetical shocks, or to make forecasts. However, where it is being used to examine actual historical data, so that a measure of the actual value of $\Delta\left(\frac{z^F}{p_c}\right)$ can be obtained for the aggregate of all the sources of such a change (ie. both exogenous and endogenous price changes), the distinction ceases to be important. In other words, for an examination of historical data, equations (10') and (11') can be used, regardless of the source of any price change which may have occurred.

Section III. Parameter Values for the Model

In Appendix I, several important marginal propensities are identified, a value or range of values for each is suggested (based, in large measure, on the review of the empirical literature presented in Chapter VIII) and the implied values for the various parameters in equations (10') and (11') are calculated. Of the combinations of marginal propensities, and hence parameter values, which are possible, 24 are examined in some detail in the present exercise. These chosen sets of parameter values are listed in Table IX(1)

While the model clearly draws heavily on the theoretical analyses presented in Chapters III to VII, there are several important issues which were examined in those earlier chapters which have not been explicitly considered in the simple quantitative version of the model. In general, these omissions were made in order to avoid excessive complexity in the present exercise. It is useful, however, to briefly review several of the more important of these issues because they have a bearing on the interpretation which should be placed on the numerical values chosen for the parameters in the model - particularly for the induced multiplier, k.

Firstly, countervailing interest rate effects, which were examined in some detail in the earlier chapters, including the potential importance of the ambiguity surrounding the appropriate scale argument in the demand for money function, have been ignored in the present exercise. In other words, the simple quantitative model captures only the horizontal movement of the IS_Y and IS_Z curves.

TABLE IX(1)

Combinations of Parameter Values for the Model

Marginal Propensities					Simulation Parameters			
MPC_{NF}	MPT	MPI	MPC_F	MPi_F	σ^{NF}	σ_F	σ	k
0.5	0.3	0.15	0	0	0.3	0	0.85	1.4
0.6	0.3	0.15	0	0	0.35	0	0.85	1.5
0.7	0.3	0.15	0	0	0.4	0	0.85	1.65
0.5	0.3	0.15	0.5	0	0.3	0.3	0.85	1.4
0.6	0.3	0.15	0.6	0	0.35	0.35	0.85	1.5
0.7	0.3	0.15	0.7	0	0.4	0.4	0.85	1.65
0.5	0.3	0.15	0.25	0.4	0.3	0.35	0.85	1.4
0.6	0.3	0.15	0.3	0.4	0.35	0.35	0.85	1.5
0.7	0.3	0.15	0.35	0.4	0.4	0.35	0.85	1.65
0.5	0.3	0.15	0.25	1	0.3	0.6	0.85	1.4
0.6	0.3	0.15	0.3	1	0.35	0.6	0.85	1.5
0.7	0.3	0.15	0.35	1	0.4	0.6	0.85	1.65
0.5	0.3	0.3	0	0	0.25	0	0.7	1.3
0.6	0.3	0.3	0	0	0.3	0	0.7	1.4
0.7	0.3	0.3	0	0	0.35	0	0.7	1.5
0.5	0.3	0.3	0.5	0	0.25	0.25	0.7	1.3
0.6	0.3	0.3	0.6	0	0.3	0.3	0.7	1.4
0.7	0.3	0.3	0.7	0	0.35	0.35	0.7	1.5
0.5	0.3	0.3	0.25	0.4	0.25	0.25	0.7	1.3
0.6	0.3	0.3	0.3	0.4	0.3	0.3	0.7	1.4
0.7	0.3	0.3	0.35	0.4	0.35	0.3	0.7	1.5
0.5	0.3	0.3	0.25	1	0.25	0.5	0.7	1.3
0.6	0.3	0.3	0.3	1	0.3	0.5	0.7	1.4
0.7	0.3	0.3	0.35	1	0.35	0.5	0.7	1.5

In general, it might be expected that interest rate movements would serve to partly counteract the effects of the horizontal movements of the IS curves, thus reducing the size of the induced non-farm multiplier, k, relative to the values listed in Table IX(1). This would reinforce the point, noted in Appendix I, that the value of k might also be overstated because of the time lags involved in the completion of later rounds of the income multiplier process. However, it was shown in the earlier theoretical analyses that, when balance of payments considerations were explicitly introduced, countervailing interest rate effects tended to become less important. In particular, the extent of the countervailing interest rate effect was determined by the slope and position of the TT schedule, rather than the LM curve. In the extreme case of perfect interest rate parity, the TT schedule became horizontal, and countervailing interest rate effects largely disappeared. It should also be recalled that, in analysing the first, second and fourth paradigms, in Chapters III, IV and VI, various scenarios were identified in which the 'countervailing' interest rate effect could, in fact, be perverse, ie. would reinforce, rather than counteract, the effect of the horizontal movement of the IS curves on aggregate production and expenditure. Therefore, there would seem to be some ambiguity as to the overall impact of the abstraction from interest rate effects in the present analysis. The value of k may not be seriously overstated, and may even be understated, at least in some periods.

In Chapter III, an attempt was made to consider the impact of a shock to farm output on such variables as non-traded goods prices and nominal and real wages. It was shown that the shock would, in

general, be expected to have some bearing on the level of production in the non-traded and non-farm traded goods sectors via these other variables. In particular, a degree of flexibility in nominal wages and non-traded goods prices would be expected to reduce the impact of the decline in farm production on overall G.D.P. However, this issue was not taken up in Chapters IV to VII, or in the present exercise, because of the inherent complexity of the analysis. More is said on the issue, however, in Chapter X and O'Mara et al. (1985), where theoretical simulation techniques are applied to Models I and II respectively.

In the theoretical models presented in earlier chapters, the specification of non-farm investment expenditure explicitly catered for an accelerator effect, which reinforced the multiplier effect coming through the various induced consumption responses. No allowance has been made for such an accelerator effect in the present exercise. If an accelerator effect on non-farm investment expenditure was felt to accord with reality, then the absence of such an effect in the simple quantitative model would probably be seen as causing some understatement of the size of the induced non-farm multiplier, k.

Finally, no consideration has been given to the effect of advance payment schemes which operated for several farm commodities over much of the observation period, and for which some changes occurred in the method of financing. However, the theoretical analysis presented in Chapter VII would seem to indicate that this particular omission may be of less concern. It was shown there that, under a wide range of circumstances, the method of financing

the advance payment scheme is of little consequence for variables such as the interest rate and the level of real G.D.P. (the latter being the focus of attention in the present exercise), although it could be of major consequence for the state of the balance of payments in the short run.

In general, then, these various simplifications serve to highlight the tentative and preliminary nature of the quantitative results obtained from the present exercise. They also suggest that there is some ambiguity as to the direction of any bias which may exist in the results. Therefore, it is clearly important that the results are carefully cross-checked against any results which may eventually be obtained from a more complete quantitative model in which these other linkages are captured.

Section IV. Data for the Model

Data was obtained for each of the variables appearing in equations (10') and (11') over the period 1952-53 to 1982-83, in order to allow those equations to be simulated over the period 1953-54 to 1982-83 (noting that the model utilises annual changes in the data.) All of the data used to form those variables are presented and discussed in Appendix II, and the sources of the data are documented in detail. For convenience, the final data actually used in the simulations are reproduced in Table IX(2).

TABLE IX(2)
Simulation Data

Year	$\Delta\left(\frac{y_F^F}{p_1}\right)$	$\Delta\left(\frac{y_F^F}{p_2}\right)$	$\Delta\left(\frac{y_F^F}{p_3}\right)$	$\Delta\left(\frac{y_F^{NF}}{p_c}\right)$	ΔJ_{NT}	$\Delta\left(\frac{p_j J_{NT}}{p_c}\right)$	$\Delta\left(\frac{3^F}{p_c}\right)$	ΔY_F
	$m	$m	$m	$m	$m	$m	$m	$m
1953-54	-129	-125	-139	34	25	15	-8	-91
1954-55	-142	-143	-139	13	-15	-20	-2	87
1955-56	9	7	15	-5	1	2	-24	101
1956-57	133	139	117	6	6	3	55	56
1957-58	-424	-427	-417	43	1	5	-61	-130
1058-59	244	245	240	-509	312	316	-53	-95
1959-60	41	44	35	-10	81	67	77	-102
1960-61	-21	-14	-40	-11	-11	-25	-99	64
1961-62	-83	-82	-82	8	68	83	-51	84
1962-63	194	195	189	21	25	10	6	189
1963-64	333	332	336	18	63	34	-124	33
1964-65	-156	-154	-164	15	1	-1	-90	94
1965-66	-303	-299	-311	4	65	64	110	-290
1966-67	331	331	330	23	-43	-33	-124	409
1967-68	-1005	-997	-1018	43	75	50	77	-844
1968-69	680	680	669	33	59	41	-310	1257
1969-70	-392	-387	-399	-14	75	6	-122	-443
1970-71	-381	-379	-384	-5	-113	-147	-422	-62
1971-72	332	285	326	-81	11	27	102	295
1972-73	837	898	810	13	69	39	-173	-682
1973-74	883	883	881	97	-5	-50	125	544
1974-75	-1726	-1766	-1629	45	-169	2	-1058	281
1975-76	-397	-399	-392	-63	-58	-5	-11	247
1976-77	40	39	46	-93	25	-7	-354	10
1977-78	-213	-217	-209	22	-65	-41	343	-243
1978-79	1498	1503	1492	-3	116	127	533	1244
1979-80	44	44	45	31	36	121	31	-404
1980-81	-691	-700	-668	46	-177	-81	-384	-562
1981-82	-457	-462	-446	25	60	87	135	1067
1982-83	-1795	-1788	-1811	256	-76	- 75	-471	-1359

$p_1 = p_c$

p_2 = simple average of the implicit deflators for private final consumption expenditure and private gross fixed capital formation.

p_3 = weighted average of the above two deflators.

-- indicates a change of base year for the various implicit deflators used.

Section V. Simulation Results

V(1). Main Features of the Results

Equations (10') and (11') were simulated over the period 1953-54 to 1982-83. With 24 combinations for the parameters in equation (10'), and with 3 alternative deflators for (Δy_F^F), 72 values were obtained for $\Delta Y_{NF}/\Delta p_F O_F$ each year. Similarly, 72 values were obtained for $\Delta Y/\Delta p_F O_F$ from equation (11') each year.

Some of the main features of the results are summarised in Table IX(3). For ease of exposition, some of these results are also reproduced in Graph IX(1).

Of the 24 combinations of parameters used in (10'), a 'best-bet' (or central scenario) combination was chosen to be the focal point in the analysis of the results. The best-bet combination was based on the following combination of marginal propensities:

$MPC_{NF} = 0.6$, $MPT = 0.3$, $MPI = 0.15$, $MPC_F = 0.5\ (MPC_{NF}) = 0.3$, $MPi_F = 0.4$. This implied the following combination of simulation parameters:

$$\sigma^{NF} = 0.35, \quad \sigma_F = 0.35, \quad \sigma = 0.85, \quad k = 1.5$$

It was assumed that the most consistent deflator for (Δy_F^F) in the presence of this best-bet combination was p_2, ie. a simple average of the private consumption and investment deflators.

In Table IX(3), the most positive value obtained for $\Delta Y_{NF}/\Delta p_F O_F$ from any of the combinations examined is also reported, as is the most negative value. This provides an

illustration of the range of values obtained for $\Delta Y_{NF} / \Delta p_F O_F$ from equation (10') each year.

The first broad conclusion which would seem to emerge from the results is that fluctuations in the nominal gross value of farm production, $\Delta p_F O_F$, do <u>not</u> seem to have become relatively less important as a source of change in non-farm economic activity over the period. Consider, for example, the ratio

$$(21) \quad \frac{| \Delta Y_{NF} / \Delta p_F O_F \text{ (best-bet)} |}{| \Delta Y_{NF} |}$$

Over the period 1953-54 to 1959-60, this ratio averaged .15. In other words, over that period the contribution of the farm sector (either positive or negative) to the annual change in non-farm output was about 15%. Over the period 1960-61 to 1971-72, the ratio averaged .25. Even if the relatively large observation of 1.18 in 1961-62 is removed, the average is .16. Similarly, over the period 1972-73 to 1982-83, the average value of the ratio is .30, or .20 if the relatively large observation of 1.31 in 1977-78 is removed.

A similar exercise can be undertaken for the maximum and minimum absolute values obtained for $\Delta Y_{NF} / \Delta p_F O_F$ each year. In the case of the maximum values, ratio (21) averaged .33 between 1953-54 and 1959-60, rising to .40 between 1960-61 and 1971-72 (or .28 without 1961-62), and rising further to .64 between 1972-73 and 1982-83 (or .55 without 1977-78). The corresponding figures for the minimum absolute ratios were .07 between 1953-54 and 1959-60, .11 between 1960-61 to 1971-72 (.05 without 1961-62), and .14 between 1972-73 and 1982-83 (.07 without 1977-78).

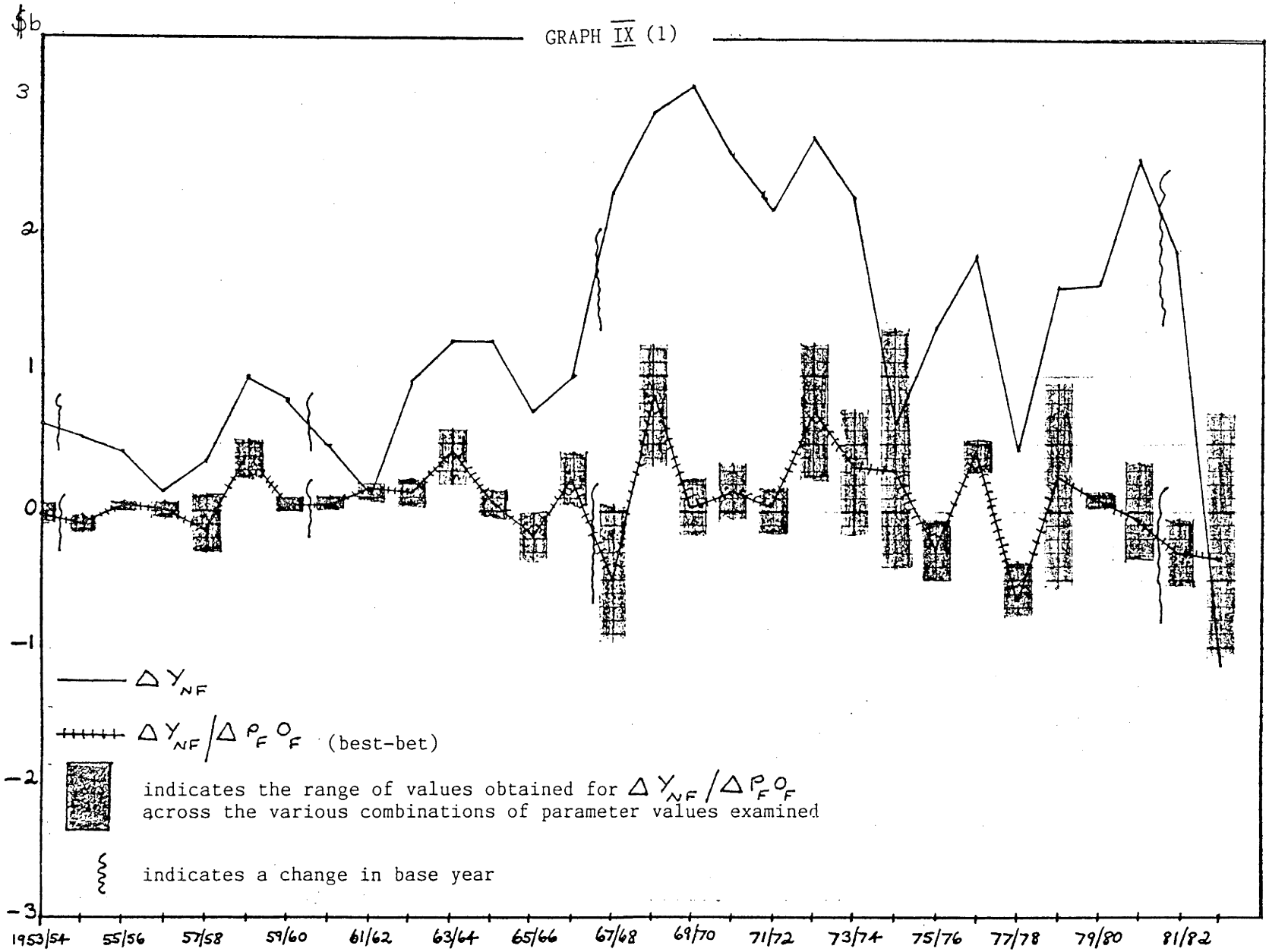
TABLE IX(3)

Summary of Simulation Results

Year	ΔY_{NF}	$\Delta Y_{NF}/\Delta p_F o_F$ Best-bet	Most Pos.	Most Neg.	ΔY_F
	$m	$m	$m	$m	$m
1953-54	634	-7	69	-69	-91
1954-55	544	-91	-15	-158	87
1955-56	455	35	48	22	101
1956-57	168	10	72	-65	56
1957-58	384	-119	118	-305	-130
1958-59	997	406	502	259	-95
1959-60	816	34	63	11	-102
1960-61	494	85	104	41	64
1961-62	116	137	200	90	84
1962-63	990	135	230	30	189
1963-64	1274	423	604	193	33
1964-65	1279	41	136	-26	94
1965-66	740	-199	-13	-352	-290
1966-67	1003	284	452	67	409
1967-68	2366	-502	43	-979	-844
1968-69	2942	850	1216	365	1257
1969-70	3139	21	241	-154	-443
1970-71	2623	145	379	-38	-62
1971-72	2215	27	161	-168	295
1972-73	2751	756	1235	244	-682
1973-74	2309	324	725	-149	544
1974-75	654	299	1346	-402	281
1975-76	1382	-288	-70	-483	247
1976-77	1899	445	501	315	10
1977-78	475	-624	-383	-773	-243
1978-79	1664	288	938	-550	1244
1979-80	1679	99	137	57	-404
1980-81	2599	-69	338	-355	-562
1981-82	1907	-293	-23	-513	1067
1982-83	-1119	-322	704	-1089	-1359

--- indicates a change in the base year for the various implicit deflators.

GRAPH IX (1)


$b
3
2
1
0
-1
-2
-3
ΔY_{NF}
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet)
indicates the range of values obtained for $\Delta Y_{NF} / \Delta P_F O_F$ across the various combinations of parameter values examined
indicates a change in base year
1953/54
55/56
57/58
59/60
61/62
63/64
65/66
67/68
69/70
71/72
73/74
75/76
77/78
79/80
81/82

These ratio calculations are presented in detail in Table IX(4).

This result is of considerable significance. On most of the more traditional measures, the "importance" of the farm sector to the overall economy has declined over the period since the early 1950s. For example, the share of farm gross product in G.D.P., the share of farm employment in total employment and the share of farm exports in total exports have all declined markedly - see Tables IX(5), IX(6) and IX(7). The results of the present analysis would indicate, however, that, based on what is arguably a more important measure - the role of the farm sector in producing short term changes in non-farm economic activity - the relative importance of the farm sector has not declined, and may well have increased. It is also important to note that this more general conclusion would not seem to be seriously affected by the inevitable degree of uncertainty which surrounds the choice of values for the simulation parameters, because the same combinations of parameter values have been used throughout.

When we move on to consider the results for some individual years or sub-periods, the simplifying assumptions on which the analysis is based, and the element of uncertainty which surrounds the choice of values for the simulation parameters obviously may take on more significance. It is sensible, therefore, to limit our attention to those periods in which the results are more striking, and even then to focus more on orders of magnitude than on specific numerical results.

It is evident from Tables IX(3) and IX(4) and Graph IX(1) that

TABLE IX(4)

Impact Ratios

Year	$\frac{\lvert\Delta Y_{NF}/\Delta p_F O_F(\text{best-bet})\rvert}{\lvert\Delta Y_{NF}\rvert}$	$\frac{\lvert\Delta Y_{NF}/\Delta p_F O_F\rvert(\text{max})}{\lvert\Delta Y_{NF}\rvert}$	$\frac{\lvert\Delta Y_{NF}/\Delta p_F O_F\rvert(\text{min})}{\lvert\Delta Y_{NF}\rvert}$
1953-54	.01	.11	.00
1954-55	.17	.29	.03
1955-56	.08	.10	.05
1956-57	.06	.43	.00
1957-58	.31	.79	.17
1958-59	.41	.50	.26
1959-60	.04	.08	.01
1060-61	.17	.21	.08
1961-62	1.18	1.72	.78
1962-63	.14	.23	.03
1963-64	.33	.47	.15
1964-65	.03	.11	.01
1965-66	.27	.48	.02
1966-67	.28	.45	.07
1967-68	.21	.41	.01
1968-69	.29	.41	.12
1969-70	.01	.08	.00
1970-71	.06	.14	.00
1971-72	.01	.08	.09
1972-73	.27	.45	.05
1973-74	.14	.31	.05
1974-75	.46	2.06	.06
1975-76	.21	.35	.05
1976-77	.23	.26	.17
1977-78	1.31	1.63	.81
1978-79	.17	.56	.09
1979-80	.06	.08	.03
1980-81	.03	.14	.01
1981-82	.15	.27	.01
1982-83	.29	.97	.15

TABLE IX(5)

Contribution of Major Sectors to G.D.P.

Period	Contribution to G.D.P. by			
	Agriculture, Fishing, Forestry %	Mining %	Manufacturing %	Tertiary %
Average of 3 years ended				
1953-54	19	2	27	52
1972-73	7	4	24	65
1981-82	6	5	20	69

Drawn from Bureau of Agricultural Economics (1983) Quarterly Review of the Rural Economy, 5(2), May, Table 2, 195.

TABLE IX(6)

Contribution of the Rural Labour Force to the Total Labour Force

Period-Average of 3 years ended	Total Labour Force '000	Rural Labour Force '000	%
1953-54	3634	485.5	13.4
1972-73	5612	406.0	7.2
1981-82	6596	380.2	5.8

Data for the rural labour force drawn from Bureau of Agricultural Economics,(1983), Quarterly Review of the Rural Economy, 5(2) May, Table 12, 206. Data for the total labour force drawn from W.E. Norton, P.M. Garmston and M.W. Brodie(1982), Australian Economic Statistics 1949-50 to 1980-81: 1 Tables, Reserve Bank of Australia, Occasional Paper No.8a,May,Table 4.3, p.92.

TABLE IX(7)

Contribution of Major Sectors to Exports

Period	Contribution to Exports by		
	Agriculture, Fishing Forestry %	Mining %	Manufacturing and Other %
Average of 3 years ended			
1953-54	84	7	9
1972-73	54	24	22
1981-82	45	27	28

Drawn from Bureau of Agricultural Economics (1983), Quarterly Review of the Rural Economy, 5(2), May, Table 2, 195.

the role of changes in $p_F O_F$ as a source of change in non-farm economic activity varied substantially from year to year, being of negligible importance in some years, and of marked importance in others. The first years in the observation period in which the farm sector seems to have made a marked contribution to the changes in non-farm economic activity, were the drought year of 1957-58 and the subsequent recovery in 1958-59. Based on the best-bet parameter combination, the farm sector made a negative contribution to non-farm economic growth in 1957-58, equal to around 30 percent of the actual growth which occurred, and a positive contribution equal to around 40 percent of the actual growth in 1958-59. It is interesting to note, from Table IX(3), that the general conclusion of a significant positive contribution in 1958-59 is robust with respect to the combinations of parameter values, but the negative contribution in 1957-58 is less robust.

In 1961-62, the farm sector is estimated to have made a major contribution to the growth in non-farm economic activity, and this result is very robust with respect to parameter values. It is evident, however, that this conclusion is due more to the sharp slowdown in the growth of non-farm output in 1961-62 than to any marked developments in the farm sector - in Graph IX(1), for example, there is a sharp trough in the ΔY_{NF} locus, rather than a marked rise in the $\Delta Y_{NF}/\Delta p_F O_F$ locus. Nevertheless, had the farm sector not made its estimated positive contribution to non-farm output in that year, the little growth which did occur in Y_{NF} would have been approximately eliminated, and the recession of 1961-62 would therefore have been more severe.

During the four year period from 1965-66 to 1968-69, the farm sector seems to have assumed a reasonably high profile as a source of instability in the non-farm sector of the economy. Ratio(21) ranged between about 0.20-0.30 during this period, with some other parameter combinations generating values for (21) in excess of 0.40. This, of course, is a reflection of the marked seasonal changes which occurred during this period. A moderately severe drought occurred in 1965-66 in some parts of Australia, followed by a reasonable recovery during 1966-67. A return to severe drought conditions occurred in 1967-68, with a marked recovery in 1968-69.

Several other points emerge from a consideration of the results from this period. It is clear that, despite the substantial impact that the farm sector is estimated to have had on non-farm economic activity in this period, in both a positive and negative direction, consistently strong economic growth was recorded in the non-farm sector. The casual observation that the droughts and recoveries in the farm sector were associated with strong ongoing growth in the non-farm sector has led some commentators to suggest that the influence of the farm sector on the non-farm sector was negligible during this period - see, for example, Bates (1976). Such a conclusion, however, would seem questionable. It is quite possible, for example, that in the absence of these shocks in the farm sector, and with other factors unchanged, non-farm economic growth may have been relatively stronger in 1965-66 and 1967-68, and relatively weaker in 1966-67 and 1968-69.

The rapid growth in non-farm output during the mid 1960s does, however, raise another important issue. In presenting the earlier

theoretical analyses, in Chapters III to VII, it was emphasised that the 'Popular Keynesian' flavour of those analyses was dependent upon an assumption that the non-traded goods sector of the economy operated throughout in the presence of an effective constraint on aggregate demand. In other words, given the real wage as a cost to employers in the non-traded goods sector, it was assumed that the demand for non-traded goods was always less than the neo-classical optimum level of non-traded goods production. From the viewpoint of an analysis of historical data, such as is being attempted here, such an assumption would seem to be reasonable in those periods where non-farm economic activity was weak, such as in 1961-62. It may also be a reasonable assumption during periods in which non-farm economic growth is relatively rapid, provided that the direction of the impact of the farm sector on non-farm economic activity was negative. For example, if, in the absence of a shock in the farm sector, the non-traded goods sector would have operated at or close to its neo-classical optimum level of output and employment, then the adverse effects of the shock in the farm sector may work towards the establishment of an effective constraint on the demand for non-traded goods. The assumption is more questionable, however, in periods during which the farm sector is estimated to have made a positive contribution to an already very strong rate of non-farm economic growth - such as in 1968-69.

Fortunately, this problem is likely to have been less consequential in more recent periods. Between 1969-70 and 1971-72, the farm sector is estimated to have made only a negligible contribution to the changes in non-farm output. The more significant positive contribution estimated for 1972-73 seems

reasonable, given that, in that year, the economy was emerging from a modest recession. From 1974-75 onwards, the economy was characterised by relatively slow growth in non-farm output and an unemployment level which was high by Australian standards. While this represents prima facia evidence of the presence of a substantial Popular Keynesian type demand constraint over this period, there is a strong suggestion in the literture that the poor economic performance was also at least partly due to an exessive real wage level - see, for example, Fisher et al (1978), Snape (1981), Hughes (1981), Corden (1978), Pitchford (1983). Of course, these two sources of unemployment are not mutually exclusive in the theoretical model structure developed and explored in Chapters III to VII. In terms of that theoretical model, an excessive real wage could, for example, constrain the actual levels of output and employment in the farm and non-farm traded goods sectors, and the optimum level of output and employment in the non-traded goods sector, with the actual level of output and employment in the non-traded goods sector held below the optimum by inadequate effective demand. If such a configuration was felt to be a reasonable description of the Australian economy over the period since the mid 1970s, then this 'real wage overhang' debate would pose few problems for the validity of the empirical results presented in the present chapter.

In 1974-75, despite the collapse of the commodities boom, and the major decline in farm incomes which occurred in that year, the farm sector, rather than contributing to the marked slide into recession, is estimated to have made a significant positive contribution to non-farm economic activity. Based on the best-bet

parameter combination, ratio (21) was 0.46, ie. the positive contribution made by the farm sector was equal to about half of the actual growth which occurred in non-farm output. Further, most of the other parameter combinations also indicated a positive contribution of some degree.

In 1977-78, the results from all of the various parameter combinations cluster into a reasonably tight range - all being suggestive of a marked negative contribution by the farm sector to non-farm economic activity. The magnitudes are such as to suggest that, had the farm secor made a zero contribution rather than the estimated negative contribution, then the growth in non-farm output in 1977-78 may have been approximately twice as great as that actually recorded. By contrast, the best-bet results for 1978-79 imply a modest positive contribution by the farm sector - largely reflecting the record wheat harvest of that year - although a relatively wide range of results are produced by the various other parameter combinations.

Over the 3 year period between 1979-80 and 1981-82, the general conclusion that the farm sector was relatively unimportant as a source of change in non-farm output seems to be quite robust with respect to the choice of parameter values used in the model. It would be expected, however, that the severe drought of 1982-83 would produce some more striking results in that year. In fact, 1982-83 marked the most severe recession in Australia in the post-war period. Non-farm output actually declined by about 1 percent - a result which compares unfavourably with the recession of 1961-62, and the slide into recession in 1974-75. In both of those earlier

episodes, some positive (albeit modest) growth in non-farm output was recorded. The results obtained using the best-bet parameter combination suggest that the farm sector made a negative contribution to non-farm output in 1982-83, with ratio (21) taking a value of 0.29. In other words, had the farm sector made a zero contribution, rather than the estimated negative contribution, then non-farm output would have declined by about 0.7 percent, rather than by 1 percent. It is also clear, from Table IX(3), that the most negative contribution by the farm sector, obtained from any of the other parameter combinations, was approximately equal in magnitude to the actual decline in non-farm output which occurred. In other words, if we were to accept this more extreme estimate, then we would conclude that, had the farm sector made a zero contribution rather than this extreme negative contribution, non-farm output would have recorded approximately zero change in 1982-83. Such an outcome would still have represented a marked recession by Australian standards.

In general then, there is substantial evidence that the farm sector made a significant contribution to the downturn in non-farm output in 1982-83 (although it should be noted that a <u>positive</u> contribution was obtained from some parameter combinations). However, it would seem highly improbable that the recession can be explained entirely in terms of the farm sector shock, ie. one or more other significant negative influences on non-farm economic activity must also have been present.

V(2). The Impact of $\left(\frac{\Delta z^F}{p_c}\right)$

Of the various linkages incorporated into the simulating equations, the expenditure switching effects captured in the term $\left(\frac{\Delta z^F}{p_c}\right)$ are probably the least conventional. Further, the data problems which were encountered and the simplifying assumptions which were made in order to generate that variable were more significant than was the case for the other variables. Therefore, it is interesting and useful to consider the impact of that channel of influence on the simulation results.

The results obtained from equation (10), using the best-bet parameter combination, are recorded in Table IX(8). The best-bet results from equation (10') are also reproduced. The difference between the two series, of course, is the contribution of the term $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$, given the best-bet parameter combination. To facilitate a comparison with the earlier results, the values obtained for ratio (21) with respect to the best-bet results from equations(10) and (10') are also included in the Table. For ease of exposition, some of the results have also been illustrated in Graph IX(2).

It is evident from Table IX(8) and Graph IX(2) that the term $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\cdot\left(k\right)$ has tended to make a significant contribution to the best-bet results right through the period. The extent of that conribution, however, varied considerably from year to year. For example, in 1954-55, 1962-63, 1964-65, 1969-70, 1975-76 and 1979-80, the contribution was either very small or negligible, while in other years, such as 1974-75, 1977-78 and 1982-83, the contribution was major.

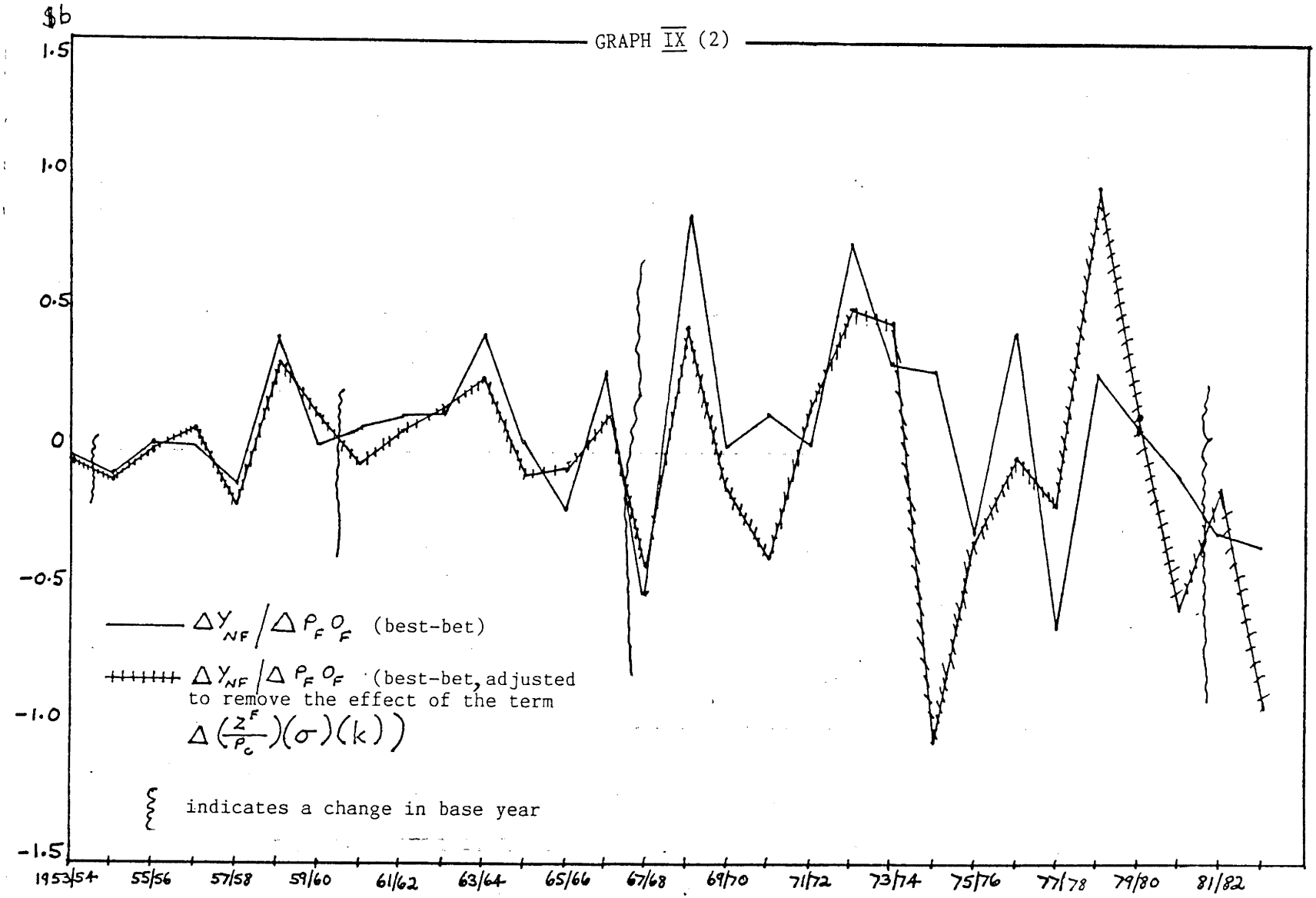
TABLE IX(8)

The Impact of $\Delta\left(\frac{3^F}{p_c}\right)$

Year	(1) $\Delta Y_{NF}/\Delta p_F O_F$(best-bet) (from (10))	(2) $\Delta Y_{NF}/\Delta p_F O_F$(best-bet) (from (10'))	$\left\lvert\frac{(1)}{\Delta Y_{NF}}\right\rvert$	$\left\lvert\frac{(2)}{\Delta Y_{NF}}\right\rvert$
	$m	$m		
1953-54	-17	-7	.03	.01
1954-55	-93	-91	.17	.17
1955-56	4	35	.01	.08
1956-57	81	10	.48	.06
1957-58	-196	-119	.51	.31
1958-59	339	406	.34	.41
1959-60	132	34	.16	.04
1960-61	-41	85	.08	.17
1961-62	72	137	.62	1.18
1962-63	143	135	.14	.14
1963-64	265	423	.21	.33
1964-65	-74	41	.06	.03
1965-66	-58	-199	.08	.27
1966-67	126	284	.13	.28
1967-68	-404	-502	.17	.21
1968-69	455	850	.15	.29
1969-70	-135	21	.04	.01
1970-71	361	145	.14	.06
1971-72	157	27	.07	.01
1972-73	536	756	.19	.27
1973-74	483	324	.21	.14
1974-75	-1050	298	1.61	.46
1975-76	-302	-288	.22	.21
1976-77	-7	445	.00	.23
1977-78	-187	-624	.39	1.31
1978-79	968	288	.58	.17
1979-80	139	99	.08	.06
1980-81	-558	-69	.21	.03
1981-82	-121	-293	.06	.15
1982-83	-923	-322	.82	.29

---- indicates a change in the base year for the various implicit deflators

GRAPH IX (2)


$b
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
1953/54
55/56
57/58
59/60
61/62
63/64
65/66
67/68
69/70
71/72
73/74
75/76
77/78
79/80
81/82
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet)
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet, adjusted to remove the effect of the term $\Delta\left(\frac{Z^F}{P_c}\right)(\sigma)(k)$)
indicates a change in base year

There is some evidence that the contribution of $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$ to the results has tended to increase over time. It will be recalled that, based on the results from (10'), the relative contribution of the farm sector to the annual changes in non-farm economic activity seems to have increased over the period since the early 1950s. However, when one considers the results from equation (10) rather than (10'), so that the effects of $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$ are removed, the tendency for the importance of the farm sector to increase becomes much weaker. For example, consider ratio (21) calculated from the best bet results obtained from equation(10), as tabulated in Table IX(8). The average value of this ratio over the period 1953-54 to 1959-60 is about .24. It subsequently falls to .14 over the period 1960-61 to 1971- 72. Over the period 1972-73 to 1982-83, the average ratio was .40. However, if the observation for 1974-75 is removed (when the ratio was 1.61),the average for the remaining years in that period was .28 - a figure only marginally greater than in the 1950s.

The increasing role of $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$, of course, provides a partial explanation for the earlier conclusion that the farm sector has become relatively more important as a source of change in non-farm output. While the relative size of the farm sector has declined over time, thus probably reducing the potential for pure output fluctations in the farm sector to influence non-farm output, this has coincided with a gradually increasing degree of volatility in the relative price of farm and non-farm commodities, allowing the channel of influence captured by the term $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$ to become more important.

The results for two individual years are worthy of special mention. Firstly, for 1974-75, it is clear that the result, noted earlier, that the farm sector made a significant positive contribution to the growth in non-farm output is heavily dependent on the contribution of the $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$ term. For example, the best-bet results from (10) suggest a converse conclusion, ie. that the farm sector made a negative contribution greater in magnitude than the actual growth in non-farm output which occurred in that year. Similarly, in 1982-83, this relative price effect is also estimated to have made a significant positive contribution to the growth of non-farm output. As noted earlier, the best-bet results from equation (10') suggest that the farm sector made a negative contribution to non-farm output, equal to about 30 percent of the actual decline in non-farm output in that year. However, the best-bet results from equation (10) suggest a much larger negative effect, approximately equal in magnitude to the total decline in non-farm output which occurred.

V(3) A Characterisation of the N.I.F., Nevile and R.B.A. Models

In Chapter VIII, the existing theoretical and empirical literature on farm consumption and investment responses was reviewed in some detail. In the light of that review, the approaches adopted to these issues in the main forecasting and policy models in Australia was presented and discussed. As noted in Appendix I, it is relatively simple to characterise the approaches adopted in the N.I.F., Nevile and R.B.A. models in the present empirical model.

It is assumed that the N.I.F./Nevile position is captured using the following marginal propensities: $MPC_{NF} = 0.6$, $MPT = 0.3$, $MPI = 0.15$, $MPC_F = 0$, $MPi_F = 0$. These marginal propensities imply the following parameter combinations: $\sigma^{NF} = 0.35$, $\sigma_F = 0$, $k = 1.5$, $\sigma = 0.85$.

Similarly, it is assumed that the R.B.A. position is captured by the marginal propensities: $MPC_{NF} = 0.6$, $MPT = 0.3$, $MPI = 0.15$, $MPC_F = 0.6$, $MPi_F = 0$, implying that $\sigma^{NF} = 0.35$, $\sigma_F = 0.35$, $k = 1.5$ and $\sigma = 0.85$.

Several points should be noted about these assumptions:

i) firstly, it is assumed that each of the models adequately capture the effects of changes in farm prices as they work through the term $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$ in equation (10'). The validity of this assumption may be open to some question, particularly for the more highly aggregated R.B.A. and Nevile models;

ii) secondly, the characterisation of the R.B.A. approach produced an equivalent parameter combination to that adopted as the best bet combination. The reason is that, by coincidence, the overstatement of MPC_F in the R.B.A. model relative to the best-bet position is almost exactly cancelled by the understatement of the value for MPi_F (ie. MPi_F = 0.4 in the best-bet combination, with MPi_F = 0 in the characterisation of the R.B.A. model, while MPC_F = 0.5 MPC_{NF} in the best-bet combination and MPC_F = MPC_{NF} in R.B.A. model).

In Table IX(9), results are reported from equation (10') for the N.I.F./Nevile parameter combination, and the R.B.A./best-bet parameter combination. In addition, reflecting the argument made in Chapter VIII that the existing empirical literature may seriously understate the value of MPi_F, results are also reported in Table IX(9) for the best-bet parameter combination modified to set MPi_F = 1. Some of the results are also illustrated in Graph IX(3).

It is clear that the choice of assumptions as to the value of MPC_F and MPi_F has the potential to significantly influence the results. It is also clear that there is no consistent pattern in the direction and magnitude of these divergences in the results. In some years, such as 1955-56, 1959-60, 1976-77 and 1979-80, the divergences are small relative to, for example, the overall change in non-farm output. In other years, however, the differences are very prominent - for example 1957-58, 1958-59, 1967-68, 1968-69, 1974-75, 1978-79 and 1982-83.

If it were argued that MPi_F = 1 has a stronger claim to be a

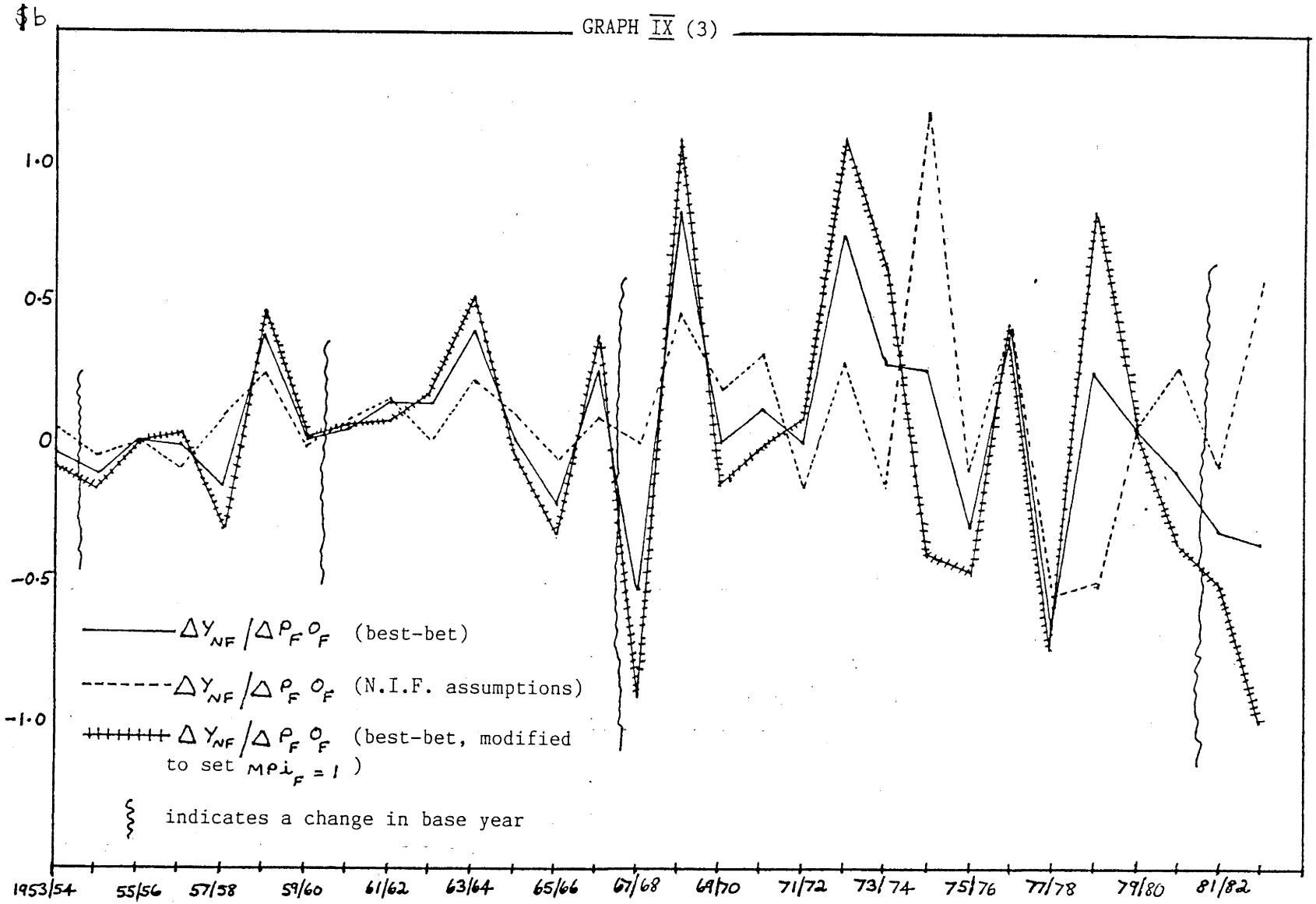
TABLE IX(9)

A Characterisation of the N.I.F., Nevile and R.B.A. Models

Year	ΔY_{NF}	$\Delta Y_{NF}/\Delta p_F O_F$ (N.I.F./Nevile)	$\Delta Y_{NF}/\Delta p_F O_F$ (best-bet/RBA)	$\Delta Y_{NF}/\Delta p_F O_F (MPi_F=1)$
	$m	$m	$m	$m
1953-54	634	61	-7	-52
1954-55	544	-16	-91	-145
1955-56	455	30	35	36
1956-57	168	-59	10	66
1957-58	384	104	-119	-280
1958-59	997	278	406	499
1959-60	816	13	34	52
1960-61	494	96	85	84
1961-62	116	181	137	107
1962-63	990	34	135	209
1963-64	1274	248	423	547
1964-65	1279	123	41	-16
1965-66	740	-40	-199	-309
1966-67	1003	110	284	408
1967-68	2366	26	-502	-872
1968-69	2942	493	850	1105
1969-70	3139	226	21	-122
1970-71	2623	345	145	4
1971-72	2215	-147	27	109
1972-73	2751	317	756	1125
1973-74	2309	-140	324	655
1974-75	654	1205	298	-385
1975-76	1382	-80	-288	-439
1976-77	1899	424	445	459
1977-78	475	-512	-624	-708
1978-79	1664	-498	288	854
1979-80	1679	76	99	116
1980-81	2599	294	-69	-336
1981-82	1907	-53	-293	-469
1982-83	-1119	620	-323	-990

---- indicates a change in the base year for the various implicit deflators

GRAPH IX (3)


$b
1·0
0·5
0
-0·5
-1·0
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet)
$\Delta Y_{NF} / \Delta P_F O_F$ (N.I.F. assumptions)
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet, modified to set $MPi_F = 1$)
indicates a change in base year
1953/54
55/56
57/58
59/60
61/62
63/64
65/66
67/68
69/70
71/72
73/74
75/76
77/78
79/80
81/82

best-bet assumption than does MPi_F = 0.4, then the coincidental equivalence between the R.B.A. results and the best-bet results, thus defined, would no longer hold. Also, it is evident that the divergences between the N.I.F./Nevile results, and these preferred best-bet results are, in general, more substantial than the divergences between the N.I.F./Nevile and the original best-bet results.

These results carry several important implications. Suppose, for example, that N.I.F., R.B.A. or the Nevile model was being used to make short term forecasts or projections of some important macroeconomic variables. Suppose, also, that a significant shock, originating in the farm sector, was present and its broad dimensions were known to be model users. The above results would indicate that the forecasts or projections could, potentialy, differ markedly from one model to another because of the alternative approaches adopted to farm consumption and investment responses. In addition, they could differ substantially from the results that might be implied by a framework based more closely on the existing empirical and theoretical literature on farm consumption and investment. A similar sort of reservation would also hold if these models were used, without some degree of modification, as a framework for analysing the problem being considered in the present chapter - the contribution of the farm sector to short term changes in non-farm and total G.D.P. over recent decades.

V(4) The Importance of MPI

In all of the results discussed in detail so far, the marginal propensity to spend on traded goods, MPI, was set to 0.15. In Appendix I, it was argued that this value for MPI was broadly consistent with the average propensity to import in Australia. However, it was also noted that this would be a reasonable measure for MPI only if the average and marginal propensities to spend on importables were equal, and if the marginal propensity to spend on farm commodities and non-farm exportables was zero. To cater for the liklihood that such assumptions are not strictly valid, a higher value for MPI of 0.3 was also examined.

In Table IX(10), the best-bet results from equation (10') are reproduced. Alongside these are listed the results obtained from (10') for the best-bet parameter combination modified to change MPI from its best-bet value of 0.15 to the alternative value of 0.3. For purposes of comparison, the actual values for ΔY_{NF} are also included in the Table. For convenience, some of these results are also illustrated in Graph IX(4).

In general, it would be expected that the effect of a larger value for MPI would be to reduce the size of the multiplier, and hence to dampen the movements in $\Delta Y_{NF}/\Delta p_F O_F$ relative to those associated with MPI=0.15. However, as the simulation equation, (10'), captures several channels of influence from the farm to the non-farm sector, it is clear that the relationship between the two sets of results would not simply be proportional.

These expectations are borne out by the results. For example, in Graph IX(4), there is some tendency for the locus associated with

TABLE IX(10)

The Importance of Alternative Values for MPI

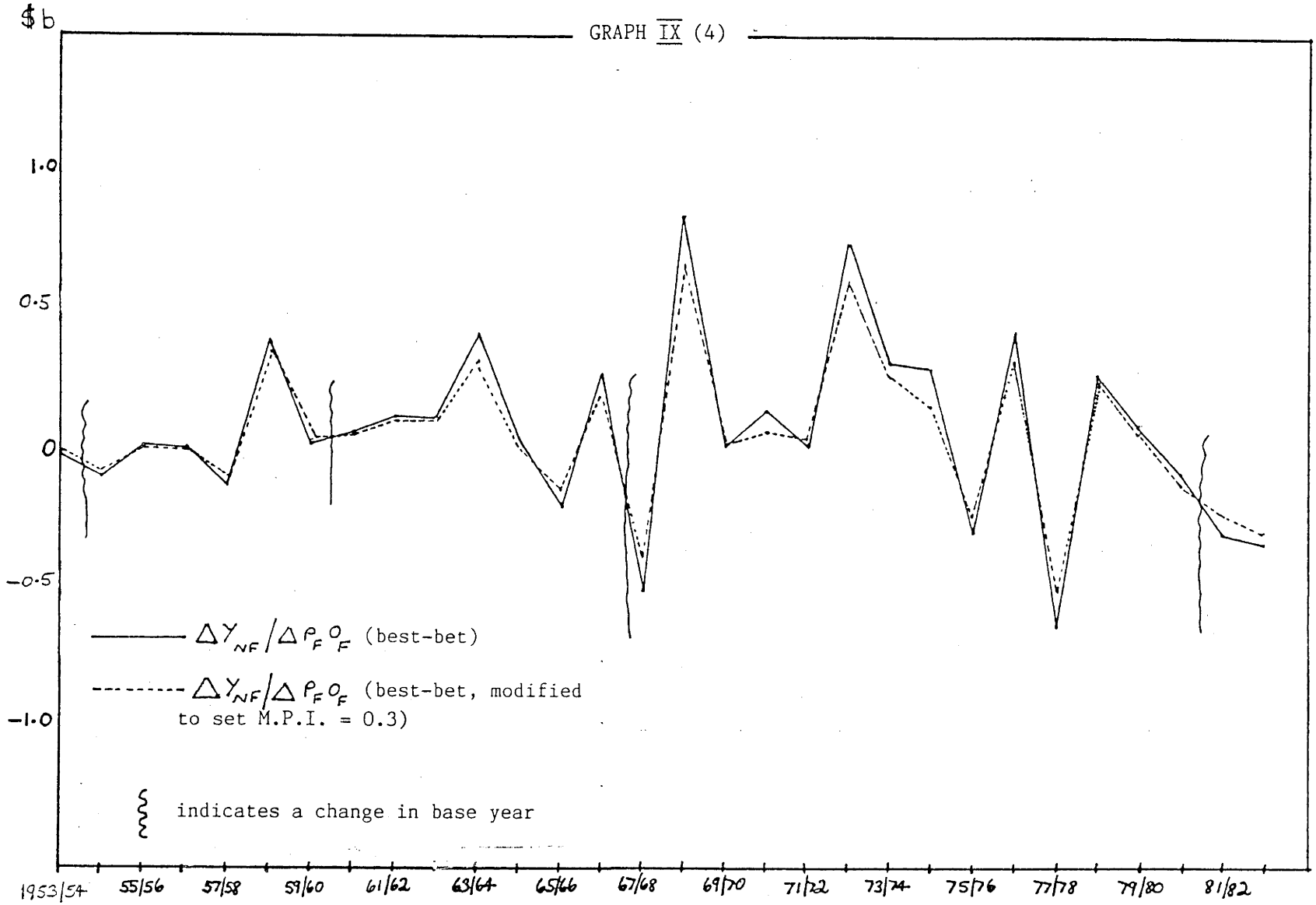
Year	ΔY_{NF}	$\Delta Y_{NF}/\Delta p_F O_F$(best-bet)	$\Delta Y_{NF}/\Delta p_F O_F$(MPI=0.3)
	$m	$m	$m
1953-54	634	-7	-1
1954-55	544	-91	-76
1955-56	455	35	27
1956-57	168	10	12
1957-58	384	-119	-97
1958-59	997	406	385
1959-60	816	34	47
1960-61	494	85	62
1961-62	116	137	121
1962-63	990	135	114
1963-64	1274	423	346
1964-65	1279	41	30
1965-66	740	-199	-142
1966-67	1003	284	213
1967-68	2366	-502	-386
1968-69	2942	850	679
1969-70	3139	21	27
1970-71	2623	145	77
1971-72	2215	27	28
1972-73	2751	756	612
1973-74	2309	324	263
1974-75	654	298	163
1975-76	1382	-288	-243
1976-77	1899	445	347
1977-78	475	-624	-499
1978-79	1664	288	275
1979-80	1679	99	88
1980-81	2599	-69	-106
1981-82	1907	-293	-217
1982-83	-1119	-323	-292

---- indicates a change in the base year for the various implicit deflators

MPI=0.3 to be a dampened version of the best-bet locus. However, there are some significant variations to this pattern - such as is evident for 1971-72, when the two sets of results were almost exactly identical, and 1974-75, when, starting from a reasonable base, one result was little more than half the size of the other.

For the majority of years considered, the differences between the two sets of results are relatively minor compared to the concurrent value of ΔY_{NF}. The two possible exceptions to that conclusion would be 1974-75 and 1977-78 when the differences between the two results were equal to around 20 percent to 25 percent of the absolute value of ΔY_{NF} in those years. In general, however, on the basis of these results, it would seem reasonable to suggest that any qualitative conclusions drawn from results where MPI=0.15 would largely carry over to the results where MPI=0.3.

GRAPH IX (4)


$b
1.0
0.5
0
-0.5
-1.0
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet)
$\Delta Y_{NF} / \Delta P_F O_F$ (best-bet, modified to set M.P.I. = 0.3)
indicates a change in base year
1953/54
55/56
57/58
59/60
61/62
63/64
65/66
67/68
69/70
71/72
73/74
75/76
77/78
79/80
81/82

V(5) Concluding Comments on Section V

Perhaps the most significant result to emerge from the simple empirical version of the model is that there is evidence that the relative importance of the farm sector as a source of change in non-farm output has not declined over the period from the early 1950s to the early 1980s, and, indeed, may have increased in importance. This result would seem to run counter to the conclusion which might be reached on the basis of the substantial decline which has occurred over this period in the relative contribution made by the farm sector to the absolute size of major macroeconomic variables such as G.D.P., employment and exports. There is also evidence that the greater volatility of farm prices since the early 1970s has been an important contributing factor to this outcome.

This result, if valid, would seem to carry several important implications. Firstly, it suggests that a satisfactory and consistent treatment of the farm sector in, for example, macroeconomic policy making and forecasting has tended to become more, rather than less, important over time. Therefore, it attests to the importance of developing a macroeconomic model for the Australian economy in which farm/macro linkages are emphasised - such as is attempted in the present thesis. It also provides additional motivation for undertaking further development and refinement of the model and for moving towards the establishment of an empirical version of the full model. Important progress towards that end is made in Chapter X and O'Mara et al.(1985), with the development of theoretical simulation variants of Models I and II. The result is also suggestive of a very important hypothesis which should be tested within the context of an empirical version of the

full model when such a model becomes available. In particular, does the result that the farm sector has increased in relative importance, since the early 1950s, as a source of change in non-farm output remain valid when all of the linkages, which were captured and explored in the earlier theoretical analyses, are satisfactorily captured in an empirical version of the model?

Section VI. A Review of Other Studies

VI(1) Introduction

There is a paucity of published studies in which the impact of the farm sector on the main macroeconomic aggregates in Australia are examined over a time period comparable to that considered in the above analysis. The purpose of the present section is to briefly review the main components of this limited literature, and then to examine two of the most recent studies in some detail.

In an early study, Duloy and Nevile (1965) used a variant of Nevile's macroeconomic model - see Nevile (1962) - to assess the potential macroeconomic impact of a hypothetical reserve price scheme for wool. The study was not extended to include an examination of actual historical data. Two variables were included - G.N.P. and the balance of trade. It is interesting to note that movements in the latter variable tended to be interpreted as the impact on the overall balance of payments. However, the theoretical analyses presented in earlier chapters served to highlight the complexity of the impact which developments in the farm sector are likely to have on the overall balance of payments, and the inadequacy of merely examining the current account aspects.

Around the same time, Duloy and Woodland (1967) used essentially the same framework to assess the impact of a hypothetical drought shock on G.N.P. and the balance of trade. While interest in this issue had been heightened by the volatile seasonal conditions experienced in the mid 1960s, no attempt was made to examine or analyse actual historical data.

More recently, Bates (1976), provided a review of the role of the farm sector in the macroeconomy, focussing mainly on the period of the 1950s and 1960s. However, the analysis was largely qualitative, supported only by casual empiricism.

Powell and Mandeville (1978) used original survey data and input/output tables to assess the importance of the farm sector to the local economy in a particular rural region of N.S.W. Only data for the year 1968-69 was examined, and the study would seem to have only limited relevance for more macroeconomic oriented issues.

Two more recent studies are of more direct relevance to the present analysis, and hence will be considered in some detail below. Firstly, Gray and Gruen (1981, 1982), developed a Keynesian oriented growth decomposition model for the Australian economy. While they were concerned with a much wider range of issues than simply the contribution of the farm sector to the annual growth in G.D.P., some estimates of this contribution emerged from the model for the period 1966-67 to 1978-79. This analysis was subsequently revised and refined by Gray (1984). Secondly, Campbell, Crowley and Demura (1983) used the ORANI model to obtain some estimates of the impact of the 1982-83 drought on some important macroeconomic variables.

VI(2). The Gray and Gruen Analysis

The growth decomposition model developed by Gray and Gruen is as follows (see Gray and Gruen (1981)):

Notation

- Y - interchangeable output or income
- C - consumption
- M - imports
- X - exports
- G - government spending
- S - change in stocks
- D - statistical discrepancy
- T - tax collected domestically (excluding withholding taxes)
- R - transfers to private sector from govt.
- t - tax rate
- q - firms' income share
- b - average propensity to consume
- k - average propensity to invest by households
- v - average propensity to invest by firms (incorporated enterprises)
- u - average propensity to import
- p - ratio of the subscript deflator to the G.D.P. deflator

Superscripts

- d - demand for corresponding output
- $\sim$ - the variable in nominal terms

Subscripts

- n - non-farm sector
- f - farm sector
- h - households

e - firms (incorporated enterprises)

a - used in Y_a - net income paid abroad

Model

(1) $Y^d = C+I - M+X +G +S_n + D$ (total demand)

(2) $Y^d = Y_n{}^d + Y_f{}^d$

(3) $S_f = Y_f - Y_f{}^d$

$\therefore$ (4) $Y_n{}^d = Y^d - Y_f + S_f$

(5) $Y_n = Y_n{}^d$

$\therefore$ (6) $Y_n = C+I+X-M+G+S_n + D-Y_f + S_f$

(7) $Y = Y_f + Y_n$

(8) $Y = Y_h + Y_e + (T - R) + Y_a$ (the distribution of Y amongst income recipients).

(9) $t = \frac{T}{Y_h+Y_e+(T-R)}$ [in the original text, y_e was listed as Y_f]

(10) $q = \frac{Y_e}{Y_h+Y_e}$ (firms' income share)

(11) $Y_h = (1-q)\ [(1-t)(Y_n + Y_f - Y_a) + R]$

(12) $Y_e = q\ [(1-t)(Y_n + Y_f - Y_a) + R]$ (in the

original text, Y_e was again listed as Y_f)

(13) $b = \dfrac{\tilde{C}}{\tilde{Y}_h}$ (in the original text, $\tilde{Y}_h$ was listed as Y_h)

$\therefore$ (14) $C = \dfrac{b\tilde{Y}_h}{p_c}$ (in the original text, $\tilde{Y}_h$ was listed as Y_h)

(15) $k = \dfrac{\tilde{I}_h}{\tilde{Y}_h}$ (the average propensity to invest by households, reflecting the fact that households include unincorporated enterprises)

(16) $v = \dfrac{\tilde{I}_e}{\tilde{Y}_e}$ (the average propensity to invest by firms)

(17) $I = \dfrac{k\,\tilde{Y}_h + v\tilde{Y}_e}{p_I}$ (in the original text, $\tilde{Y}_h$ was listed as Y_h and $\tilde{Y}_e$ as Y_e)

(18) $n = \dfrac{\tilde{M}}{\tilde{Y}}$ (the average propensity to import)

$\therefore$ (19) $M = \dfrac{n\tilde{Y}}{p_m}$ (in the original text, $\tilde{Y}$ was listed as Y)

Then from (19), (17), (14), (12), (11) and (6),

(20) $$Y_n = \left[\left(\frac{b}{p_c} + \frac{k}{p_I}\right)\left(1-q\right) + \left(\frac{v}{p_I}\right)\left(q\right) \right]\left[(1-t)(Y_n+Y_f-Y_a)+R \right]$$

$$- \frac{n}{p_m}(Y_n + Y_f) + X + G + S_n + D + S_f - Y_f$$

or

(21) $$Y_n = \frac{1}{\alpha}\left[X + G + S_n + D + S_f + (\alpha-1-n)(Y_a - \frac{R}{1-t}) \right] - Y_f$$

where (22) $$\alpha \equiv 1 - (1-t)\left((\frac{b}{p_c} + \frac{k}{p_I})(1-q) + \frac{v}{p_I}.(q) \right) + \frac{n}{p_m}$$

Gray and Gruen used the multivariate mean value theorem to calculate the contribution made by each variable in (21) or (22) to the growth in Y_n. The theorem states that, given

$$Z = f(x,y) \text{ and } x_0 < x_1,\ y_0 < y_1 \text{ then}$$

$$(23) \quad Z_1 - Z_0 \doteqdot f_1(x^1,y^1)(x_1-x_0) + f_2(x^1,y^1)(y_1-y_0)$$

$$\text{where } x_0 \leqslant x^1 \leqslant x_1 \text{ and } y_0 \leqslant y^1 \leqslant y_1$$

It follows that:

$$(24) \quad \frac{Z_1-Z_0}{Z_0} = f_1(x^1,y^1)\left(\frac{x_1-x_0}{x_0}\right)\left(\frac{x_0}{Z_0}\right) + f_2(x^1,y^1)\left(\frac{y_1-y_0}{y_0}\right)\left(\frac{y_0}{Z_0}\right)$$

Therefore, the contribution made by some variable to the growth in Y_n between two periods is calculated by taking the growth rate of the variable, multiplying it by its share in base period G.N.F.P., and then multiplying it by the appropriate partial derivative of (21) or (22), where that partial derivative is evaluated by substituting in the average value of each variable in the two periods.

On this basis, Gray and Gruen assessed the role of the farm sector as follows. From (21), it is immediate that, ceteris paribus,

$$\frac{dY_n}{dY_f} = -1$$

ie. ceteris paribus, a rise in farm production results in an equivalent fall in non-farm output. Alternatively, a rise in farm production which is drawn entirely into farm stocks raises non-farm output. Again from (21),

$$\frac{dY_n}{dY_f} + \frac{dY_n}{dS_f} = -1 + \frac{1}{\alpha} > 1$$

They explain these results as follows: "In our model, an

increase in farm output may be sold or taken into farm stocks. An increase in farm output which is taken entirely into farm stocks, ie. a ceteris paribus increase in farm income, will give a net stimulation of demand for non-farm output because it increases farm incomes and hence demand for non-farm output without satisfying or absorbing any extra aggregate demand. But a ceteris paribus increase in farm output, ie. one not accompanied by any change in farm stocks, will depress non-farm output. This is because all of the increase must have been sold, otherwise stocks would have increased. This can only have been accomplished under ceteris paribus by a shift in demand away from the non-farm sector. On this account non-farm demand falls by the full amount of the increase in farm output..... A ceteris paribus increase in stocks is a reduction in the share of demand satisfied by the farm sector, and therefore an increase in demand for non-farm output unaccompanied by any change in farm income; output is added to marketing authorities inventories rather than being sold to foreign or domestic consumers". (Gray and Gruen, 1981, pp.16-17).

This approach to assessing the contribution of the farm sector to non-farm economic growth seems inadequate for several reasons. Firstly, consider the case of a rise or fall in farm production absorbed entirely in farm exports. The theoretical analysis presented in Chapter III, and the results from the simple empirical version of the model presented earlier in the present chapter, strongly suggest an impact on the non-farm sector in the same direction as the change in output and exports in the farm sector. Such a result <u>could</u> also be obtained from the Gray and Gruen model. It is clear from (21) that a change in Y_f, complemented by an

equivalent change in X, produces an identical outcome to that described above for the case of a change in farm output absorbed entirely in farm stocks, ie.

$$\frac{dY_n}{dY_f} + \frac{dY_n}{dX} = 1 + \frac{1}{\alpha} > 1$$

However, this is not the interpretation placed on these results by Gray and Gruen. Rather, their interpretation is that the farm sector makes a contribution to non-farm output equal in magnitude but opposite in sign to the change in farm output, while a vaguely defined "external" sector makes a more than offsetting contribution to non-farm output. In other words, the farm sector is credited with the term

$$\frac{dY_n}{dY_f} = -1$$

while the "external" sector is credited with the term

$$\frac{dY_n}{dX} = \frac{1}{\alpha} > 1$$

Under the Gray and Gruen interpretation, a similar smudging of the roles of the farm and the "external" sector would occur in the case of a change in farm exports absorbed entirely by farm stocks, ie. with farm output and local expenditure on farm commodities unchanged. More specifically, suppose farm exports were to rise, with an equivalent fall in farm stocks. In this case, the Gray and Gruen interpretation would be that the farm sector had made a negative contribution to non-farm output: ie.

$$\frac{dY_n}{dY_f} + \frac{dY_n}{dS_f} = 0 - \frac{1}{\alpha}$$

and the "external" sector had made a positive contribution of equal magnitude

$$\frac{dY_n}{dX} = \frac{1}{\alpha}$$

A more reasonable interpretation, and one which is consistent with the approach adopted in the simple empirical model, would be to aggregate these two expressions and hence conclude that the farm sector had made a zero contribution, ie.

$$\frac{dY_n}{dY_f} + \frac{dY_n}{dS_f} + \frac{dY_n}{dX} = 0 - \frac{1}{\alpha} + \frac{1}{\alpha} = 0$$

A further problem emerges in the case of a change in farm prices. In the Gray and Gruen analysis, the effects of an exogenous change in the price of farm commodities are captured, not in the contribution of the farm sector, but rather in the various relative price expressions embedded in α in (21). In other words, the impact of an exogenous change in farm prices, and hence farm incomes and expenditure originating in the farm sector, is credited to a terms of trade effect, and not to the farm sector. Similarly, the impact of the change in farm prices on the pattern of aggregate expenditure and hence the demand for non-farm output, is also credited to a terms of trade effect. By contrast, in the simple empirical model both of these effects were attributed directly to the farm sector.

A related, but slightly different, problem emerges for the case where a change in the volume of farm production occurs, and is absorbed entirely on the domestic market. In the Gray and Gruen interpretation, the farm sector would be credited with producing a change in non-farm output of equal magnitude to the change in farm production, but of opposite sign, ie.

$$\frac{dY_n}{dY_f} + \frac{dY_n}{dS_f} = -1 + 0$$

It is evident, however, that a sharp rise or fall in the volume of farm production absorbed on the local market would not, in general, occur at an unchanged relative price of farm and non-farm commodities. A change in the relative price of farm and non-farm commodities would, in turn, influence real farm incomes and hence the volume of expenditure originating from the farm sector. The switching effect of the relative price change would also influence the direction of aggregate expenditure. In the Gray and Gruen interpretation, both of these effects are attributed to the relative price terms in the expression for α, and not to the farm sector, whereas in the simple empirical model, they were, in fact, attributed to the farm sector.

It is interesting to note that some concern at these sorts of interpretations by Gray and Gruen has also recently been expressed by Hancock(1982). Referring to their analysis, Hancock argued that "...their method of disaggregating economic aggregates, and their wish to focus on variations of non-farm output lead them to a rather contorted presentation of the role of farm activity in determining aggregate demand. It is not credible that farm sales depress aggregate demand whereas additions to stocks stimulate it. On close inspection, these surprising propositions turn out to be a misinterpretation of the arithmetic; but, at first sight, they are perplexing" (p.116).

Unfortunately, Hancock did not expand upon this point. As it stands, it is not clear, from his comments, the exact nature of the

'misinterpretation of the arithmetic' which he believed had occurred.

To summarise, the analysis of the contribution of the farm sector to the growth in non-farm output as undertaken, firstly, with the simple empirical model, and secondly, by Gray and Gruen, differ in the following main respects:

- in the simple empirical model, the contribution made by farm exports is attributed directly to the farm sector, whereas in Gray and Gruen, farm exports are aggregated with non-farm exports, and their contribution credited to an 'external' sector;

- in the simple empirical model, the impact of exogenous changes in the relative price of farm and non-farm commodities is credited to the farm sector. By contrast, in Gray and Gruen, such relative price changes are grouped with all other relative price changes in the economy and their contribution is assessed as part of an overall relative price effect;

- in the simple empirical model, the impact of 'endogenous' changes in the relative price of farm and non-farm commodities — ie. price changes resulting from forced changes in the volume of farm output absorbed on the domestic market — is credited to the farm sector. In Gray and Gruen, such relative price changes are again incorporated into an overall relative price effect;

- in the simple empirical model, a range of values for the important marginal propensities is considered, based on the relevant empirical and theoretical literature. In the Gray and Gruen model, the marginal propensities to consume and invest, by farm and non-farm households alike, are assumed to be equal to the observed economy wide average propensities to consume and invest. A similar approach is adopted for the marginal propensity to import and to tax.

Having examined the theoretical differences between the approaches adopted in the two models, we can now proceed to compare and contrast the two sets of results obtained.

The Gray and Gruen analysis covered the period from 1966-67 to 1978-79. From the results which they reported, it is possible to

form the ratio

$$\frac{FARM}{GGDP}$$

where GGDP is the percentage change in G.D.P. between year t and year t-1, and FARM is the estimated contribution to that growth made by the farm sector. The results are listed in Table IX(11).

Noting that the denominator in this ratio is total G.D.P., rather than non-farm G.D.P., it is clear that the results obtained from equation (11') in the simple empirical model can be utilised, in order to form the ratio

$$\frac{\Delta Y_{NF} / \Delta p_F 0_F + \Delta Y_F}{\Delta Y}$$

This ratio is directly comparable to the ratio $\frac{FARM}{GGDP}$ obtained from the Gray and Gruen results.

In Table IX(11), three sets of results are listed for the ratio

$$\frac{\Delta Y_{NF} / \Delta p_F 0_F + \Delta Y_F}{\Delta Y}$$

each year. These are (i) the ratio obtained using the best-bet value of the numerator, (ii) the ratio obtained using the most positive (least negative) value for the numerator obtained from any of the parameter combinations; and (iii) the ratio obtained using the most negative (least positive) value for the numerator.

It is clear, from Table IX(11) and Graph IX(5), that the theoretical differences between the two models, outlined above, have a significant bearing on the results obtained. The results from the simple empirical model, using the best-bet parameter combination, differ substantially to the Gray and Gruen results over most of the

TABLE IX(11)

A Comparison of the Results Obtained from the Simple Empirical Model and from the Gray and Gruen Model

Year	$\frac{FARM}{GGDP}$	$\frac{\Delta Y_{NF}/\Delta p_F O_F + \Delta Y_F}{\Delta Y}$ (best-bet)	$\frac{\Delta Y_{NF}/\Delta p_F O_F + \Delta Y_F}{\Delta Y}$ (most pos.)	$\frac{\Delta Y_{NF}/\Delta p_F O_F + \Delta Y_F}{\Delta Y}$ (most neg.)
1966-67	0.16	0.49	0.61	0.34
1967-68	-0.72	-0.88	-0.53	-1.20
1968-69	0.39	0.50	0.58	0.39
1969-70	-0.56	-0.16	-0.07	-0.22
1970-71	-0.36	0.03	0.12	-0.04
1971-72	-0.15	0.13	0.18	0.05
1972-73	0.30	0.04	0.27	-0.21
1973-74	0.62	0.30	0.44	0.13
1974-75	-1.21	0.62	1.74	-0.13
1975-76	-0.53	-0.03	0.11	-0.14
1976-77	-0.09	0.24	0.27	0.17
1977-78	-2.07	-3.74	-2.70	-4.37
1978-79	0.81	0.53	0.75	0.24

Data for $\frac{FARM}{GGDP}$ derived from Gray and Gruen (1981), Table 2, p.11.

period. Further, with the exception of 1967-68, 1968-69 and 1978-79, the Gray and Gruen results lie outside the range of values suggested by the various combinations of parameters used in the simple empirical model. In addition, the magnitude and direction of the divergences between the two sets of results do not follow a consistent pattern.

It is instructive to examine the results for 1974-75 in more detail. The divergence between the two sets of results in that year is the most extreme of any of the years considered. From the earlier discussion of the theoretical differences between the two models, it is clear that the divergence may have resulted from the disparate treatment of farm exports and/or the disparate treatment of changes in the relative price of farm and non-farm commodities and/or the different values assigned to the relevant marginal propensities. In this case, however, several pieces of evidence would tend to suggest that the major reason for the divergence was the disparate treatment of changes in the relative price of farm and non-farm commodities. Firstly, it was noted, in Section V(2), that, when the term $\Delta\left(\frac{z^F}{p_c}\right)\left(\sigma\right)\left(k\right)$ is removed from the simulation equations, the estimated contribution of the farm sector to the change in non-farm economic activity in 1974-75 was altered from being modestly positive to markedly negative - a result much more consistent with the Gray and Gruen result. Secondly, in the Gray and Gruen results, changes in relative prices (including, presumably, changes in the relative prices of farm and non-farm commodities) were estimated to have made a marked positive contribution to the growth in G.D.P. in 1974-75 (see Gray and Gruen (1981) Table 2, p.11). Finally, the change in the value of farm

exports in 1974-75 was only relatively modest, (see Appendix II), suggesting that the disparate treatment of this variable would be unlikely, in itself, to produce such a marked difference in the two sets of results.

In general, therefore, it is evident that the different approaches and assumptions adopted in the two competing models lead to significantly different conclusions about the contribution of the farm sector to the growth in G.D.P. in Australia — at least over the significant period for which a direct comparison of the results has been possible.

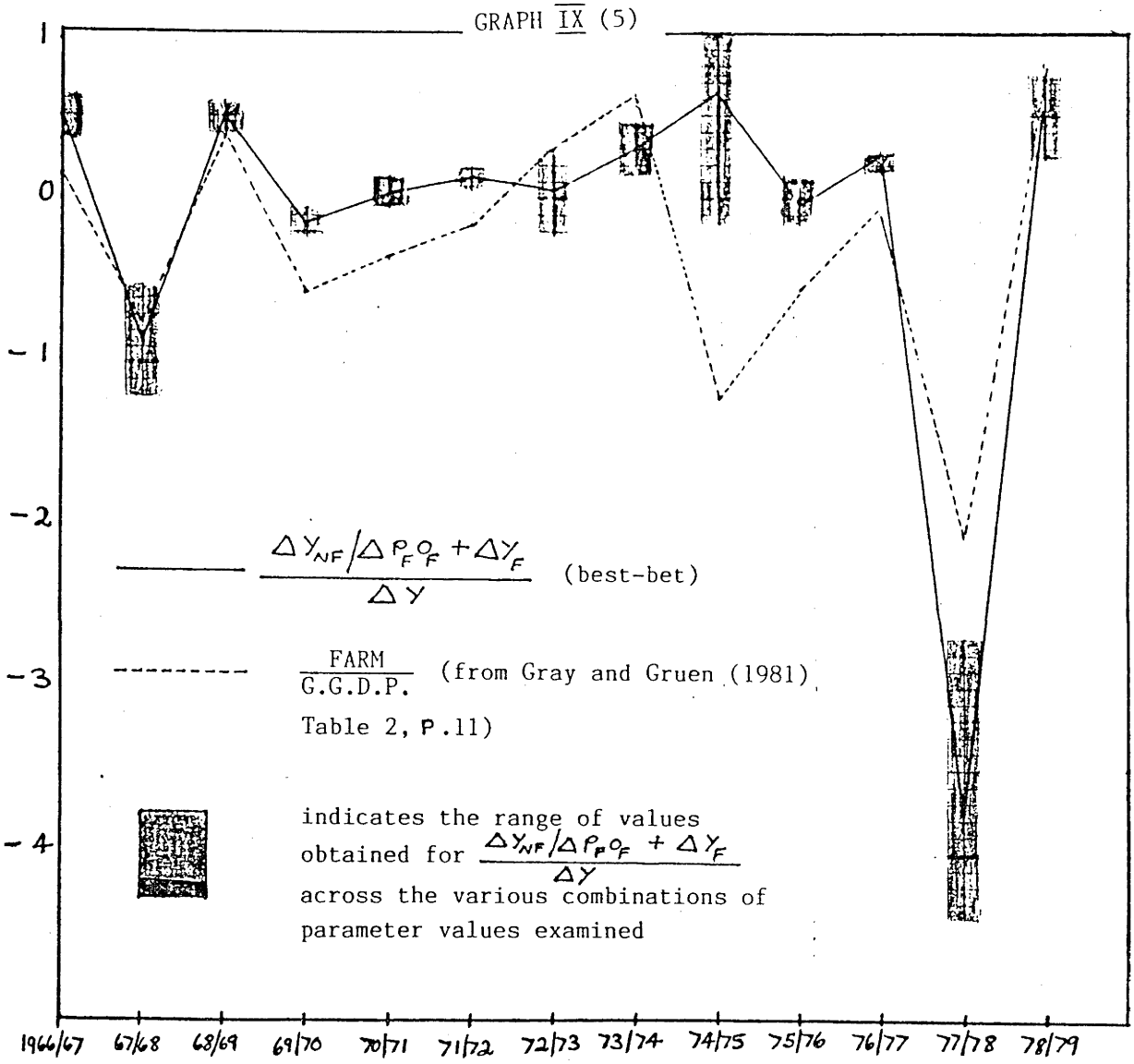
Gray (1984) made several refinements and modifications to the original growth decomposition model which had been developed earlier by Gray and Gruen. Two of the modifications which were made by Gray were undertaken in response to the sorts of criticisms of the earlier approach that were outlined above. In particular:

1) the contribution made by farm exports was credited directly to the farm sector, rather than to an 'external sector', as had been the case in the original analysis;

2) expenditure switching effects caused by changes in the relative price of farm and non-farm commodities were also credited to the farm sector, rather than to a 'relative price' term.

In addition, Gray also incorporated a lagged adjustment process into the model, thus allowing a distinction to be drawn between current period effects and total effects. However, as necessitated

GRAPH IX (5)


1
0
-1
-2
-3
-4
$\frac{\Delta Y_{NF}/\Delta P_F O_F + \Delta Y_F}{\Delta Y}$ (best-bet)
$\frac{\text{FARM}}{\text{G.G.D.P.}}$ (from Gray and Gruen (1981) Table 2, P.11)
indicates the range of values obtained for $\frac{\Delta Y_{NF}/\Delta P_F O_F + \Delta Y_F}{\Delta Y}$ across the various combinations of parameter values examined
1966/67
67/68
68/69
69/70
70/71
71/72
72/73
73/74
74/75
75/76
76/77
77/78
78/79

by data constraints, Gray continued to assume that the consumption and investment behaviour of farm and non-farm households was identical. Finally, the time period considered by Gray was extended from 1966/67 - 1978/79 (as used by Gray and Gruen) to 1962/63 - 1981/82.

Some of the main features of Gray's results, as they apply to the present discussion, are summarised in Table IX(12).

In general, Gray's results more closely approximate the results obtained from the simple empirical model than was the case for the earlier results obtained by Gray and Gruen. In particular:

- of the 20 years considered by Gray, his results fall inside the range of results obtained from the present model on 11 occasions;
- for several of the remaining 9 years, Gray's results lie only marginally outside the range of results obtained from the present model, eg. 1968-69, 1971-72, 1973-74 and 1981-82;
- for each year other than for 1972-73 and 1975-76, Gray's results and the best-bet results obtained from the present model share the same sign.

It is not implausible that most of the remaining differences between the two sets of results could be satisfactorily explained in terms of, firstly, the lagged adjustment process assumed by Gray and, secondly, the alternative approaches adopted with respect to farm consumption and investment behaviour.

The results obtained from the two models for 1974-75 are worth discussing briefly. It is clear from Table IX(12) that Gray's estimate for that year lies comfortably inside the range of values

TABLE IX(12)

A Comparison of Gray's Results with the Results Obtained from the Simple Empirical Model

Year	TOT / G.D.P.	P / G.D.P.	B B	M P	M N
1962-63	.22	.01	.27	.36	.19
1963-64	.20	.03	.35	.49	.17
1964-65	.16	.09	.10	.17	.05
1965-66	-.81	-.02	-1.09	-.67	-1.42
1966-67	.45	.06	.49	.61	.34
1967-68	-.43	0	-.88	-.53	-1.20
1968-69	.36	-.04	.50	.58	.39
1969-70	-.18	-.03	-.16	-.07	-.22
1970-71	.04	.09	.03	.12	-.04
1971-72	.20	0	.13	.18	.05
1972-73	-.09	.13	.04	.27	-.21
1973-74	.09	.03	.30	.44	.13
1974-75	.05	-.34	.62	1.74	-.13
1975-76	.26	-.02	-.03	.11	-.14
1976-77	.44	.38	.24	.27	.17
1977-78	-.79	-.76	-3.74	-2.70	-4.37
1978-79	.42	.05	.53	.75	.24
1979-80	-.98	.17	-.24	-.21	-.27
1980-81	-.22	.09	-.31	-.11	-.45
1981-82	.42	-.13	.26	.35	.19

$\frac{TOT}{GDP}$ - Gray's estimate of the relative, current period, contribution made by the farm sector to the annual change in G.D.P. - derived from Gray (1984), Table 17, p.57.

$\frac{P}{GDP}$ - Gray's estimate of the relative, current period, contribution made to the annual change in G.D.P. by the switching of expenditure between farm and non-farm commodities in response to a change in the relative price of farm and non-farm commodities - derived from Gray (1984), Table 17, p.57.

B B - $\frac{(\Delta Y_{NF}/\Delta p_F O_F) + \Delta Y_F}{\Delta Y}$ (best-bet) - drawn from Table IX(11), suitably extended to include the additional years considered by Gray.

M P - $\frac{(\Delta Y_{NF}/\Delta p_F O_F) + \Delta Y_F}{\Delta Y}$ (most positive) - drawn from Table IX(11), suitably extended to include the additional years considered by Gray.

M N - $\frac{(\Delta Y_{NF}/\Delta p_F O_F) + \Delta Y_F}{\Delta Y}$ (most negative) - drawn from Table IX(11), suitably extended to include the additional years considered by Gray.

obtained from the present model and that Gray's result and the best-bet result both imply a positive contribution by the farm sector. However, Gray's estimate of $\frac{P}{G.D.P.}$ implies that the expenditure switching effect between farm and non- farm commodities made a substantial negative contribution to G.D.P. in that year. In other words, it is implied that there was a switching of expenditure away from non-farm commodities. It is also clear that, as the overall contribution made by the farm sector to the growth in G.D.P. was estimated to have been positive, the remaining channels of influence from the farm sector to the non-farm sector — most notably via farm consumption and investment expenditure — were implied to have made a positive contribution. Such a configuration is the reverse of that obtained from the present model, as discussed in Section V. In particular, there the expenditure switching effect was estimated to have made a substantial positive contribution to the growth in G.D.P., with the remaining channels of influence making a negative contribution.

Gray's result for 1974-75 would seem difficult to rationalise. It is clear, from Table IX(13), that farm incomes fell sharply in that year — a fall which was due primarily to a relative decline in farm commodity prices. A negative expenditure switching effect, such as that implied by Gray's results, would suggest that the demand for farm commodities was own price elastic. Further, Gray's suggestion that the remaining channels of influence from the farm sector to the non-farm sector made a positive contribution to the growth in G.D.P. is difficult to reconcile with the sharp fall in farm income.

Finally, it is important to observe that, from 1962-63 to 1969-70, the mean absolute value of the variable $\frac{TOT}{G.D.P.}$ was about 0.35, falling only marginally to about 0.33 between 1970-71 and 1981-82. Further, over the period from 1975-76 to 1981-82, the corresponding figure was about 0.50. In other words, the results are suggestive of the proposition that, since the early 1960s, the relative importance of the farm sector as a source of change in G.D.P. has not declined significantly and may, in fact, have increased in relative importance since the mid 1970s. This lends a measure of support to the tentative conclusion reached in Section V — that the farm sector has not declined in relative importance as a source of change in non- farm output since the early 1950s and may have increased in relative importance over that period.

VI(3) The Campbell, Crowley and Demura Analysis of the 1982-83 Drought

Campbell, Crowley and Demura (1983) made an assessment of the macroeconomic effects of the drought in 1982/83, using the framework of the Orani model. In particular, they obtained estimates from the model for the impact of a 1 percent decline in gross farm product on some important macroeconomic variables. Then, on the basis of their assumption that most of the 18 percent decline which occurred in real gross farm product in 1982-83 could be attributed to the drought, they extrapolated the results from Orani accordingly.

In Chapter VIII, the potential value of the Orani model as a framework for quantifying the impact of shocks originating in the farm sector on the macroeconomy was discussed briefly. Before proceeding to assess the Campbell et al results, it is instructive to consider this issue in more detail. The linkages from the farm sector to the macroeconomy which are captured in Orani - at least in 'stand alone mode', as was used in the present exercise - are relatively weak:

1) the model does not capture the effect that a drought induced decline in farm income would have on the level of farm consumption expenditure and hence on aggregate consumption expenditure. This also means that any subsequent induced multiplier effects of such a change in consumption expenditure would not be captured;

2) while some assessment of the drought on the farm component of aggregate investment expenditure might be possible within Orani, this would occur within the

context of a given level of aggregate investment expenditure. In other words, the probable decline in farm investment expenditure would not be permitted to have any impact on aggregate investment expenditure, and hence would produce no subsequent multiplier effects in the model;

3) Orani would provide some guidance as to the effect that the drought would have on the usage of intermediate inputs in the farm sector. To the extent that a decline in the usage of these inputs occurred, and this resulted in a decline in the level of output and incomes in the non-farm sector of the economy, that would be captured in Orani. However, any subsequent multiplier effects of that decline in non-farm income would not be captured. Further, the usage of intermediate inputs in the farm sector seems to exhibit only a limited degree of variation from year to year. For example, the decline in 1982-83 was only marginal - see Appendix II;

4) similarly, Orani would provide some guidance as to the impact of the drought on the level of farm employment. However, to the extent that farm employment falls, resulting in a decline in the level of household income accruing to farm employees, the likely effect of that on aggregate consumption expenditure, and any subsequent multiplier effects, would not be captured;

5) Orani would also probably provide some information on the

supply side effects that the reduced volume of farm production would have after it left the farm gate - for example, a smaller wheat crop would be reflected in a reduced usage of rail transport. Again, however, to the extent that such effects would reduce output and incomes in the non-farm sector, any subsequent multiplier effects of that would not be captured;

If it was considered that the size of the effects captured in (3) & (5) above were likely to be relatively small, then it seems probable that the estimated impact of the drought on the non-farm economy, which would emerge from Orani, would be very small. In other words, it would be expected that the estimated impact of the drought on total G.D.P. would only be marginally different from the estimate obtained simply by considering the direct impact of the decline in gross farm product on G.D.P. In the present context, as gross farm product was 6.03 percent of total G.D.P. in 1974-75 (the base year for ORANI), the estimated 18 percent decline in gross farm product in 1982-83 would directly reduce total G.D.P. by around 1.09 percent. It would be expected, therefore, that the estimate obtained from Orani in the present exercise would only be marginally different from that figure.

This expectation is largely supported by the results reported by Campbell et al. They report that, from Orani, a 1 percent decline in farm gross product produced an 0.06 percent decline in total G.D.P. On that basis, they extrapolated that the 18 percent decline in real gross farm product in 1982- 83 would reduce total G.D.P. by 1.1 percent - almost exactly the figure suggested by the

above reasoning.

This estimate can be compared with the one obtained from the simple empirical model for 1982-83. From Table IX(3), the decline in real gross farm product in 1982-83 was $1359m. in 1979-80 prices. In addition, the best-bet estimate for $\Delta Y_{NF}/\Delta p_F O_F$ in that year was $-322m. Summing these two components and calculating the sum as a percentage of real G.D.P. in 1981-82, we get

$$\frac{-1681}{121890} = -1.38\%$$

In other words, the estimated decline in total G.D.P. as a result of the drought was 1.38 percent, compared with the Orani estimate of 1.1 percent, and the actual overall decline in G.D.P. in 1982-83 of about 2 percent. The more significant negative impact implied by the results obtained from the simple empirical model is a reflection of the stronger linkages from the farm to the non-farm sector captured in that model.[1]

It is not clear to what extent the estimates obtained from Orani would capture the effects of changes in the relative price of farm and non-farm commodities as they operate through the term $\Delta\left(\frac{z^F}{p}\right)\left(\sigma\right)\left(k\right)$ in the simple empirical model. If we consider the best-bet results obtained from equation (10) (ie. with the effects of the above term removed), the corresponding estimate is -1.87 percent. This is clearly a substantially more negative effect than either the estimate from Orani, or the earlier best-bet estimate and

---

[1]In another, more preliminary study undertaken around the same time using the Orani model, Vincent (1983) estimated that the 1982-83 drought reduced total G.D.P. by around 1.2 percent.

is of a similar order of magnitude to the total decline in real G.D.P. of 2 percent. It might also be noted that the most significant negative effect obtained from equation (10') for any of the parameter combinations used was 2.01 percent.

Finally, it is interesting to note that Campbell et al argue that, on the basis of their results, a decline of $1m. in farm output results in a further decline in non-farm output of $0.5m. They suggest that this result implies a total multiplier effect of about 1.5. However, it is difficult to rationalise this conclusion, given the actual results reported. As was noted above, the feedback effects from the farm sector to the non-farm sector that are captured in Orani would seem, in theory, to be limited. Further, the numerical results reported by Campbell et al imply that the estimated decline in total G.D.P. as a result of the drought can be almost entirely accounted for by the direct impact of the decline in farm gross product alone, ie. the implied total multiplier is approximately unity.

Section VII. Concluding Comments on Chapter IX

In Chapter IX, a simple empirical model was presented which could be interpreted as a simplified version of the theoretical model developed and explored in earlier chapters. The model was used to assess the contribution of the farm sector to annual changes in non-farm and total G.D.P. over the period from 1953-54 to 1982-83.

The main conclusions to emerge from the empirical results were that:

1) there is considerable evidence that the relative contribution of the farm sector to changes in non-farm output has not declined over this period, and may have increased. This is despite the fact that the relative contribution of the farm sector to the absolute values of variables such as G.D.P., employment and exports has declined substantially over the period;

2) the effects of switches in aggregate expenditure, resulting from changes in the relative price of farm and non-farm commodities, have been of marked importance in some years, and of negligible importance in others. There is some evidence, however, that the overall importance of this channel of influence has tended to increase in the 1970s, reflecting the greater volatility of farm prices since the early 1970s;

3) the results are relatively sensitive to the assumptions made with respect to the values of the various marginal

propensities. The degree of this sensitivity is such as to suggest that the rather divergent assumptions made with respect to these marginal propensities in the main Australian macroeconomic models could, potentially, have a significant bearing on empirical analyses, forecasts or projecions undertaken with those models in the presence of a significant shock in the farm sector;

4) the results obtained for a number of individual years were interesting and instructive. For example, there is evidence to suggest that the farm sector made a significant positive contribution to non-farm output in 1974-75 - a year more normally associated with a depressed farm economy. In 1982-83, the results indicate that, even without the drought, the non-farm economy would have experienced, at best, zero growth, ie. a relatively severe recession would still have been experienced.

It was then noted that, in the Australian literature, there have been relatively few studies, directed towards an examination of the impact of developments in the farm sector on important macroeconomic variables, against which the present results could be compared or verified. Two noteworthy recent studies were reviewed in some detail — firstly, that undertaken by Gray and Gruen (1981,1982) and subsequently revised and refined by Gray (1984) and, secondly, Campbell, Crowley and Demura (1983). It was observed that the results reported in the original Gray and Gruen analysis and by Campbell et al were substantially at variance with the results

obtained in the present study. Several rationales for these differences were suggested. It was also observed that the results reported by Gray (1984) were more consistent with those obtained in the present study and lent a measure of support to the tentative conclusion noted in (1) above.

Finally, the material presented in Chapters VIII and IX has provided substantial incentive for undertaking further development and refinement of the model structure presented and, to some extent, explored in Chapters III to VII. It was argued, in Chapter VIII, that the treatment of farm/macro linkages in the main Australian macroeconomic models are unsatisfactory, and this was reinforced by the empirical results presented in Chapter IX - particularly in Section V(3). The results presented in Chapter IX could also be interpreted as implying that a satisfactory and consistent treatment of the farm sector in Australian macroeconomic models has become more, rather than less, important over time. They have also suggested a very important hypothesis which should be tested when an empirical version of the full model structure used in this thesis is eventually developed. That hypothesis is that the farm sector has become relatively more important as a source of change or instability in the non-farm sector of the Australian economy over the period since the early 1950s.

Appendix I

It is assumed that $\sigma_F^{NF} = \sigma_j^{NT} = \sigma^{NF}$, ie. the induced change in expenditure on, and hence production of, non-farm output in the first round following a change in non-farm household incomes via a change in y_F^{NF} or $p_j J_{NT}$ is a proportion σ^{NF} of that change.

It is further assumed that:

(17) $\sigma^{NF} = (1-MPT)(MPC_{NF})(1-MPI)$ where MPT is the marginal propensity to tax non-farm household incomes, MPC_{NF} is the marginal propensity to consume by non-farm households, and MPI is the marginal propensity to consume traded commodities.

The most basic formula for the induced multiplier, k, is

$$(18) \quad k = \frac{1}{1-(1-MPT)(MPC_{NF})(1-MPI)} = \frac{1}{1-\sigma^{NF}}$$

The use of this formula for k is based on an implicit assumption that each of the various rounds of the income multiplier would be completed within a single time period, ie. within one year. While this is obviously an oversimplification,it is well known that the first two or three terms in a series formed by expanding a typical multiplier process tend to dominate the total effect. Therefore, it is felt that this simplification would not produce seriously misleading results.

To quantify σ^{NF}, and hence k, the following assumptions are made:

$$MPT = 0.3$$

$$MPC_{NF} = 0.5,\ 0.6,\ 0.7$$

$$MPI = 0.15,\ 0.3$$

It is felt that these magnitudes are realistic. An MPT = 0.3 is consistent with the standard marginal rate of personal income tax, at least in recent years. The three chosen values for MPC_{NF} would seem to be consistent with the empirical evidence for Australia, as reviewed in Chapter VIII. The assumption that MPI = 0.15 is broadly consistent with the average propensity to import in Australia. Of course, this would only be an acceptable measure of MPI if the average and marginal propensities to import were similar, and if the marginal propensities to spend on farm commodities and non-farm exportables were around zero. To cater for the possibility that the marginal propensity to import may exceed the average propensity, and/or that the marginal propensity to spend on farm and non-farm exportable commodities may be of some significance, a larger value of 0.3 for MPI is also considered in the analysis.

The approximate implied values for σ^{NF} and hence k, associated with the six possible combinations of values for the above parameters are:

MPC_{NF}	MPI		σ^{NF}	k
0.5	0.15	$\longrightarrow$	0.3	1.4
0.6	0.15	$\longrightarrow$	0.35	1.5
0.7	0.15	$\longrightarrow$	0.4	1.65
0.5	0.3	$\longrightarrow$	0.25	1.33
0.6	0.3	$\longrightarrow$	0.3	1.4
0.7	0.3	$\longrightarrow$	0.35	1.5

Moving on to σ_F, it is assumed that:

$$(19) \quad \sigma_F = \frac{(1-MPT)(MPC_F)(1-MPI) + MPi\left[1-MPT-(1-MPT)(MPC_F)\right]}{(1-MPI)}$$

where MPC_F is the marginal propensity to consume by farm households, MPi is the marginal propensity to invest out of farm residual funds, and where it is assumed that MPT is common to both farm and non-farm households. Farm residual funds are defined as in equation (6) of Chapter VIII - the balance of farm household income after farm consumption expenditure and farm taxation payments are deducted.

The empirical evidence on the size of MPC_F and MPi was reviewed in some detail in Chapter VIII, along with some discussion of the theoretical underpinnings of the residual funds hypothesis. The treatment of farm consumption and investment expenditure in the main Australian macroeconomic models was also reviewed. Some of the main conclusions were that:

1) several Australian macroeconomic models, including N.I.F., impose an assumption that MPC_F is zero. Empirical evidence in support of that position is reasonably weak;

2) by contrast, the R.B.A. model imposes an assumption that $MPC_F = MPC_{NF}$. Empirical evidence in support of that position is also weak;

3) a middle ground, with $0 < MPC_F < MPC_{NF}$ seems to receive a degree of empirical and theoretical support;

4) a residual funds effect on farm investment emerges readily from a

largely neo-classical investment model in which some allowance is made for credit rationing. In such a framework, residual funds serve as an argument influencing the speed of adjustment of the actual farm capital stock to its neo-classically determined optimum level. Focusing exclusively on this adjustment role, it was shown that MPi could theoretically assume any value between 0 and 1 inclusive and, indeed, that values in excess of 1 were also possible. It was also suggested that the value need not be stable over time or across regions and industries, and that the value may change depending on whether residual funds rise or fall;

5) it is common for empirical analyses of farm investment behaviour to find a statistically significant residual funds effect - often with the specification of the empirical models being consistent with an 'adjustment' role for farm residual funds, as outlined in (4) above. Typical estimated values for MPi ranged between about 0.05 to about 0.5;

6) it was argued that many of these empirical models may have been misspecified in such a way as to bias downwards the estimated value of MPi;

7) the existing Australian macroeconomic models do not explicitly recognise, or allow any role for, a residual funds effect on the farm component of investment expenditure.

In view of these conclusions, the following combinations of values for MPC_F and MPi are utilised in the simple quantitative version of the model:

(a) $MPC_F = 0,\ MPi = 0 \longrightarrow \sigma_F = 0$

Combination (a) could be interpreted as the approach adopted in the N.I.F. and Nevile models.

(b) $MPC_F = MPC_{NF}$, $MPi = 0 \longrightarrow \sigma_F = \sigma^{NF}$

This combination could be interpreted as the approach adopted in the R.B.A. model.

(c) $MPC_F = 0.5\ MPC_{NF}$, $MPi = 0.4$

Combination (c) would seem to represent a reasonable consensus position based on the existing empirical literature, as reviewed in Chapter VIII.

(d) $MPC_F = 0.5\ MPC_{NF}$, $MPi = 1$.

Combination (d) retains the consensus position for $M.P.C._F$ that was used in (c). In the present case, however, it is combined with a value of unity for MPi. There are several reasons for considering a higher value for MPi than suggested by the empirical literature:

(1) as noted above, the existing empirical estimates of MPi may be biased downwards, and values of unity or greater have been shown to be theoretically plausible;

(2) it is possible that changes in farm production or prices may also influence farm investment expenditure through channels other than through the adjustment role played by residual funds. For example, a rise in farm prices or an improvement in seasonal conditions may not only increase residual funds and hence the speed of adjustment of the actual capital stock to its optimal level, but

may also serve to increase the optimal level of the capital stock itself. In general, to the extent that such an effect was operative, it is clear that it would tend to work in the same direction as, and hence reinforce, the residual funds effect. In other words, developments which result in an increase in residual funds would, if anything, raise the optimal capital stock and conversely. From the viewpoint of the simple, highly aggregated version of the model used in the present exercise, it may be possible to adequately capture such an effect by adjusting upwards the assumed value of MPi relative to the values which have been estimated in the literature for MPi in its purely adjustment role.

Several further points should be noted. Firstly, the choice of value for MPC_F and MPi has no bearing on the value of the induced non-farm multiplier, k - although it obviously affects the size of the multiplicand and hence the size of the <u>total</u> multiplier effect. Secondly, it is implicitly assumed in the above formulation that a change in the level of farm residual funds influences farm investment expenditure with time lags which are small relative to the length of the time period being considered, ie. one year. Unfortunately, the existing empirical literature does not provide much guidance on this point because of the 'smudging' of an accelerator type effect and a residual funds effect in many of those studies, as noted in Chapter VIII.

The final parameter to be considered in equations (10') and (11') is σ. It will be recalled that this is the conversion factor to produce a multiplicand from the variable $\Delta\left(\frac{z^F}{p_c}\right)$. It is assumed that a satisfactory measure of σ is given by:

(20) $\sigma = 1\text{-MPI}.$

In other words, given the measure of the rise or fall in real expenditure on non-farm commodities as a result of a change in the relative price of farm and non-farm commodities, the initial rise or fall in non-farm production can be obtained by adjusting $\Delta\left(\frac{z^F}{p_c}\right)$ to allow for a spillover onto traded commodities. Therefore, in those combinations of parameters which are based on the assumption that MPI = 0.15, σ is set at 0.85. Similarly, in those combinations of parameters based on the assumption that MPI = 0.30, σ is set at 0.7 .

Appendix II

Data was obtained for each of the variables appearing in equations (10') and (11') over the period 1952-53 to 1982-83, in order to allow those equations to be simulated over the period 1953-54 tO 1982-83 (noting that the model utilises annual changes in the data). Over a period of that length, a single base year could not be validly used to convert nominal data to volume terms. Therefore, the period was divided into several sub-periods. In particular, for 1952-53 and 1953-54, 1953-54 prices were used, while for the period 1954-55 to 1959-60, 1959-60 prices were used, with 1966-67 prices being used for the period 1960-61 to 1966-67, 1974-75 prices for the period 1967-68 to 1980-81, and 1979-80 prices for 1981-82 and 1982-83.

The first variable on th R.H.S. of equation (10') is $\Delta\left(\frac{y_F^F}{p}\right)$, where y_F^F is the level of nominal income accruing to farm households. Data for y_F^F was drawn from a consistent series published by the Bureau of Agricultural Economics (B.A.E.). Farm depreciation allowances were added back into the measure of y_F^F, as they represent funds which remain in the hands of farm households, and which are therefore available to finance consumption or investment expenditure. Three separate deflators for y_F^F were used - the implicit consumption deflator, a simple average of the implicit consumption and investment deflators, and a weighted average of those two deflators - in order to reflect the variety of consumption and investment responses by farm households being assumed in the model. These 3 separate measures for p, coupled with the 24 parameter combinations listed in Table IX(1), meant that 72 values were obtained for the L.H.S. of (10') for each year, and

hence 72 values for the L.H.S of (11').

The second variable on the R.H.S. of (10') is $\Delta\left(\frac{y_F^{NF}}{p_c}\right)$. The term y_F^{NF} is a measure of that part of nominal value added in the farm sector which accrues to non-farm households. For this purpose, a B.A.E. measure of depreciation, wages, net rent and interest paid was used, from which a measure of farm depreciation allowances was deducted. The deflator used was the implicit private consumption deflator.

To obtain a series for $\Delta(p_j J_{NT})$, B.A.E. data on production costs other than wages, depreciation, seed and fodder was utilised. The series thus obtained was multiplied by 0.7 to reflect the fact that a significant proportion of non-primary inputs used in the farm sector are traded goods. Data for the variable ΔJ_{NT} was obtained by deflating the series for $\Delta(p_j\ J_{NT})$ by an index of prices paid by farmers for equipment and supplies, excluding seed and fodder, as compiled by the B.A.E. . Obviously, it would have been preferable to have used an implicit deflator for this purpose, with the same base years as used for the other variables in the model. However, no such series is available.

To obtain a series for $\Delta\left(\frac{z^F}{p_c}\right)$, it was assumed that:

(i) private final consumption expenditure was responsible for all of the farm commodities absorbed on the domestic market, other than for seed, fodder and farm stocks; and

(ii) private final consumption expenditure was allocated between farm and non-farm commodities according to a homothetic preference mapping.

It follows from these assumptions that, in the absence of any change in the relative price of farm and non-farm commodities, nominal expenditure directed onto farm commodities would change, between year t-1 and year t, in the same proportion as the change in aggregate private consumption expenditure. Therefore, given a measure of nominal expenditure on farm commodities in year t-1, and the observed change in aggregate nominal private consumption expenditure between year t-1 and year t, it is trivial to calculate a measure of 'expected' consumption expenditure on farm commodities, ie. expected in the absence of any change in the relative price of farm and non-farm commodities. The difference between the actual level of nominal expenditure on farm commodities, and its expected level was then assumed to represent a measure of Δz^F in year t.

Of course, for this procedure to be operative, a series for the level of private final consumption expenditure directed onto farm commodities (and measured as close as possible to the farm gate) was necessary. No such data is readily available. It was assumed that a tolerable set of data could be obtained by subtracting from the nominal gross value of farm output the aggregate of exports of farm origin, seed and fodder used on farms and the change in the value of farm (and public authority) stocks.

It should be noted that this procedure captures the effect of changes in the relative price of farm and non-farm commodities from all sources. In other words, it does not distinguish between price changes originating exogenously on overseas markets, or resulting from changes in the real exchange rate, or price changes which are endogenous in the sense that they result from changes in the volume

of farm commodities being forced onto the local market.This is consistent with the point, noted above, that for the purpose of analysing historical data, the distinction between equations (10') and (11') on the one hand, and (10") and (11") on the other, ceases to be of practical relevance.

The final variable to be considered is ΔY_F in equation (11'). For the period since 1959-60, data for this variable was drawn directly from the National Accounts. However, prior to 1959-60, real G.D.P. was not separated into its farm and non-farm components in the National Accounts. Therefore, for that period, an estimate of real gross farm product and real gross non-farm product had to be made, in 1953-54 and 1959-60 prices as relevant. This was done using a double deflation procedure based on the B.A.E. prices paid and prices received indices, on the assumption that such indices represented tolerable approximations to the true implicit deflators.

All of the data used to form the variables discussed above and the sources of that data are documented in detail in Table IX(13).

Appendix

TABLE IX(13)

Data for the Model

Year	(1) $m	(2) $m	(3) $m	(4) $m	(5) $m
1952-53	2326	1914	412	172	240
1953-54	2301	1858	443	175	268
1954-55	2209	1788	421	172	249
1955-56	2313	1868	445	183	262
1956-57	2549	2096	453	172	281
1957-58	2258	1762	496	204	292
1958-59	2523	1552	971	234	737
1959-60	2656	1611	1045	193	852
1960-61	2745	1635	1110	253	857
1961-62	2734	1576	1158	192	966
1962-63	2990	1784	1206	218	988
1963-64	3368	2105	1263	215	1048
1964-65	3389	2036	1353	270	1083
1965-66	3278	1803	1475	267	1208
1966-67	3790	2240	1550	353	1197
1967-68	3301	1747	1554	273	1281
1968-69	3905	2221	1684	331	1353
1969-70	3730	2057	1673	256	1417
1970-71	3580	1924	1656	292	1364
1971-72	3968	2228	1740	256	1484
1972-73	4957	2994	1963	343	1620
1973-74	6412	4183	2229	476	1753
1974-75	5877	3338	2539	474	2065
1975-76	6174	3333	2841	462	2379
1976-77	6757	3658	3099	457	2642
1977-78	6972	3741	3231	422	2809
1978-79	10228	6373	3855	513	3342
1979-80	11720	7122	4598	639	3959
1980-81	11525(P)	6602	4923	829(P)	4094
1981-82	12670(P)	6955	5816	890(P)	4625
1982-83	11400(S)	5405	5995	990(S)	5005

Year	(6) $m	(6') $m	(7) $m	(7') $m	(7") $m
1952-53	1172	1314	742	142	600
1953-54	1025	1209	833	184	649
1954-55	899	1115	889	216	673
1955-66	930	1174	940	244	696
1956-57	1111	1353	985	242	743
1957-58	713	975	1057	262	795
1958-59	954	1228	589	274	315
1959-60	1007	1297	604	290	314
1960-61	1017	1317	618	300	318
1961-62	942	1250	634	308	326
1962-63	1118	1432	662	314	348
1963-64	1406	1760	724	354	370
1964-65	1292	1666	771	374	397
1965-66	1041	1419	792	378	414
1966-67	1373	1791	867	418	449
1967-68	827	1257	920	430	490
1968-69	1251	1697	970	446	524
1969-70	1074	1519	983	445	538
1970-71	939	1356	985	417	568
1971-72	1263	1680	965	417	548
1972-73	1960	2401	1034	441	593
1973-74	3019	3437	1164	418	746
1974-75	1943	2415	1395	472	923
1975-76	1821	2339	1512	518	994
1976-77	2053	2669	1605	616	989
1977-78	1998	2627	1743	629	1114
1978-79	4460	5162	1913	702(712)	1211
1979-80	4945	5741	2177	796(821)	1381
1980-81	4144(P)	5015	2458	871(986)	1587
1981-82	3880(P)	4950	2835	1070	1765
1982-83	1950(S)	3100	3455	1150	2305

Year	(8)	(8')	(9)	(10)	(11)
			$m		
1952-53	89	103	233	97.5	98.9
1953-54	86	89(100)	301(268)	83.6(100.0)	84.8(100)
1954-55	86	89	280	85.3	87.0
1955-56	90	93	282	88.8	91.3
1956-57	94	97	290	94.0	94.4
1957-58	97	100	292	95.4	97.2
1958-59	97	100	737	97.3	98.3
1959-60	97	89(100)	957(852)	84.6(100.0)	88.7(100)
1960-61	99	91	942	88.2	90.4
1961-62	101	93	1039	88.5	90.9
1962-63	100	92	1074	89.5	91.1
1963-64	98	90	1164	90.9	92.4
1964-65	101	93	1165	94.0	95.0
1965-66	105	96	1258	97.1	97.3
1966-67	109	58(100)	2064(1197)	56.7(100.0)	55.7(100)
1967-68	112	59	2171	58.7	56.4
1968-69	114	60	2255	60.4	58.2
1969-70	114	60	2362	63.0	60.0
1970-71	118	62	2200	66.9	62.9
1971-72	126	67	2215	71.4	67.3
1972-73	132	70	2314	75.9	71.5
1973-74	144	76	2307	85.0	81.0
1974-75	189	100	2065	100.0	100.0
1975-76	226	120	1982	115.6	116.1
1976-77	248	131	2017	129.0	130.3
1977-78	276	146	1924	141.2	143.6
1978-79	302	160	2089	154.0	154.7
1979-80	349(85)	185(100)	2140	169.0	169.9
1980-81	411(100)	217(117)	1887(3499)	183.8(109.3)	188.1(110.9)
1981-82	452(110)	129	3585	119.5	122.0
1982-83	505(123)	144	3476	133.0	136.1

Year	(12)	(12')	(13)
1952-53	98.2	98.5	102.8 [6714/6533]
1953-54	84.2(100)	84.4(100)	85.6 [7504/8771]
1954-55	86.2	86.5	87.9 [8190/9315]
1955-56	90.1	90.6	91.5 [8938/9770]
1956-57	94.2	94.3	97.4 [9681/9938]
1957-58	96.3	96.7	99.5 [10272/10322]
1958-59	97.8	98.0	96.4 [10907/11319]
1959-60	86.7(100)	87.5(100)	82.8
1960-61	89.3	89.7	85.6
1961-62	89.8	90.2	87.6
1962-63	90.3	90.6	88.6
1963-64	91.7	92.0	90.1
1964-65	94.5	94.7	93.6
1965-66	97.2	97.2	96.6
1966-67	56.2(100)	56.0(100)	52.6
1967-68	57.6	57.1	54.7
1968-69	59.3	58.9	56.9
1969-70	61.5	60.9	59.8
1970-71	64.9	64.1	63.5
1971-72	69.4	70.0	67.8
1972-73	73.7	72.8	72.3
1973-74	83.0	82.2	82.2
1974-75	100.0	100.0	100.0
1975-76	115.9	116.0	116.3
1976-77	129.7	129.9	128.8
1977-78	142.4	142.9	139.7
1978-79	154.4	154.5	150.0
1979-80	169.5	169.6	164.1
1980-81	186.0(110.1)	186.8(110.4)	181.8(110.2)
1981-82	120.8	121.3	123.2
1982-83	134.6	135.2	137.3

Year	(14) $m	(15) $m
1952-53	1949 $\left[2326.\frac{100}{99} - 412.\frac{100}{103}\right]$	6533
1953-54	1694(1853) $\left[2301.\frac{100}{105} - 443.\frac{100}{89}\right]$	8771(7167)
1954-55	1781 $\left[2209.\frac{100}{98} - 421.\frac{100}{89}\right]$	9315
1955-56	1882 $\left[2313.\frac{100}{98} - 445.\frac{100}{93}\right]$	9770
1956-57	1938 $\left[2549.\frac{100}{106} - 453.\frac{100}{97}\right]$	9938
1957-58	1808 $\left[2258.\frac{100}{98} - 496.\frac{100}{100}\right]$	10322
1958-59	1713 $\left[2523.\frac{100}{94} - 971.\frac{100}{100}\right]$	11319
1959-60	1743(1611) $\left[2656.\frac{100}{100} - 1045.\frac{100}{100}\right]$	14646(12135)
1960-61	1807	15140
1961-62	1891	15256
1962-63	2080	16246
1963-64	2113	17520
1964-65	2207	18799
1965-66	1917	19539
1966-67	3378(2326)	39025(20542)
1967-68	2534	41391
1968-69	3791	44333
1969-70	3348	47472
1970-71	3286	50095
1971-72	3581	52310
1972-73	2899	55061
1973-74	3443	57370
1974-75	3724	58024
1975-76	3971	59406
1976-77	3981	61305
1977-78	3738	61780
1978-79	4982	63444
1979-80	4578	65123
1980-81	4016(6615)	67722(112301)
1981-82	7682	114208
1982-83	6323	113089

Year	(16) $m	(17) $m	(18) $m	(18')
1952-53	8482	1434	5450	
1953-54	10465(9025)	1382	5985	9.8
1954-55	11096	1290	6510	8.8
1955-56	11652	1248	6990	7.4
1956-57	11876	1556	7465	6.8
1957-58	12130	1256	7830	4.9
1958-59	13032	1259	8233	5.1
1959-60	16389(13746)	1451	9040	9.8
1960-61	16947	1400	9586	6.0
1961-62	17147	1635	9876	3.0
1962-63	18326	1645	10592	7.2
1963-64	19633	2147	11429	7.9
1964-65	21006	1927	12360	8.1
1965-66	21456	1849	13143	6.3
1966-67	42403(22868)	2013	14196	8.0
1967-68	43925	1836	15488	9.1
1968-69	48124	1871	16773	8.3
1969-70	50820	2108	18473	10.1
1970-71	53381	2105	20404	10.5
1971-72	55891	2419	22687	11.2
1972-73	57960	3310	25444	12.2
1973-74	60813	3509	30054	18.1
1974-75	61748	3863	36456	21.3
1975-76	63377	4260	43537	19.4
1976-77	65286	5222	49792	14.4
1977-78	65518	5206	55390	11.2
1978-79	68426	6011	62131	12.2
1979-80	69701	8285	69733	12.2
1980-81	71738(118916)	8180(P)	78669	12.8
1981-82	121890	7850(P)	89415	13.7
1982-83	119412	7300(S)	100249	12.1

	(19)	(20)	(20')	(21)	(22)
Year	$m			$m	$m
1952-53	68	106	99	652	
1953-54	36	107	105	708	716
1954-55	-21	100	98	768	770
1955-56	78	101	98	804	825
1956-57	-90	108	106	911	859
1957-58	-100	100	98	898	956
1958-59	138	96	94	892	944
1959-60	-44	102		1056	979
1960-61	60	102		1032	1119
1961-62	-111	97		1018	1063
1962-63	31	101		1096	1091
1963-64	-64	109		1070	1183
1964-65	120	106		1072	1157
1965-66	-85	110		1247	1140
1066-67	201	109		1223	1347
1967-68	-187	107		1379	1334
1968-69	397	106		1306	1493
1969-70	5	101		1361	1438
1970-71	-39	98		1222	1504
1971-72	-139	106		1432	1359
1972-73	-172	144		1476	1607
1973-74	578	168		1849	1743
1974-75	355	148		1185	2243
1975-76	50	155		1402	1415
1976-77	-69	173		1147	1604
1977-78	-575(-416)	179		(1760)1919	1275
1978-79	1340(908)	217		(2796)2364	2153(1975)
1979-80	-393	263(93)		3189	2652(3137)
1980-81	-213(-375)	283(100)		(2891)2729	3597
1981-82	482			3448	3103(3287)
1982-83	-128			3238	3865

	(23)	(24)	(25)	(26)	(27)
Year	$m	$m	$m	$m	$m
1952-53			1338		1334
1953-54	-8	-8	1436(1209)	-129	1432(1209)
1954-55	-2	-2	1294	-142	1289
1955-56	-21	-24	1303	9	1296
1956-57	52	55	1436	133	1435
1957-58	-58	-61	1012	-424	1008
1958-59	-52	-53	1256	244	1253
1959-60	77	77	1496(1297)	41	1482(1297)
1960-61	-87	-99	1475	-21	1468
1961-62	-45	-51	1392	-83	1386
1962-63	5	6	1586	194	1581
1963-64	-113	-124	1919	333	1913
1964-65	-85	-90	1763	-156	1759
1965-66	107	110	1460	-303	1460
1966-67	-124	-124	3187(1791)	331	3198(1791)
1967-68	45	77	2182	-1005	2201
1968-69	-187	-310	2862	680	2881
1969-70	-77	-122	2470	-392	2494
1970-71	-282	-422	2089	-381	2115
1071-72	73	102	2421	332	2400
1972-73	-131	-173	3258	837	3298
1973-74	106	125	4141	883	4181
1974-75	-1058	-1058	2415	-1726	2415
1975-76	-13	-11	2018	-397	2016
1976-77	-457	-354	2058	40	2055
1977-78	644(485)	456(343)	1845	-213	1838
1978-79	211(821)	137(533)	3343	1498	3341
1979-80	537(52)	318(31)	3387	44	3385
1980-81	-868(-706)	-472(-384)	2696(4555)	-691	2685(4543)
1981-82	345(161)	289(135)	4098	-457	4081
1982-83	-627	-471	2303	-1795	2293

	(28)	(29)	(30)	(31)	(32)
Year	$m	$m	$m	$m	$m
1952-53		1348		615	
1953-54	-125	1446(1209)	-139	776(649)	34
1954-55	-143	1307	-139	789	13
1955-56	7	1322	15	784	-5
1956-57	139	1439	117	790	6
1957-58	-427	1022	-417	833	43
1958-59	245	1262	240	324	-509
1959-60	44	1533(1297)	35	371(314)	-10
1960-61	-14	1493	-40	360	-11
1961-62	-82	1411	-82	368	8
1962-63	195	1600	189	389	21
1963-64	332	1936	336	407	18
1964-65	-154	1772	-164	422	15
1965-66	-299	1461	-311	426	4
1966-67	331	3159(1791)	330	792(449)	23
1967-68	-997	2141	-1018	835	43
1968-69	680	2810	669	868	33
1969-70	-387	2411	-399	854	-14
1970-71	-379	2027	-384	849	-5
1971-72	285	2353	326	768	-81
1972-73	898	3163	810	781	13
1973-74	883	4044	881	878	97
1974-75	-1766	2415	-1629	923	45
1975-76	-399	2023	-392	860	-63
1976-77	39	2069	46	767	-93
1977-78	-217	1860	-209	789	22
1978-79	1503	3352	1492	786	-3
1979-80	44	3397	45	817	31
1980-81	-700	2729(4588)	-668	863(1452)	46
1981-82	-462	4142	-446	1477	25
1982-83	-1788	2331	-1811	1733	256

Year	(33) $m	(34) $m	(35) $m	(36) $m	(37) $m
1952-53	246				
1953-54	321(268)	22	35	-91	634
1954-55	292	-29	-21	87	544
1955-56	295	3	2	101	455
1956-57	299	4	8	56	168
1957-58	306	7	2	-130	384
1958-59	757	451	445	-95	997
1959-60	1007(852)	95	115	-102	816
1960-61	972	-35	-15	64	494
1961-62	1090	118	97	84	116
1962-63	1104	14	35	189	990
1963-64	1153	49	90	33	1274
1964-65	1152	-1	1	94	1279
1965-66	1244	92	93	-290	740
1966-67	2111(1197)	-47	-61	409	1003
1967-68	2182	71	107	-844	2366
1968-69	2240	58	84	1257	2942
1969-70	2249	9	107	-443	3139
1970-71	2039	-210	-162	-62	2623
1971-72	2078	39	15	295	2215
1972-73	2134	56	99	-682	2751
1973-74	2062	-72	-7	544	2309
1974-75	2065	3	-242	281	654
1975-76	2058	-7	-83	247	1382
1976-77	2048	-10	35	10	1899
1977-78	1989	-59	-93	-243	475
1978-79	2170	181	165	1244	1664
1979-80	2343	173	51	-404	1679
1980-81	2227(3746)	-116	-253	-562	2599
1981-82	3870	124	86	1067	1907
1982-83	3763	-107	-109	-1359	-1119

Year	(38) $m	(39) $m	(40) $m
1952-53			
1953-54	543	15	25
1954-55	631	-20	-15
1955-56	556	2	1
1956-57	224	3	6
1957-58	254	5	1
1958-59	902	316	312
1959-60	714	67	81
1960-61	558	-25	-11
1961-62	200	83	68
1962-63	1179	10	25
1963-64	1307	34	63
1964-65	1373	-1	1
1965-66	450	64	65
1966-67	1412	-33	-43
1967-68	1522	50	75
1968-69	4199	41	59
1969-70	2696	6	75
1970-71	2561	-147	-113
1971-72	2510	27	11
1972-73	2069	39	69
1973-74	2853	-50	-5
1974-75	935	2	-169
1975-76	1629	-5	-58
1976-77	1909	-7	25
1977-78	232	-41	-65
1978-79	2908	127	116
1979-80	1275	121	36
1980-81	2037	-81	-177
1981-82	2974	87	60
1982-83	-2478	-75	- 76

Notes on Table IX(13)

COLUMN(1) : Nominal gross value of farm production. Data for years 1952-53 to 1975-76 drawn from Bureau of Agricultural Economics (B.A.E) (1980), Historical Trends in Australian Agricultural Production, Exports, Incomes and Prices, 1952-53 to 1978-79, AGPS, Canberra, Table 11, p.20-21, 'gross value of agricultural commodities'. Data for 1976-77 to 1980-81 drawn from B.A.E(1982), Quarterly Review of the Rural Economy, 4(4), Nov, Table 1, p.325, 'gross value of rural production'. Data for 1981-82 and 1982-83 drawn from B.A.E(1983). Quarterly Review of the Rural Economy, 5(3), Aug, Table 1, p.283. P=(preliminary) S=(estimated by B.A.E)

COLUMN(2) : Nominal gross farm product - calculated as (1) - (3)

COLUMN(3) : Nominal value of non-primary inputs used in the farm sector. Data for 1952-53 to 1977-78 drawn from B.A.E(1980), op.cit, Table 11, p.20-21, 'costs - marketing, seed, fodder and other'. Data for 1978-79 to 1980-81 drawn from Australian Bureau of Statistics (A.B.S) (1982), Quarterly Estimates of National Income and Expenditure: Australia, September Quarter 1982, AGPS, Canberra, Dec, Table 15, 'production costs other than wages and depreciation'. Data for 1981-82 and 1982-83 drawn from the comparable table in A.B.S(1983), Quarterly Estimates... June Quarter 1983, AGPS, Canberra, Aug.

COLUMN(4) : Nominal value of seed and fodder used in the farm sector. Data for 1952-53 to 1977-78 drawn from B.A.E(1980), op.cit, Table 4, p.6-7, 'seed and fodder'. Data for 1977-78 to 1980-81 drawn from B.A.E(1982) op.cit, Table 3, p.327. Data for 1981-82 and 1982-83 drawn from B.A.E(1983), op.cit, Table 3, p.285. P=(preliminary) S=(estimated by B.A.E)

COLUMN(5) : Nominal value of non-primary inputs other than seed and fodder - calculated as (3) - (4)

Notes (Continued)

COLUMN(6) : Nominal farm income. Data for 1952-53 to 1975-76 drawn from B.A.E(1980), op.cit, Table 11, p.20-21, 'farm income'. Data for years 1976-77 to 1980-81 drawn from B.A.E(1982),op.cit, Table 1, p.325, 'net value of rural production'. Data for 1981-82 and 1982-83 drawn from B.A.E(1983), op.cit, Table 1,p.283. P=(preliminary) S=(estimated by B.A.E)

COLUMN(6') : Nominal farm income plus depreciation allowances - calculated as (6) + (7')

COLUMN(7) : That part of nominal gross farm product which accrues to non-farm households. Data for years 1952-53 to 1975-76 drawn from B.A.E(1980) op.cit, Table 11, p.20-21, 'costs - depreciation, wages, net rent and interest paid'. This series is also equivalent to (2) - (6). Data for years 1976-77 to 1982-83 calculated as (2) - (6)

COLUMN(7') : Farm depreciation allowances
Data for 1952-53 drawn from Commonwealth Bureau of Census and Statistics (CBCS)(1966), Australian National Accounts: National Income and Expenditure 1948-49 to 1974-65, Canberra, Feb, Table 40, p.43

Data for 1953-54 to 1958-59 drawn from CBCS(1968), Australian... 1953-54 to 1966-67, Canberra, Feb, Table 40, p.49
Data for 1959-60 to 1961-62 drawn from CBCS(1973) Australian... 1971-72, Canberra, April, Table 36, p.50
Data for 1962-63 drawn from A.B.S(1975), Australian... 1973-74, Canberra, June, Table 33, p.47
Data for 1963-64 drawn from A.B.S(1976), Australian... 1974-75, Canberra, May, Table 32, p.46
Data for 1964-65 and 1965-66 drawn from A.B.S(1977), Australian... 1975-76, Canberra, March, Table 36, p.50
Data for 1966-67 to 1968-69 drawn from A.B.S(1978), Australian... 1976-77, Canberra, Feb, Table 36, p.50
Data for 1969-70 to 1980-81 drawn from A.B.S(1982), Australian... 1980-81, Canberra, May, Table 28, p.22
Data for 1981-82 drawn from A.B.S(1983), Australian... 1981-82, Canberra, Table 28, p.22

Figure for 1982-83 is an unofficial estimate provided by the B.A.E.

COLUMN(7") : A measure of that part of nominal gross farm product which accrues to non-farm households - net of an adjustment for depreciation allowances - calculated as (7) - (7')

Notes (Continued)

COLUMN(8) : A 'deflator' for non-primary inputs used in the farm sector. Data for years 1952-53 to 1978-79 drawn from B.A.E(1980) op.cit, Table 10, p.18-19, 'index of prices paid by farmers, equipment and supplies without seed and fodder'. Data for 1979-80 drawn from B.A.E(1981), Quarterly Review of the Rural Economy, 3(4), Nov, Table 9, p.387, 'equipment and supplies excluding seed and fodder'. Data for 1980-81 calculated from rebased figures in B.A.E(1982), op.cit, Table 9, p.334, 'equipment and supplies excluding seed, fodder and livestock'. Data for 1981-82 drawn from B.A.E(1983), Quarterly Review of the Rural Economy, 5(2) May, Table 9, p.204. Data for 1982-83 drawn from B.A.E(1983), Quarterly Review of the Rural Economy, 5(4), Nov, Table 9, p.404.

COLUMN(8') : (8) modified so that 1953-54, 1959-60, 1966-67, 1974-75 and 1979-80 equalled 100 as base years for the relevant sub-periods

COLUMN(9) : Volume of non-primary inputs (other than seed and fodder) used in the farm sector - calculated by deflating (5) by (8')

COLUMN(10) : Private final consumption deflator. Data for 1952-53 to 1976-77 drawn from Norton, W.E, Garmston, P.M. and Brodi,M.W. (1982), Australian Economic Statistics 1949-50 to 1980-81:1 Tables, Reserve Bank of Australia, Occassional Paper No.8A, May,Table 5.15a p.140-141, 'price index for private final consumption expenditure'. Data for 1952-53 use 1953-54 as base, 1953-54 to 1958-59 use 1959-60 as base, 1959-60 to 1965-66 use 1966-67 as base and 1966-67 to 1976-77 use 1974-75 as base. Data for 1977-78 to 1980-81, at 1974-75 prices, drawn from A.B.S(1981), Quarterly Estimates of National Income and Expenditure: Australia, Sept. Quarter, 1981, AGPS Canberra, Dec, Table 42, p.38-39. Data for 1980-81 to 1982-83 at 1979-80 prices drawn from A.B.S(1983), Quarterly... June Quarter 1983, op.cit, Table 42, p.38-39

Notes (Continued)

COLUMN(11) : Private investment deflator. Data for 1952-53 to 1976-77 drawn from Norton, W.E, et al (1982), op.cit, Table 5.150, p.140-141, 'price index for total private gross fixed capital expenditure'. Data for 1952-53 use 1953-54 as base, 1953-54 to 1958-59 use 1959-60 as base, 1959-60 to 1965-66 use 1966-67 as base and 1966-67 to 1976-77 use 1974-75 as base. Data for 1977-78 to 1980-81, at 1974-75 prices, drawn from A.B.S(1981), Quarterly... Sept.Quarter 1981, op.cit, Table 42, p.38-39, 'implicit deflator for total private gross fixed capital expenditure'. Data for 1980-81 to 1982-83, at 1979-80 prices, drawn from A.B.S(1983), Quarterly... June Quarter 1983, op.cit, Table 42, p.38-39

COLUMN(12) : Simple average of (10) and (11)

COLUMN(12') : A weighted average of (10) and (11), with (10) given a weight of 0.3 and (11) a weight of 0.7

COLUMN(13) : Implicit deflator for gross non-farm product. Data for years 1959-60 to 1976-77 drawn from Norton, W.E. et al (1982), op.cit, Table 5.14, p.138-139, 'price indices for gross domestic product: non-farm'. Data for 1959-60 to 1965-66 use 1966-67 as base, and 1966-67 to 1976-77 use 1974-75 as base. Data for years 1977-78 to 1980-81, at 1974-75 prices, drawn from A.B.S(1981), Quarterly... Sept. Quarter, 1981, op.cit, Table 42, p.38-39. Data for 1980-81 to 1982-83, at 1979-80 prices, drawn from A.B.S(1983),Quarterly... June Quarter 1983, op.cit, Table 42, p.38-39

The implicit deflators for farm and non-farm gross product were not published separately prior to 1959-60. The figures for 1953-54 to 1958-59, at 1959-60 prices, were estimated by taking the ratio of nominal non-farm G.D.P. and estimated real non-farm G.D.P. at 1959-60 prices. Similarly, the figure for 1952-53 was estimated by taking the ratio of nominal non-farm G.D.P. in 1952-53, and the estimated real non-farm G.D.P. in 1952-53 at 1953-54 prices. The figures used to form these ratios are noted in brackets in the column alongside(13). Data for nominal non-farm gross product over the relevant period was drawn from Norton, W.E.(op.cit), Table 5.1, p.116

Notes (Continued)

COLUMNS(14),(15) : Real gross farm product and real gross non-farm product respectively. Data for years 1959-60 to 1965-66, at 1966-67 prices and for years 1966-67 to 1976-77 at 1974-75 prices, drawn from A.B.S(1982), Australian... 1980-81, op.cit. Data for 1977-78 to 1980-81, at 1974-75 prices, drawn from A.B.S(1981), Quarterly... Sept Quarter 1981, op.cit, Table 7, p.11. Data for 1980-81 to 1982-83, at 1979-80 prices, drawn from A.B.S(1983), Quarterly... June Quarter 1983, op.cit, Table 7, p.11

Prior to 1959-60, the farm and non-farm components of real G.D.P. were not published separately. The figure for real gross farm product in 1952-53, at 1953-54 prices was estimated via the double deflation procedure, using the farm prices paid and received indexes ((8') and (20) respectively). Figures for 1953-54 to 1958-59 were similarly estimated, at 1959-60 prices.

The figures for real gross non-farm product from 1952-53 to to 1958-59 were estimated by subtracting the estimated figure for real gross farm product from the published figure for real gross product.

COLUMN(16) : Real G.D.P. Data for 1952-53 to 1976-77 drawn from A.B.S(1982) Australian... 1980-81, op.cit. Data for 1952-53 use 1953-54 as base, 1953-54 to 1958-59 use 1959-60 as base, 1959-60 to 1965-66 use 1966-67 as base, and 1966-67 to 1976-77 use 1974-75 as base. Data for 1977-78 to 1980-81 at 1974-75 prices are drawn from A.B.S(1981), Quarterly... Sept Quarter 1981, op.cit, Table 7, p.11. Data for 1980-81 to 1982-83 at 1979-80 prices drawn from A.B.S(1983). Quarterly... June Quarter 1983, op.cit, Table 7, p.11

COLUMN(17) : Nominal value of exports of farm origin. Data for 1952-53 to 1976-77 drawn from B.A.E(1980), op.cit, Table 7, p.12-13, 'total exports of agricultural origin'. Data for 1977-78 to 1980-81 drawn from B.A.E(1982) op.cit, Table 7, p.331-332, 'total exports of rural origin'. Data for 1981-82 and 1982-83 drawn from B.A.E(1983), Aug. op.cit, Table 7, p.290. P=(preliminary) S=(estimated by B.A.E)

COLUMN(18) : Nominal private final consumption expenditure. Data for 1952-53 to 1976-77 drawn from A.B.S(1982), Australian... 1980-81, op.cit. Data for 1977-78 drawn from A.B.S(1981), Quarterly... Sept Quarter 1981, op.cit, Table 5, p.9. Data for 1978-79 to 1980-81 drawn from A.B.S(1982), Quarterly... Sept. Quarter, 1982, op.cit, Table 5, p.9. Data for 1981-82 and 1982-83 drawn from A.B.S(1983), Quarterly... June Quarter 1983, op.cit, Table 5, p.9

Notes (Continued)

COLUMN(18') : Percentage change in (18) between year t and year t-1

COLUMN(19) : Increase in farm and public authority stocks. Data for 1952-53 to 1976-77 drawn from A.B.S(1982), Australian... 1980-81, op.cit, 'increase in stocks - farm and public authority (net of stock valuation adjustment)'. Data for 1977-78 drawn from A.B.S. (1981), Quarterly... Sept Quarter, 1981, op.cit,Table 7, p.11. Data for years 1978-79 to 1980-81 drawn from A.B.S(1982), Quarterly... Sept Quarter 1982, op.cit, Table 7, p.11. Data for 1981-82 and 1982-93 drawn from A.B.S(1983). Quarterly... June Quarter 1983, op.cit, Table 5, p.9

COLUMN(20) : Index of prices received for farm commodities. Data for 1952-53 to 1978-79 drawn from B.A.E(1980) op.cit, Table 9, p.16-17, 'index of prices received: total all products'

COLUMN(20') : (20) rebased to set 1953-54 and 1959-60 to 100

COLUMN(21) : A measure of nominal expenditure directed voluntarily onto farm produce in the local economy. The series is calculated as farm G.V.P. less farm exports, less seed and fodder, less the change in farm and public authority stocks, ie. (1) - (4) - (17) - (19)

COLUMN(22) : A measure of the 'expected' level of (21) in the absence of any change in the relative prices of farm and non-farm commodities from the previous year. The series is formed by increasing (21) in year t by the percentage increase in (19) between year t and year t+1, in order to obtain (22) in t+1

COLUMN(23) : A measure of the difference between the actual and the 'expected' level of nominal expenditure on farm commodities - formed from (21) - (22)

Notes (Continued)

COLUMN(24) : $\Delta\left(\frac{3^F}{p_c}\right)$ - obtained from (23) x $\frac{100}{(10)}$

COLUMN(25) : $\frac{y_F^F}{p_2}$ - obtained from (6) x $\frac{100}{(12)}$

COLUMN(26) : $\Delta\left(\frac{y_F^F}{p_2}\right)$ - obtained from $(25)_t - (25)_{t-1}$

COLUMN(27) : $\frac{y_F^F}{p_3}$ - obtained from (6) x $\frac{100}{(12')}$

COLUMN(28) : $\Delta\left(\frac{y_F^F}{p_3}\right)$ - obtained from $(27)_t - (27)_{t-1}$

COLUMN(29) : $\frac{y_F^F}{p_1} = \frac{y_F^F}{p_c}$ - obtained from (6) x $\frac{100}{(10)}$

COLUMN(30) : $\Delta\left(\frac{y_F^F}{p_1}\right)$ - obtained from $(29)_t - (29)_{t-1}$

COLUMN(31) : $\frac{y_F^{NF}}{p_c}$ - obtained from (7") x $\frac{100}{(10)}$

COLUMN(32) : $\Delta\left(\frac{y_F^{NF}}{p_c}\right)$ - obtained from $(31)_t - (31)_{t-1}$

COLUMN(33) : $\frac{p_j J}{p_c}$ - obtained from (5) x $\frac{100}{(10)}$

COLUMN(34) : $\Delta\left(\frac{p_j J}{p_c}\right)$ - obtained from $(33)_t - (33)_{t-1}$

COLUMN(35) : ΔJ - obtained from $(9)_t - (9)_{t-1}$

COLUMN(36) : ΔY_F - obtained from $(14)_t - (14)_{t-1}$

COLUMN(37) : ΔY_{NF} - obtained from $(15)_t - (15)_{t-1}$

COLUMN(38) : ΔY - obtained from $(16)_t - (16)_{t-1}$

COLUMN(39) : $\Delta\left(\frac{p_j J_{NT}}{p_c}\right)$ - obtained from (34) X 0.7

COLUMN(40) : ΔJ_{NT} - obtained from (35) X 0.7

PART D

Towards a Theoretical Simulation Analysis

CHAPTER X

A THEORETICAL SIMULATION VARIANT OF MODEL I AND SOME FURTHER ANALYSIS OF THE FIRST PARADIGM[1]

Introduction

In Chapter II, five paradigms were identified which, it was argued, capture, betweem them, the essential features of the marketing and institutional environment in which the major Australian agricultural industries operate, and the interaction between that environment and the production and price shocks which affect the farm sector. Then, in Chapters III to VII, some of the macroeconomic consequences of these five paradigms were examined in turn, using five very similar, but nevertheless distinct, versions of a macroeconomic model in which the linkages between the farm sector and the macroeconomy are emphasised. These theoretical models proved to be too large and complex to permit the convenient use of conventional algebraic modes of analysis. Instead, the approach adopted was to develop a geometric construct which captured some of the essential features of the various models, and then to undertake some analysis using this geometric construct. While this approach necessarily sacrificed some formal rigour, it proved to be quite productive, providing considerable feel for some of the properties of the model, and permitting some significant theoretical results to be established, at least tentatively.

In Chapter VIII, in the light of these earlier theoretical analyses, and in the light of a review of the relevant empirical literature, it was argued that the existing quantitative macro-

1. Some of the theoretical simulation results in Chapter X were published earlier in O'Mara, Nguyen and Adams (1984).

economic models in Australia were, for various reasons, unsuitable as frameworks for analyses of issues in which farm/macro linkages are of central importance. Then, in Chapter IX, it was noted that, probably reflecting this lack of a suitable vehicle, there is a paucity of published studies in the Australian literature directed towards a detailed and consistent examination of farm/macro linkages. It was also noted in Chapter IX that, while a major objective of the line of research commenced in the thesis is to develop a model capable of filling this gap, it is not possible to bring such a project fully to fruition within the context of a single thesis. Therefore, as an interim measure, a very simple empirical version of the theoretical models used in Chapters III to VII was presented in Chapter IX. This empirical model was used to assess the contribution of the farm sector to annual variations in non-farm and total G.D.P. over the period from 1953-54 to 1982-83.

Perhaps the most important, albeit tentative, result to emerge from that empirical analysis was that the farm sector may not have declined as a source of instability in the non-farm sector over this period and, indeed, may have increased in importance. Such a result would seem to provide substantial motivation for attempting to further develop and refine the model and the associated analyses that were initiated in Chapters III to VII, and for moving towards the eventual development of a more complete empirical version of the model.

To that end, the major objective of Chapter X is to further develop and refine Model I and the associated analysis of the first paradigm, that was initiated in Chapter III. In particular, a theoretical simulation variant of Model I is presented, and used to

examine some of the macroeconomic implications of a shock to the volume of farm production (which could be readily interpreted as the effects of a drought and the subsequent recovery from that drought) in the presence of a perfect residual export market for farm commodities. The cause is furthered in O'Mara et al (1985), where a theoretical simulation variant of Model II is presented and used to undertake some further analysis of the second paradigm. Theoretical simulation is a more formal and rigorous mode of analysis than the geometrically oriented approach used in Chapters III to VII. Theoretical simulation also permits a wider range of important variables to be explicitly considered in the analysis than was possible using the geometric construct in those earlier chapters. For example, in the theoretical simulation variants of Models I and II, a degree of flexibility of nominal and real wages and non-traded goods prices can be readily catered for, whereas (with the exception of some limited analysis in Chapter III), these variables were held fixed in the earlier theoretical analyses.

It should be emphasised, however, that the successful development of a relatively large theoretical simulation model, and the interpretation and write-up of the large volume of results obtained, makes very heavy demands on time. Therefore, within the confines of the thesis, it was possible to apply the technique only to Model I and to very briefly summarize the results obtained by O'Mara et al (1985) using Model II. In that sense, theoretical simulation does not represent a practical alternative to the geometric mode of analysis adopted in Chapters III to VII. Further, the insights gained from the earlier, less rigorous, analyses often prove invaluable as an aid to the interpretation of the simulation results. Moreover, the successful development of theoretical

simulation variants of Models I and II should facilitate the ready extension of the technique to Models III, IV and V as part of a future research project.

While not too much emphasis should be placed, in most instances, on the precise numerical results obtained from such theoretical simulation exercises, the development of theoretical simulation variants of Models I and II can, nevertheless, also be regarded as an important step towards the development of a full scale empirical version of these models, relevant to the Australian economy. In particular, it is unlikely that the transition from the theoretical simulation to the empirical versions of the model will be clear or discrete. Rather, the credence placed on the actual numerical results will increase gradually, as some of the more important equations and/or parameters are estimated using Australian data, and as the ability of the model to broadly replicate actual episodes of Australian history gradually increases.

In Section II, the role and philosophy of the theoretical simulation technique are discussed briefly. Then, in Section III, some aspects of the theoretical simulation variant of Model I are reviewed - the detailed specification of the model is presented in Appendix A. The parameter values used in the model are presented in Section IV. In Section V, the simulation results are presented and discussed in detail. Finally, some concluding comments are contained in Section VI.

Section II The Role and Philosophy of Theoretical Simulation

To assess the properties and characteristics of a theoretical model which is too large and complex for convenient mathematical analysis, there are, in general, three approaches which might be adopted. Firstly, it may be possible to develop a useful geometric characterisation of the model which allows at least some worthwhile progress to be made. This approach, of course, was the one adopted earlier in the thesis. The two remaining approaches involve the substitution of numerical values for the algebraic parameters, either by estimating the model using econometric techniques, or by using theoretical simulation techniques.

In general, econometric estimation and simulation allow the various properties and characteristics of any system being studied to be depicted with greater 'realism'. However, any results or conclusions which emerge would only be applicable to, for example, a particular country over a particular time period. If more generally applicable results, conclusions and insights were sought, repeated experiments would need to be performed in order to generate an adequate sample of points in the response space. This can be extremely costly if a large number of paramaters are involved. Further, for satisfactory econometric estimation, it is often necessary to pay close attention to institutional factors and other matters of detail, which can mask the central economic issues. Such detail can also result in the model becoming so complex, and the interactions so difficult to comprehend, that the model may become regarded as a 'black box' by researchers not directly involved in its development. Finally, and perhaps most importantly, econometric estimation sometimes requires more data, and more resources, than are readily available.

In macroeconomics, the term 'simulation' is most often associated with econometrically estimated models, as outlined above. However, Nguyen and Turnovsky (1979), took the view that simulation can also be a numerical, but theoretically oriented, complement to the traditional analytical approach (for some other recent examples of the theoretical simulation approach applied to macroeconomic models, see Nguyen and Turnovsky (1983), Nguyen (1982), Carlozzi (1982), Camilleri, Nguyen and Campbell (1981), Camilleri, Campbell and Nguyen (1980), Turnovsky and Nguyen (1980), Crowley, O'Mara and Campbell (1983)). The theoretical simulation approach involves the construction and analysis of models with quite general structures. The parameter values, although plausible, need not pertain to any individual real world economy. Rather, they should reflect conditions underlying a wide variety of possible systems. A fundamental feature of the approach, however, is that the parameters are subjected to extensive sensitivity analysis in order to determine the robustness of any observed pattern in the behaviour of the system.

It should be re-emphasised that (as noted in Section III of Chapter I), the theoretical simulation technique is not seen as a substitute for the more traditional analytical techniques (both algebraic and geometric) or for econometric estimation of a system. Rather, it is seen as a complement to these other approaches and, under some circumstances, as a compromise between them. In particular:

(1) as in the present case, theoretical simulation can complement the more traditional <u>analytical</u> techniques where the objective is to assess the properties and characteristics of a relatively large theoretical model. This aspect of the

complementarily was also highlighted recently by Turnovsky and Nguyen (1980), who used both purely algebraic and theoretical simulation techniques to analyse various aspects of a particular macroeconomic model;

(2) there are several respects in which theoretical simulation can complement <u>econometric</u> estimation. For example:

(a) theoretical simulation could be applied to the basic model structure before the model is actually estimated for a particular set of data. In this way, the model builders could accumulate a body of knowledge about the more general properties and characteristics of their model, including its ability to produce sensible or counterintuitive results and useful insights, before burdening the model with institutional detail and limiting themselves to a particular set of estimated parameters. As it is expected that the present model will eventually be estimated using Australian data, this aspect of the complementarily is obviously of relevance to the present case;

(b) as noted in the Introduction, given the existence of a theoretical simulation variant of the model, it is likely that the emergence of an 'econometric' version would not be clear or discrete. Rather, the reliance placed on the actual numerical results obtained from the model would increase gradaully, as some of the more sensitive equations and paramters are estimated, and as the model becomes better able to replicate actual historical episodes;

(3) under certain special circumstances (which would probably occur only infrequently) model builders may be prepared to place some reliance on the actual numerical results which emerge from a theoretical simulation model even at a stage where few, if any, of the equations have been estimated econometrically. Such a circumstance might arise, for example, if some calibration was required for forecasting or policy analysis, and if no suitable, superior empirical framework was readily available. In such an application, which might be interpreted as a compromise between theoretical simulation and econometric techniques, an attempt would need to be made to ensure that the parameter values were based on empirical or theoretical work relevant, as far as possible, to the particular application in question. Similarly, the relative numerical values imposed on the exogenous variables in the model should resemble the corresponding values in the economy being examined.

Finally, it should be stressed that, regardless of the application, the theoretical simulation technique necessarily produces numerical values for the endogenous variables in the model. Therefore, unless the applications noted under 2(b) or (3) above were felt to be relevant, not too much emphasis should be placed on any specific numerical results. Rather, the emphasis should be on issues such as the qualitative nature of the results, any broad patterns which emerge, and the robustness of results with respect to the choice of parameter values.

Section III A Theoretical Simulation Variant of Model I

The specification of the model is set out in detail in Appendix A. It is clear that the theoretical simulation variant of Model I is, as far as practicable, a faithful representation of the earlier variants of Model I, as presented in Chapter III, and more particularly the variant in which the balance of payments, non-traded goods prices and nominal wages were all endogenised.

In the farm sector, the classical philosophy underlying the determination of output and the usage of inputs has been captured in the theoretical simulation variant, albeit in a more complex form. Similarly, the residual funds effect on farm investment has been incorporated, as has the separate consumption function for the farm sector.

Just as the classical philosophy underlying the specification of the farm sector in the earlier variants has been captured, so too has the more Keynesian philosophy underlying the specification of the non-farm sector. Non-traded goods prices are imperfectly flexible, being influenced partly by wage costs, and partly by a proxy for the gap between the actual level and the optimal level of output of non-traded goods. As a result, output of non-traded goods is largely demand determined in the short run, and employment in the non-traded goods sector is a function of the output of that sector. Similarly, movements in nominal wages are influenced partly by expected movements in consumer prices, and partly by the gap between the actual and the 'natural' level of employment. The 'natural' level of employment, in turn, can be conceptualised as the level of employment which is consistent with trade unions seeking only to maintain existing real wages, and hence may not necessarily conform to the more general concept of full employment. Each of these

various points were emphasised in Chapter III. Also as assumed, not only in the earlier variants of Model I, but also in Models II, III, IV and V, international capital flows are imperfectly responsive to interest rate differentials, and the money supply is linked to the outcome for the balance of payments.

Several minor points of difference between the earlier variants of Model I, in Chapter III, and the present theoretical simulation variant are worth noting. Firstly, for simplicity, non-farm traded goods have been dealt with less comprehensively in the theoretical simulation variant of the model. In particular, local production of non-farm exportables is assumed to be exogenously given, and the local production of importables has not been clearly distinguished from the production of non-traded goods. Nevertheless, with the possible exception of non-farm employment, the specification of the theoretical simulation variant of the model is largely consistent with an implicit classical determination of output in import competing industries, as was assumed in the earlier variants of the model.

Secondly, in the current specification of the theoretical simulation variant, effective real income has been used as the real scale argument in the demand function for money balances. In the development of the earlier variants of the model, it was argued that there was some ambiguity as to whether this scale argument should be based on real income or real expenditure. The analysis undertaken with those earlier variants of Model I (and, indeed, with Models II, III, IV and V) indicated that the choice of scale argument could be of some consequence. It may prove instructive, thefore, to experiment with alternative specifications of the money demand function as part of a future programme of research with the theoretical simulation variant of the model.

Section IV The Combinations of Parameter Values Used in the Model

In order to generate various combinations of parameter values to use in the model, the following procedure was adopted:

1. firstly, each parameter in the model was accorded a 'best-bet' numerical value - i.e. a value which was felt to be consistent with the existing theoretical and empirical literature and a priori reasoning;
2. a standard deviation was postulated around the best-bet values for most of the parameters. In general, these standard deviations were set so that the range of values formed by adding and subtracting two standard deviations to the best-bet value would encompass most of the plausible values reasonably suggested by the empirical and theoretical literature and a priori reasoning;
3. it was postulated that the parameter values were normally distributed, with a mean equal to the best-bet value, and a standard deviation as specified above. These moments were then applied to a random number generator to obtain twenty further sets of randomly distributed parameter values. It should be noted that, implicit in this procedure is an assumption that the parameters are independently distributed i.e. that each of the covariance terms is zero. Such an assumption, of course, may not be strictly valid. It may be useful, therefore, to further explore, at a later date, the implications of some non-zero covariance terms;
4. for some individual parameters, it was felt that there was also some interest in examining particular numerical values other than the best-bet value - in many cases lying further than two standard deviations from the best-bet value. For example, it was

noted, in Chapter VIII, that rather extreme assumptions are made with respect to the farm marginal propensities to consume and to invest in the major Australian macroeconomic models. Therefore, it was considered interesting to examine similar assumptions in the context of the present model. In this way, a number of 'outlying' parameter combinations were formed - by setting one parameter (or in some cases, two parameters) at some interesting, but relatively extreme, value, while leaving all of the other parameters at their best-bet value.

It is worth noting that, in principle, a more complete approach to sensitivity analyses in the model would involve treating each parameter as an outlier, in turn. In particular, two outlying numerical values could be used for each parameter, where those numerical values were felt to be at opposite extremes in the range of plausible values. However, time and space limitations have precluded such an approach from being adopted in the present case, although it could be usefully taken up at a later date.

Of course, in a linear or linearised model, some more efficient procedures are available for undertaking sensitivity analyses. For example, sensitivity elasticities could be calculated, in turn, for each of the endogenous variables with respect to each of the parameters. The information required for such a procedure would typically be readily available as a by-product of the solution procedure for a linear model. In the case of a non-linear model, however, access to the necessary information is likely to be more problematical, particularly if the model has been solved using an iterative program. For some further discussion on this point, see Pagan and Shannon (1983), Kuh, Hollinger and Neese (1983).

Table X(1): PARAMETER VALUES FOR THE MODEL

Parameter	'Best-bet'	Standard deviation	Outliers
α	.114687	-	
β	0.25	-	
γ	0.3	-	
A	0.8	-	
Θ_o	0.5	0.2	0.1
Θ_1	0.4	0.1	0,1
λ_1	0.6	0.1	
λ_2	0.3	0.1	
C_F^o	14	2	
C_F^1	0.2	0.05	0,0.4
C_F^2	-40	25	
ηo	500	100	
η_1	.25	.05	
x^o	5	2	
x^1	.05	.01	
C_{NF}^o	100	20	
C_{NF}^1	0.4	0.1	0.2
C_{NF}^2	0.4	0.1	
C_{NF}^3	1 000	250	
I_{NF}^o	200	25	
I_{NF}^1	0.5	0.2	0
I_{NF}^2	175	65	
M^o	50	10	

Continued on next page

Table X(1) (continued)

Parameter	'Best-bet'	Standard deviation	Outliers
M^1	0.15	0.025	0.25
M^2	0.20	0.025	
P^1_{NT}	0.001	0.0005	0
Y^{*1}_{NF}	500 000	250 000	0
λ_3	0.1	0.025	
λ_4	0.6	.1	
λ_5	0.35	.1	
λ_6	0.05	0.025	
λ_7	2	.5	
λ_8	1	-	
w^1	0.17×10^{-7}	0.85×10^{-8}	0
L^1_{NF}	3 000	1 200	
a_1	0.7	0.1	
a_2	0.2	0.1	
a_3	0.1	0.1	
k^o	5 000	1 500	
k^1	-200 000	100 000	-400 000
λ_9	1	-	
λ_{10}	-0.1	-	
md^1	0.5	-	
w^o	0.0001	-	
P^o_{NT}	10 000	-	

In Table X(1), all of the parameters in the model are listed, along with their best-bet values, their assumed standard deviations, and the values (if any) that were used to form outlying parameter combinations. Some notes on the choice of individual parameter values are contained in Appendix B.

Section V : Some Analysis of the First Paradigm[2]

V(1) The Shock

The theoretical simulation variant of Model I was used to examine a supply side disturbance within the farm sector, which could be readily interpreted as a drought and subsequent recovery. More formally, the constant term in the farm production function, A, was reduced from its given value of 0.8 down to 0.75 for two periods, after which the original value of 0.8 was reinstated. This was felt to be the most direct means of simulating the effect of a relatively temporary rainfall deficiency, followed by a return to normal seasons. As dictated by the first paradigm, farm prices were held fixed throughout.

V(2) Stationary State Solutions for the Model

Following the usual convention, it was assumed that the drought shock shifted the economy from an initial position of stationary state equilibrium. Therefore, a stationary state solution had to be obtained for the model for each of the various sets of parameters used.

It was considered desirable that a number of the important endogenous variables should exhibit the following characteristics in the stationary state solutions:

---

2. The simulations were undertaken using Newton's Algorithm in the Troll Programme.

(a) the value taken by any such endogenous variable should be common to the stationary states for all of the parameter sets; and

(b) the values should be numerically convenient e.g. $Y_{NF} = 1000$.

These objectives could be readily achieved while solving for the initial stationary states by assigning such values to these variables, in effect forcing them to become temporarily 'exogenous'. That means that an equivalent number of exogenous variables and parameters must become temporarily endogenous. In Table X(2), all of the endogenous variables which took exogenously imposed values in the initial stationary states are listed, along with the exogenous variables and coefficients with which they were interchanged.

In addition, these manoeuvres, coupled with the values given to the strictly exogenous variables, were sufficient to ensure that several other endogenous variables took common and convenient values in the stationary states - $Y = 1070$, $Y^*_{NF} = 1000$, $L_{NF} = 6\ 000\ 000$, $p_{NF} = 100$, $p_{NF-NFX} = 100$, $p_c = 100$ and $p^E_c = 100$.

Of the nine exogenous variables and coefficients which were treated as endogenous variables in the initial stationary state, only the values for three of them varied from one parameter set to another - G, σ and r^W. Nevertheless, the fact that the values of all of the exogenous variables are not strictly the same for all parameter combinations needs to be borne in mind when the results are being interpreted.

The values imposed on the remaining, strictly exogenous variables in the stationary state are listed in Table X(3).

Several final points should be noted. Firstly, the growth rate variables, q and g have been set to zero. The main objective in

Table X(2): INTERCHANGED EXOGENOUS AND ENDOGENOUS VARIABLES AND COEFFICIENTS

Endogenous variable	Imposed value	Exogenous variables and coefficients treated as endogenous
O_F	100	α
K_F	450	σ
L_F	250 000	β
J_F	30	γ
y_F^F	4 000	$\bar{L}_F$
Y_{NF}	1 000	G
P_{NT}	100	$Y^*_{NF,t=0}$
w	0.01	$L^N_{t=0}$
r	0.05	r^w

Table X(3): NUMERICAL VALUES OF THE STRICTLY EXOGENOUS VARIABLES

Variable	Value
p_F	100
p_M	100
p_{NFX}	100
σ_{ED}	0.03
D_{t-1}	30 000
X_{NF}	92.3
$w_{t=0}$	0.01
$p_{NF-NFX,t=0}$	100
$L_{NF,t=0}$	6 000 000
$Y_{NF,t=0}$	1 000
$\dot{p}_{c,t-1} = \dot{p}_{C,t-2} = \dot{p}_{c,t-3}$	0
g	0
q	0
i	0.05

including these variables in the theoretical simulation variant of the model is to allow, at a later date, a more detailed consideration of various shocks within a framework of ongoing economic growth. Some results obtained using the best-bet parameter set and non-zero values for g and q are reported briefly in order to provide some feel for the potential importance of this issue.

Secondly, in the initial stationary states, it was insisted that actual gross farm investment should be just sufficient to offset the depreciation of the existing farm capital stock, so that the capital stock would remain stable. However, in an attempt to generate relative magnitudes of the farm sector variables which were broadly consistent with the Australian experience, it was decided not to insist that gross farm investment should necessarily equal farm residual funds. This implies, of course, that farm debt is not strictly stable at its 'stationary state' level. Also, it is clear from equation (5) that, in order to generate a level of gross farm investment equal to farm depreciation, it was necessary, in general, to allow the actual farm capital stock to deviate from its optimal level in the initial stationary state. However, these departures from the more conventional stationary state properties proved to be of little practical significance. For example, the tendency for farm debt to gradually move away from its stationary state level had relatively little impact on the time paths of most of the main variables with which we are concerned.

V(3) Results Obtained Using the Best-Best Paramater Combination

The results obtained using the 'best-bet' parameter combination, for the two drought periods and first three recovery periods, are listed in Table X(4) for a number of the main endogenous variables.

Table X(4): SELECTED BEST-BET RESULTS

Variable	Period					
	SS	1	2	3	4	5
O_F	100	86.0	86.5	102.1	100.9	98.9
K_F	450	437	427	444	449	445
L_F	250 000	215 000	217 000	258 000	257 000	248 000
J_F	30	25.8	26.3	31.4	30.3	29.2
I_F	13.5	0	3.9	30.0	17.5	9.7
y_F^F	4 000	3 370	3 450	3 970	3 430	3 430
C_F	20	18.8	19.1	19.9	18.8	18.8
t_F	1 500	1 340	1 360	1 490	1 360	1 360
R	500	170	230	480	170	180
Y_{NF}	1 000	978	972	1 019	1 030	1 001
Y	1 070	1 038	1 032	1 089	1 101	1 071
I_{NF}	191	191	180	188	214	197
p_{NT}	100	97.7	96.2	99.9	102.5	100.9
w	0.01	.00998	.00988	.00982	.00995	.01008
L_{NF}	$6x10^6$	$5.93x10^6$	$5.92x10^6$	$6.06x10^6$	$6.09x10^6$	$6.00x10^6$
BP	0	-1 110	-360	1 910	670	-950
m^S	53 200	51 000	50 300	54 100	55 400	53 500
Y_{NF}^*	1 000	999.31	999.30	1000.86	1001.03	999.90
r	0.05	0.048	0.05	0.061	0.058	0.046
X_F	71	58	59	73	71	70

SS - stationary state solution prior to the drought shock.

In the first drought period the volume of farm production falls from 100 to approximately 86 - a level which is broadly maintained in the second drought period. In the first period of recovery from the drought, farm output rises to a level slightly above the initial stationary state level. This reflects the fact that, at least in the first recovery period, the farm sector benefits not only from the return to normal seasons, but also from the drought induced decline in nominal wages, and in the prices of non-primary inputs and capital equipment. In subsequent periods, the volume of farm output hovers very close to its initial stationary state level.

A similar pattern is evident in the usage of labour and non-primary inputs in the farm sector. Farm employment falls from 250 000 to around 215 000 during the drought periods, recovering to 258 000 in the first recovery period. Marginal variations in farm employment, around the stationary state level of 250 000 occur in subsequent periods. The volume of non-primary inputs falls from 30 to around 26 during the drought, recovering to around 31.5, and then hovering around 30 in subsequent periods.

It is interesting to note that the combined effect of the falls in O_F and J_F imply a reduction in the level of real gross farm product during the drought of about 16 per cent, from 70 to around 59. This compares with the largely drought induced decline of 18 per cent in real gross farm product in Australia in 1982-83. This point is of some consequence because there are several other important respects in which the relative magnitudes of the variables in the model are, by design, broadly comparable to Australian data. For example, in the initial stationary state, Y_F is about 6.5 per cent of Y, which is very similar to Australian data since the early 1970s. Non-primary inputs, J, account for 30 per cent of the gross

value of farm production, compared to around 40-45 per cent in the actual data. Further, the income accruing to farm households, y_F^F, accounts for 57 per cent of nominal gross farm product, compared to about 50 per cent - 70 per cent in the actual data in recent years. It should be stressed, however, that, while such similarities with the actual Australian experience are important, not too much emphasis should be placed on specific numerical results until further testing and fine tuning of elasticities and coefficients has been undertaken.

The time path followed by the volume of farm investment expenditure is somewhat different to that for labour and non-primary inputs. From a stationary state level of 13.5, it falls to zero in the first drought period, rising only marginally to about 4 in the second drought period. This marked fall reflects the impact of the drought on the marginal productivity of capital in the farm sector, and the sharp decline in farm residual funds. In the first recovery period, farm investment rises to about 30, and remains relatively high at about 17.5 in the second recovery period. While results beyond the third recovery period are not tabulated in Table X(4), a gradual convergence to a level around 13 was evident.

The obvious volatility of farm investment which emerges from the relatively simplistic investment framework assumed here may overstate the degree of volatility which might be expected to occur in reality. In particular, in making longer term investment decisions, farmers may discount the relatively temporary effect of the drought on the marginal productivity of farm capital. On the other hand, however, if the lead times involved in putting farm capital equipment into place are relatively short, it may be quite rational for farmers to delay making investment expenditures until

the productivity of capital has returned to more normal levels following the breaking of the drought.

Nominal incomes accruing to farm households fall from 4000 to around 3400 during the drought periods, before recovering to around 3950 in the first recovery period. Some subsequent variations occur, largely reflecting variations in nominal wages, non-primary input prices and the nominal interest rate.

The volume of farm consumption falls from 20 to around 19 during the drought periods - this rather marginal fall reflecting a relatively small farm marginal propensity to consume. Farm taxation payments fall from 1500 to around 1350 during the drought, recovering to just under 1500 in the first recovery period. Farm residual funds fall from 500 to around 200 during the drought, rising again to around 480 in the first recovery period.

Importantly, the volume of farm exports falls from around 70 to around 58 in the two drought periods, subsequently returning to around 70. In other words, as dictated by the first paradigm, the variations in farm output are largely absorbed in variations in farm exports.

Turning to some of the main non-farm variables, non-farm output falls from 1000 to around 970 by the second drought period. It subsequently rises to around 1030 in the second recovery period before gradually converging (cyclically) to a level of around 1000. This substantial volatility reflects, amongst other factors, the sharp changes in farm investment expenditure, noted above, and the accelerator induced volatility of non-farm investment. The latter variable falls from 191 to around 180 in the second drought period before rising to around 214 in the second recovery period. As would be expected, non-farm employment follows a cyclical pattern similar to that followed by non-farm output.

Prices of non-traded goods fall from 100 to around 96 in the second drought period, rising to around 102.5 by the second recovery period. Subsequent smaller cyclical variations were seen to occur, with a gradual convergence to a level of around 100. These movements reflect the changing level of economic activity in the non-farm sector in general, and in the demand for non-traded commodities in particular. They also reflect variations in the level of nominal wages. The latter variable falls by about 2 per cent from .01 to .0098 by the second drought period, before rising to .0099 in the second recovery period and marginally above .01 in the third recovery period.

It is interesting to note that the level of the real wage as a cost to non-farm employers rises above its stationary state level during the two drought periods, and then falls below its stationary state level in the first two recovery periods. This can be seen by examining the time path for the desired level of non-farm output, Y^*_{NF}, noting that, as the variable g is set to zero, the only influence on Y^*_{NF} is the real wage as a cost to non-farm employers. This result is particularly instructive. It is clear that, by distinguishing between optimal and actual non-farm output, the specification of the present model does not insist that variations in non-farm output and employment, associated with the drought, are <u>necessarily</u> due to countercyclical movements in the real wage in the non-farm sector. (This, of course, is consistent with one of the central themes emerging from the extensive theoretical literature on rationed equilibrium models - see, for example, Barro and Grossman (1971, 1976), Malinvaud (1977), Neary (1980), Dixit (1978), Muellbauer and Portes (1978)). However, the model is capable of producing a <u>pattern</u> of nominal wage and price

movements on the one hand, and changes in non-farm output and employment on the other, which is quite consistent with the concept of countercyclical real wage movements. This clearly illustrates the potential danger in drawing conclusions about cause and effect from observed patterns in real wage movements and real output changes, if, in reality, there is a substantial 'Popular Keynesian' element in the structure of the economy.

The balance of payments deteriorates from an initial state of equilibrium to a deficit of around 1100 in the first drought period, and a further deficit of around 350 in the second drought period. This reflects a deterioration in the current account, and some deterioration in the capital account as a decline in the demand for money places downward pressure on the nominal interest rate. Substantial surpluses occur in the first two recovery periods as the current account improves and the demand for money rises sharply in response to the rise in output and in prices. It is interesting to note that, taking the two drought periods, and the first two recovery periods together, the cumulative effect of the drought and subsequent recovery is to produce a substantial balance of payments surplus.

In the earlier geometric analysis within the Model I framework, presented in Chapter III, it was suggested that the impact of the drought on the nominal interest rate was unclear, i.e. there were various forces at work pushing the interest rate in opposite directions. On the one hand, the drought induced decline in economic activity and prices would reduce the demand for money balances, placing downward pressure on the interest rate. The decline in economic activity would also result in some improvement in the current account of the balance of payments. However, the

direct effect of the drought on farm production and exports would weaken the current account for each given level of economic activity, thus requiring, ceteris paribus, a higher interest rate to clear the overall balance of payments. Under the best-bet parameter combination, the former effects proved to be dominant, with the average level of the interest rate being lower during the drought than in the initial stationary state. However, as will be evident from some further results reported below, this outcome was not particularly robust - thus reinforcing the earlier conclusion that the impact of the drought on the interest rate is uncertain.

In general then, the model would seem to be capable of producing sensible and intuitively appealing results which lend themselves to ready interpretation. Given the structure of the model, the best-bet results are suggestive that a drought in the farm sector can have a marked effect not only on output and employment within the farm sector, but also on a number of very important non-farm variables such as non-farm output, non-farm employment, nominal wages, real wages, non-farm prices, nominal interest rates, and the state of the balance of payments.

V(4) Summary of Results for Random Parameter Combinations

In Table X(5), the 'best-bet' results are compared with the mean results obtained from the twenty sets of randomly distributed parameters, along with the standard deviations of those random results. As before, results for the two drought periods and first three recovery periods are tabulated for selected variables.

For most of the main variables, the mean results from the random parameter sets are very similar, qualitatively, to the best-bet results, and in most cases also quantitatively. Of more interest, however, is the magnitude of the standard deviations around these

Table X(5): BEST-BET RESULTS AND THE MEAN AND STANDARD DEVIATIONS OF THE RANDOM RESULTS

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
O_F	BB	100	86.0	86.5	102.1	100.9	98.9
	RM	100	86.0	86.5	102.1	100.6	98.8
	S.D.	-	0.1	0.4	1.3	0.6	1.1
K_F	BB	450	437	427	444	449	445
	RM	450	438	427	444	446	442
	S.D.	-	3.5	4.1	8.6	7.4	6.8
L_F	BB	250 000	215 000	217 000	258 000	257 000	248 000
	RM	250 000	215 000	217 000	258 000	256 000	248 000
	S.D.	-	300	1 200	4 100	2 700	4 100
J_F	BB	30	25.8	26.3	31.4	30.3	29.2
	RM	30	25.8	26.3	31.4	30.2	29.2
	S.D.	-	0.1	0.3	0.8	0.3	0.7
I_F	BB	13.5	0	3.9	30.0	17.5	9.7
	RM	13.5	0.7	3.0	29.9	14.9	9.2
	S.D.	-	2.0	4.0	9.8	5.1	4.8
y_F^F	BB	4 000	3 370	3 450	3 970	3 430	3 430
	RM	4 000	3 350	3 450	3 960	3 310	3 340
	S.D.	-	90	150	130	450	460
C_F	BB	20	18.8	19.1	19.9	18.8	18.8
	RM	19.9	18.6	18.9	19.8	18.3	18.5
	S.D.	2.7	2.4	2.6	2.7	2.2	2.1
t_F	BB	1 500	1 340	1 360	1 490	1 360	1 360
	RM	1 710	1 560	1 580	1 700	1 550	1 560
	S.D.	800	790	790	790	770	790

Continued on next page

Table X(5) (continued)

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
R	BB	500	170	230	480	170	180
	RM	300	-40	20	280	-100	-70
	S.D.	820	870	870	880	1 020	980
X_F	BB	71	58	59	73	71	70
	RM	71	58	58	72	70	69
	S.D.	7.2	6.9	6.5	6.9	7.4	7.5
Y	BB	1 070	1 038	1 032	1 089	1 101	1 071
	RM	1 070	1 038	1 032	1 089	1 097	1 070
	S.D.	-	6	11	14	17	12
L_{NF}	BB	$6x10^6$	$5.93x10^6$	$5.92x10^6$	$6.06x10^6$	$6.09x10^6$	$6.00x10^6$
	RM	$6x10^6$	$5.94x10^6$	$5.92x10^6$	$6.05x10^6$	$6.07x10^6$	$6.00x10^6$
	S.D.	-	27 000	42 000	44 000	47 000	41 000
P_{NT}	BB	100	97.7	96.2	99.9	102.5	100.9
	RM	100	97.7	96.3	100.1	102.1	100.5
	S.D.	-	0.9	1.4	1.0	1.8	1.1
w	BB	0.01	0.00998	0.00988	0.00982	0.00995	0.01008
	RM	0.01	0.00998	0.00988	0.00984	0.00997	0.01006
	S.D.	-	0.00002	0.00004	0.00006	0.00007	0.00007
C_{NF}	BB	462	452	450	470	476	464
	RM	469	459	456	478	483	471
	S.D.	97	93	93	103	103	95
I_{NF}	BB	191	191	180	188	214	197
	RM	193	193	183	189	214	199
	S.D.	22	22	22	22	29	23

Continued on next page

Table X(5) (continued)

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
BP	BB	0	-1 110	-360	1 910	670	-950
	RM	0	-1 230	-440	2 170	550	-1 000
	S.D.	-	430	390	1 160	770	850
m^S	BB	53 200	51 000	50 300	54 100	55 400	53 500
	RM	53 200	51 100	50 300	54 200	55 200	53 400
	S.D.	-	500	900	1 000	1 400	900
Y^*_{NF}	BB	1 000	999.31	999.30	1000.86	1001.03	999.90
	RM	1 000	999.36	999.33	1000.82	1000.86	999.87
	S.D.	-	0.32	0.45	0.51	0.67	0.34
r	BB	0.05	0.048	0.05	0.061	0.058	0.046
	RM	0.05	0.047	0.049	0.062	0.059	0.046
	S.D.	-	0.003	0.003	0.008	0.084	0.005
Y_{NF}	BB	1 000	978	972	1 019	1 030	1 001
	RM	1 000	978	971	1 018	1 026	1 001
	S.D.	-	6	11	13	17	12

BB - best bet results
RM - mean of the results obtained from the random parameter sets
S.D. - standard deviation of the random results.

mean results. Given the relatively wide standard deviations imposed on a number of the parameters, it would be expected that relatively wide standard deviations would also be obtained for at least some of the variables. This, in fact, seems to be borne out by the results in Table X(5).

Despite these relatively wide standard deviations, most of the main qualitative results and conclusions identified for the best-bet parameter combination (and which would also clearly carry over to the means of the random results) remain valid even after one standard deviation is added or subtracted to the mean results. In many cases this is also true for two standard deviations. For example, the result that non-farm and total output fall during the drought and then overshoot during the recovery remains valid (at least for one standard deviation), as do the results that non-traded goods prices and nominal wages fall during the drought and rise during the recovery, and that real wages rise during the drought and fall during the recovery.

As noted in the previous section, one earlier result which does not seem quite so robust is the result that the average level of the nominal interest rate during the two drought periods is lower than in the initial stationary state. Clearly, if even a single standard deviation is added to the average level of r in periods 1 and 2, the average level would become higher during the drought than in the initial stationary state. Such an outcome was not evident, however, in any of the individual random results.

V(5) Outlying Results for $\Theta_0 = 0.1$

In the best-bet results, it was noted that the response of farm investment, I_F, to the drought was particularly marked. While a substantial response would seem to accord with the Australian

experience, it was suggested that, as the drought would be widely interpreted as a temporary phenomenon, at least some of its impact on the marginal productivity of capital would be discounted by farmers in making their investment decisions. Therefore, while the best-bet value for Θ_o of 0.5 may be sensible for some of the more general and more permanent shocks which influence the farm sector (such as a long term decline in the farmers terms of trade), it may be excessive for the particular shock considered here. It is interesting, therefore, to consider the much smaller outlying value for Θ_o of 0.1.

In general, and as would be expected, this outlying parameter combination produced time paths for the variables which were qualitatively very similar to those produced by the best-bet combination, but with the size of the deviations from the stationary state values of the variables being less marked. The results, for some selected variables, are included in Table X(6).

Several aspects of these results are of interest. Firstly, the time paths for the balance of payments diverge significantly between the two sets of results. The outlying results suggest a stronger balance of payments during the drought than do the best-bet results, and a relatively weaker balance of payments during the recovery phase. This result holds despite the fact that farm output and farm exports differ only marginally under the two combinations. Such an outcome is broadly consistent with the monetary approach to the balance of payments i.e. the smaller variations in non-farm output and prices under the outlying combination produce smaller variations in the demand for money.

Table X(6): OUTLYING RESULTS FOR Θ_o = 0.1: SELECTED VARIABLES

Variable	Model	Period					
		SS	1	2	3	4	5
O_F	BB	100	86.0	86.5	102.1	100.9	98.9
	0	100	86.4	86.8	101.0	100.7	99.8
I_F	BB	13.5	0	3.9	30.0	17.5	9.7
	0	13.5	9.0	8.5	13.7	14.4	13.4
X_F	BB	70.9	57.8	58.6	72.6	70.8	69.6
	0	70.9	57.9	58.5	72.0	71.3	70.5
Y_{NF}	BB	1 000	978	972	1 019	1 030	1 001
	0	1 000	987	982	1 000	1 013	1 007
Y	BB	1 070	1 038	1 032	1 089	1 101	1 071
	0	1 070	1 048	1 043	1 071	1 083	1 077
P_{NT}	BB	100	97.7	96.2	99.9	102.4	100.9
	0	100	98.7	97.6	98.9	100.4	100.6
BP	BB	0	-1 110	-360	1 910	670	-950
	0	0	-730	-290	880	530	-120
r	BB	0.05	0.048	0.05	0.061	0.058	0.046
	0	0.05	0.051	0.052	0.053	0.054	0.051

BB - best-bet results
0 - results obtained from the outlying parameter combination produced by setting Θ_o = 0.1, rather than Θ_o = 0.5.

Secondly, under the outlying combination, the average level of the nominal interest rate during the drought is higher than in the initial stationary state. This is the converse of the best-bet result, and highlights the point, noted earlier, that the impact of the drought on the interest rate tends to be unclear. Some additional insight into this result can be gained by recalling the geometric characterisation of Model I. The direct effect of the drought on the TT schedule is similar in both cases, shifting it upwards. However, because non-traded goods prices decline less under the outlying combination, there is a relatively stronger level of demand for importables and farm commodities at each level of aggregate expenditure, pushing the TT schedule further upwards in the present case. This, combined with a smaller leftward movement of the IS curves, results in the point of intersection between IS_Z and TT, during the drought, occurring at a higher level of the interest rate than in the initial stationary state.

Taken together, these results suggest that, where there is a degree of fixity in the nominal exchange rate, and where international capital flows are imperfectly mobile, any assessment of the impact of a drought on the balance of payments and the interest rate would need to be based upon:

(a) a consideration of the impact of the drought on the demand for money balances and hence the extent of the change in the nominal interest rate that would be required to clear the money market, other factors unchanged; and

(b) the direct and indirect effect of the drought on the state of the current account - for example, the effect of the drought on farm exports, and the effect of the drought on the level of import demand via its effect on the overall level of economic activity.

These conclusions are, of course, consistent with those reached in the earlier geometric analysis of the first paradigm, in Chapter III.

V(6) Outlying Results for Θ_1 and C_F^1

Two outlying parameter combinations were produced by changing the marginal propensity to invest out of farm residual funds, Θ_1, from its best-bet value of 0.4 to 0 and 1 in turn. Similarly, the farm marginal propensity to consume, C_F^1, was changed from its best-bet value of 0.2 to 0 and 0.4, to form two further outliers. In each of these four outliers, Θ_o (the partial adjustment coefficient in the farm investment equation) was held at its outlying value of 0.1, as examined above, in order to downplay the 'classical' component of the farm investment response, which may be overstated in the present application.

These four outliers were considered to be of interest because they characterised the approaches adopted to these parameters in several important Australian models, as discussed in Chapter VIII. For example, the outlier produced by setting C_F^1 to 0 is consistent with the approach adopted in the NIF and Nevile models, while the alternative outlier, $C_F^1 = 0.4$, (i.e. equal to the non-farm marginal propensity to consume) is consistent with the RBA model. This issue was also examined in the context of the simple empirical version of the model, developed and explored in Chapter IX.

The results, for some selected non-farm variables, are presented in Table X(7).

It is clear from the table that, in the presence of $\Theta_o = 0.1$, the choice of value for the parameters Θ_1 and C_F^1 is of some modest significance for the time paths of the main non-farm variables. For example, under the best-bet parameter combination

Table X(7): OUTLYING RESULTS FOR Θ_1 AND C_F^1, IN THE PRESENCE OF Θ_0 = 0.1

Variable	Model	Period					
		SS	1	2	3	4	5
Y_{NF}	0_1	1 000	987	982	1 000	1 013	1 007
	0_2	1 000	988	984	1 003	1 013	1 006
	0_3	1 000	988	980	997	1 012	1 008
	0_4	1 000	988	986	1 002	1 012	1 006
	0_5	1 000	987	979	999	1 014	1 007
Y	0_1	1 070	1 048	1 043	1 071	1 083	1 077
	0_2	1 070	1 049	1 044	1 073	1 084	1 077
	0_3	1 070	1 048	1 041	1 067	1 083	1 078
	0_4	1 070	1 048	1 046	1 072	1 082	1 076
	0_5	1 070	1 048	1 039	1 070	1 084	1 077
P_{NT}	0_1	100	98.7	97.6	98.9	100.4	100.6
	0_2	100	98.7	97.8	99.2	100.7	100.7
	0_3	100	98.7	97.4	98.5	100.2	100.6
	0_4	100	97.6	96.5	100.3	102.6	100.9
	0_5	100	98.0	95.9	99.7	102.4	100.9
BP	0_1	0	-730	-290	880	530	-120
	0_2	0	-730	-250	910	480	-160
	0_3	0	-720	-370	810	630	-50
	0_4	0	-610	-160	800	440	-120
	0_5	0	-860	-420	940	610	-140

Continued on next page

Table X(7) (continued)

Variable	Model	Period					
		SS	1	2	3	4	5
r	0_1	0.05	0.051	0.052	0.053	0.054	0.051
	0_2	0.05	0.051	0.053	0.054	0.054	0.050
	0_3	0.05	0.051	0.051	0.052	0.054	0.051
	0_4	0.05	0.052	0.053	0.053	0.054	0.051
	0_5	0.05	0.051	0.051	0.053	0.054	0.051

0_1 = outlying parameter combination produced by setting $\Theta_o = 0.1$

0_2 = outlying parameter combination produced by setting $\Theta_o = 0.1$ and $\Theta_1 = 0$

0_3 = outlying parameter combination produced by setting $\Theta_o = 0.1$ and $\Theta_1 = 1$

0_4 = outlying parameter combination produced by setting $\Theta_o = 0.1$ and $C_F^1 = 0$

0_5 = outlying parameter combination produced by setting $\Theta_o = 0.1$ and $C_F^1 = 0.4$

modified only for $\Theta_0 = 0.1$, the decline in non-farm output by the second drought period, relative to its initial stationary state level, is 1.8 per cent. The various outliers for Θ_1 and C_F^1 produce a range around this figure of 1.4 per cent to 2.1 per cent. Similarly, in the first recovery period, the spread of values suggested by the outliers is equal to about 0.6 percentage points of the initial stationary state level of non-farm output.

As noted above, when discussing the role and philosophy of the theoretical simulation technique, not too much emphasis should be placed on such specific figures, except under special circumstances. It is instructive to recall, however, that in the initial stationary state, the relative values of the variables most likely to influence these results - such as Y_F relative to Y and y_F^F relative to y_F - are broadly comparable to Australian data in recent years. Further, the conclusion that the value assigned to these parameters does have some macroeconomic significance is consistent with the corresponding conclusion reached in the analysis with the simple empirical version of the model, in Chapter IX.

V(7) Outlying Results for $I_{NF}^1=0$

When discussing the best-bet results, it was noted that non-farm investment expenditure followed a relatively volatile time path because of an accelerator effect built into that equation, and that this seemed to make a significant contribution to the movements in, for example, non-farm output. It is interesting, therefore, to assess the role played by non-farm investment more formally. In particular, an outlying parameter combination was produced by setting $I_{NF}^1 = 0$, therefore completely removing the influence of this accelerator effect from the model.

As was expected, the time paths followed by a number of important variables under this parameter combination differ substantially to their time paths under the best-bet combination - see Table X(8).

It is clear that, with the accelerator induced variations in non-farm investment removed, non-farm output exhibits less variation from its stationary state level. This is particularly the case in the second drought period and second recovery period, which, of course, is a reflection of the fact that the accelerator effect is specified to operate with a lag of one period. This dampening effect is reflected, at least to some extent, in the time paths of a number of the other important non-farm variables, such as non-farm employment, non-traded goods prices and nominal wages.

The changes in the time paths followed by output and by prices were sufficient to produce a significant change in the time path of the balance of payments. The outlying combination is associated with a small surplus in the second drought period, as compared to the significant deficit under the best-bet combination. Conversely, in the second recovery period, the outlying parameter combination produces a significant deficit, rather than a substantial surplus. For both parameter combinations, however, a net balance of payments surplus is evident for the two drought periods and first two recovery periods combined.

It is also noteworthy that this outlier produces an average level of the nominal interest rate which is higher than in the initial stationary state. This, of course, parallels the result noted earlier for the outlier formed by setting $\Theta_o = 0.1$. In both cases, the underlying reason is the same - a smaller impact of the drought on non-farm economic activity and prices than implied by the best-bet parameter combination.

Table X(8): OUTLYING RESULTS FOR $I^1_{NF} = 0$

Variable	Model	Period					
		SS	1	2	3	4	5
O_F	BB	100	86.0	86.5	102.1	100.9	98.9
	O	100	86.0	86.4	101.4	100.3	99.8
L_F	BB	250 000	214 000	217 000	258 000	257 000	248 000
	O	250 000	214 000	217 000	256 000	254 000	250 000
I_F	BB	13.5	0	3.9	30.0	17.5	9.7
	O	13.5	0	3.6	27.9	16.9	13.9
Y_{NF}	BB	1 000	978	972	1 019	1 030	1 001
	O	1 000	978	983	1 018	1 005	1 001
Y	BB	1 070	1 038	1 032	1 089	1 101	1 071
	O	1 070	1 038	1 044	1 089	1 075	1 071
I_{NF}	BB	191	191	180	188	214	197
	O	191	191	191	191	191	191
P_{NT}	BB	100	97.7	96.2	99.9	102.5	100.9
	O	100	97.7	97.3	100.4	100.2	100.0
w	BB	0.01	0.00998	0.00988	0.00982	0.00995	0.01008
	O	0.01	0.00998	0.00989	0.00987	0.00997	0.00999
L_{NF}	BB	$6x10^6$	$5.93x10^6$	$5.92x10^6$	$6.06x10^6$	$6.09x10^6$	$6.00x10^6$
	O	$6x10^6$	$5.93x10^6$	$5.95x10^6$	$6.05x10^6$	$6.01x10^6$	$6.00x10^6$
BP	BB	0	-1 110	-360	1 910	670	-950
	O	0	-1 080	60	1 550	-330	-140

Continued on next page

Table X(8) (continued)

Variable	Model	Period					
		SS	1	2	3	4	5
m^S	BB	53 200	51 000	50 300	54 100	55 400	53 500
	0	53 200	51 000	51 100	54 200	53 600	53 300
Y^*_{NF}	BB	1 000	999.31	999.30	1000.86	1001.03	999.90
	0	1 000	999.32	999.66	1000.79	1000.20	1000.03
r	BB	0.050	0.048	0.050	0.061	0.058	0.046
	0	0.050	0.048	0.054	0.059	0.049	0.050

BB - best-bet parameter combination

0 - outlying parameter combination produced by setting $I^1_{NF} = 0$

Finally, these significant changes in the time paths of the non-farm variables are sufficient to produce some noticeable, although relatively minor, feedback effects on the farm sector, as is evident from the results tabulated for O_F, L_F and I_F in Table X(8).

V(8) Outlying Results for w^1, p_{NT}^1 and Y_{NF}^{*1}

A number of outlying parameter combinations were examined for w^1, p_{NT}^1 and Y_{NF}^{*1}. Firstly, two outliers were formed by reducing, in turn, w^1 from its best-bet value of 1.7×10^{-8} to 1.7×10^{-12}, and p_{NT}^1 from .001 to 1×10^{-6}. This meant, of course, that nominal wages and non-traded goods prices were much less responsive to the level of excess demand or supply in the relevant markets, and were, therefore, even more consistent with the spirit of the 'Popular Keynesian' philosphy.

It was also felt to be of interest to consider outliers for p_{NT}^1 and w^1 which were much closer to the 'Classical' philosphy than that implied by the best-bet values for those parameters. In particular, two outliers were formed by setting p_{NT}^1 to .01 and w^1 to 1.7×10^{-7}. It will be recalled that, given the initial stationary state values of the relevant variables, the best-bet value for p_{NT}^1 implied that a gap of 1 per cent between the actual level and the optimal level of Y_{NF} would, ceteris paribus, raise or lower non-traded goods prices by around 1 per cent. The outlying value for p_{NT}^1 raised this price response to around 10 per cent. Similarly, given the initial stationary state values of the relevant variables, the best-bet value for w^1 implied that a gap of 1 per cent between the actual level and the 'natural' level of employment would raise or lower nominal wages by 1 per cent, ceteris paribus. The outlying value for w^1 raised this nominal wage response to around 10 per cent.

It is also clear that movements in the optimal level of non-farm output, Y_{NF}^{*}, impinge directly on non-traded goods prices by influencing the gap between the actual level and the optimal level of non-farm output. It is interesting in the present context, therefore, to vary the response of Y_{NF}^{*} to a change in the real wage as a cost to non-farm employers, as this should have a reasonably direct bearing on p_{NT}. Given the initial stationary state values of the relevant variables, the best-bet value for Y_{NF}^{*1} of 500 000 implied a real wage elasticity of optimal non-farm output of around -0.05. This was raised to -0.5 by setting Y_{NF}^{*1} to an outlying value of 5 000 000.

A further outlier was formed by combining the previous three outliers i.e. $p_{NT}^{1} = 0.01$, $w^{1} = 1.7 \times 10^{-7}$ and $Y_{NF}^{*1} =$ 5 000 000.

The results, for some of the main variables, are summarised in Table X(9).

As would be expected, the impact of the various outliers on non-traded goods prices is relatively substantial. For example, p_{NT} varies much more during the course of the drought and subsequent recovery under 0_3 than under BB, but much less under 0_2. The greater flexibility of nominal wages under outlier 0_5 is also significantly reflected in p_{NT}, because of the substantial 'mark-up' element assumed in the specification of non-traded goods prices. In contrast, however, outlier 0_1 has only a negligible effect on p_{NT}, largely reflecting the fact that, even under the best-bet value for w^{1}, there was only very limited flexibility of nominal wages, so that a change towards greater rigidity of nominal wages has little impact.

Table X(9): OUTLYING RESULTS FOR w^1, p_{NT}^1 and Y_{NF}^{*1}

Variable	Model	Period					
		SS	1	2	3	4	5
O_F	BB	100	86.0	86.5	102.1	100.9	98.9
	O_1	100	86.0	86.3	101.8	100.9	99.0
	O_2	100	85.9	85.4	99.5	99.7	99.6
	O_3	100	85.4	89.2	106.1	97.6	97.6
	O_4	100	86.0	86.2	101.8	101.3	99.4
	O_5	100	85.8	87.6	104.2	100.3	97.8
	O_6	100	85.8	87.5	104.1	100.5	98.0
L_F	BB	250 000	215 000	217 000	258 000	257 000	248 000
	O_1	250 000	215 000	216 000	257 000	257 000	249 000
	O_2	250 000	215 000	214 000	250 000	250 000	249 000
	O_3	250 000	214 000	222 000	275 000	254 000	237 000
	O_4	250 000	215 000	216 000	257 000	257 000	250 000
	O_5	250 000	214 000	222 000	268 000	253 000	242 000
	O_6	250 000	214 000	222 000	268 000	254 000	243 000
I_F	BB	13.5	0	3.9	30.0	17.5	9.7
	O_1	13.5	0	3.3	29.4	17.8	10.0
	O_2	13.5	0	0	25.2	20.0	15.5
	O_3	13.5	0	13.0	35.3	0	8.7
	O_4	13.5	0	2.5	30.1	21.0	9.8
	O_5	13.5	0	5.9	33.6	14.6	5.6
	O_6	13.5	0	5.8	33.4	15.4	6.0
Y_{NF}	BB	1 000	978	972	1 019	1 030	1 001
	O_1	1 000	977	972	1 018	1 031	1 002

continued on next page

Table X(9) (continued)

Variable	Model	Period					
		SS	1	2	3	4	5
	0_2	1 000	974	961	1 006	1 035	1 020
	0_3	1 000	988	995	1 021	997	989
	0_4	1 000	980	968	1 015	1 036	1 006
	0_5	1 000	982	977	1 024	1 025	991
	0_6	1 000	981	976	1 023	1 027	992
Y	BB	1 070	1 038	1 032	1 089	1 101	1 071
	0_1	1 070	1 037	1 032	1 088	1 101	1 072
	0_2	1 070	1 035	1 021	1 075	1 104	1 090
	0_3	1 070	1 048	1 056	1 093	1 067	1 057
	0_4	1 070	1 040	1 028	1 086	1 107	1 076
	0_5	1 070	1 042	1 038	1 095	1 095	1 060
	0_6	1 070	1 042	1 037	1 095	1 098	1 062
p_{NT}	BB	100	97.7	96.2	99.9	102.5	100.9
	0_1	100	97.8	96.3	99.8	102.3	101.0
	0_2	100	99.8	99.7	99.9	100.1	100.1
	0_3	100	91.5	92.8	110.6	100.9	92.7
	0_4	100	98.5	96.7	99.5	102.1	101.2
	0_5	100	96.9	94.9	101.2	103.5	99.8
	0_6	100	97.1	95.1	100.7	103.2	100.1
W	BB	.01	.00998	.00988	.00982	.00995	.01008
	0_1	.01	.00999	.00991	.00982	.00993	.01002
	0_2	.01	.00998	.00997	.00999	.01001	.01001

continued on next page

Table X(9) (continued)

Variable	Model	Period					
		SS	1	2	3	4	5
	0_3	.01	.01007	.00966	.00962	.01031	.01011
	0_4	.01	.01000	.00992	.00986	.00995	.01007
	0_5	.01	.00987	.00972	.00990	.01010	.01007
	0_6	.01	.00987	.00972	.00991	.01010	.01006
L_{NF}	BB	$6x10^6$	$5.93x10^6$	$5.92x10^6$	$6.06x10^6$	$6.09x10^6$	$6.00x10^6$
	0_1	$6x10^6$	$5.93x10^6$	$5.91x10^6$	$6.05x10^6$	$6.09x10^6$	$6.01x10^6$
	0_2	$6x10^6$	$5.92x10^6$	$5.88x10^6$	$6.02x10^6$	$6.10x10^6$	$6.06x10^6$
	0_3	$6x10^6$	$5.96x10^6$	$5.99x10^6$	$6.06x10^6$	$5.99x10^6$	$5.97x10^6$
	0_4	$6x10^6$	$5.94x10^6$	$5.90x10^6$	$6.05x10^6$	$6.11x10^6$	$6.02x10^6$
	0_5	$6x10^6$	$5.95x10^6$	$5.93x10^6$	$6.07x10^6$	$6.07x10^6$	$5.97x10^6$
	0_6	$6x10^6$	$5.94x10^6$	$5.93x10^6$	$6.07x10^6$	$6.08x10^6$	$5.98x10^6$
BP	BB	0	-1 110	-360	1 910	670	-950
	0_1	0	-1 080	-350	1 870	700	-900
	0_2	0	-880	-380	1 380	760	-340
	0_3	0	-2 080	340	3 470	-2 000	-1 400
	0_4	0	-1 130	-550	1 800	900	-850
	0_5	0	-1 340	-390	2 280	360	-1 390
	0_6	0	-1 300	-400	2 200	440	-1 320
Y_{NF}^*	BB	1 000	999.31	999.30	1000.86	1001.03	999.90
	0_1	1 000	999.27	999.24	1000.84	1001.08	1000.00

continued on next page

Table X(9) (continued)

Variable	Model	Period					
		SS	1	2	3	4	5
	0_2	1 000	1000.03	1000.06	1000.02	999.99	999.99
	0_3	1 000	996.65	999.24	1005.08	998.76	996.87
	0_4	1 000	994.93	992.97	1005.57	1009.43	1000.79
	0_5	1 000	999.60	999.73	1000.87	1000.64	999.58
	0_6	1 000	996.92	997.62	1006.78	1005.56	997.33
r	BB	.05	.048	.050	.061	.058	.046
	0_1	.05	.048	.050	.060	.058	.047
	0_2	.05	.050	.051	.058	.058	.051
	0_3	.05	.042	.053	.072	.042	.039
	0_4	.05	.049	.049	.059	.059	.048
	0_5	.05	.047	.049	.063	.057	.043
	0_6	.05	.047	.049	.062	.057	.044

BB - best bet parameter combination

0_1 - outlying parameter combination produced by setting $w^1 = 1.7 \times 10^{-12}$

0_2 - outlying parameter combination produced by setting $p^1_{NT} = 1 \times 10^{-6}$

0_3 - outlying parameter combination produced by setting $p^1_{NT} = .01$

0_4 - outlying parameter combination produced by setting $Y^{*1}_{NF} = 5\ 000\ 000$

0_5 - outlying parameter combination produced by setting $w^1 = 1.7 \times 10^{-7}$

0_6 - outlying parameter combination produced by setting $p^1_{NT} = .01$, $w^1 = 1.7 \times 10^{-7}$ and $Y^{*1}_{NF} = 5\ 000\ 000$

It is interesting to note that outlier 0_4, which is associated with greater sensitivity of optimal non-farm output to a change in the real wage, is also associated with less variation in non-traded goods prices. This result can be readily rationalised. Under BB, the real wage tends to rise during the drought, so that the drought is associated with a fall in both the optimal level and the actual level of non-farm output. Under 0_4, the fall in the optimal level of non-farm output, however, is greater, because optimal non-farm output is now more sensitive to the rise in the real wage. This, in turn, means that the gap between the actual level and the optimal level of non-farm output during the drought is smaller under 0_4 than under BB. Therefore, there is less downward pressure exerted on non-traded goods prices during the drought. An analogous argument also holds for the first two recovery periods because the rise in the actual level of non-farm output coincides with a fall in the real wage.

It should also be noted that, under outlier 0_2 the result that the real wage rises during the drought and falls during the recovery, which has so far proved to be reasonably robust, does not hold. Rather, there is a marginal fall in the real wage during the drought, as evidenced by the marginal rise in Y_{NF}^*. Despite this, the decline in actual non-farm output during the drought is more severe in this case than under the best-bet parameter combination. This is a striking illustration of the fact that, under a 'Popular Keynesian' (or rationed equilibrium) structure, the real wage is not necessarily the effective constraint on non-farm output and employment in the short run.

The more substantial movements in p_{NT} under outliers 0_3, 0_5 and 0_6 are reflected in some reduction in the extent of the

movement in Y_{NF}. In other words, the greater variation of the real exchange rate allows the shock in the farm sector to be accommodated with smaller movements in non-farm output. Conversely, under outliers 0_2 and 0_4, where non-traded goods prices vary less substantially, the variations in non-farm output are greater. These results for non-farm output are, of course, also largely reflected in non-farm employment.

The outcome for the state of the balance of payments is broadly similar under outliers 0_1, 0_2, 0_4, 0_5 and 0_6. In each case, the two drought periods are associated with substantial balance of payments deficits, with more than offsetting surpluses during the first two recovery periods. However, as was also the case for the outlier formed by setting $I_{NF}^{1} = o$, as discussed in Section V(7), this qualitative result is overturned by outlier 0_3. This latter result serves as a reminder of the complexity of the linkages between the farm sector and the state of the balance of payments, as captured in the present model, and that the intuitive results which hold for some parameter combinations may not be universally valid.

It is evident that each of the outliers is consistent with the qualitative result that the average level of the nominal interest rate is lower during the two drought periods than in the initial stationary state, and higher during the first two recovery periods. Whithin this, however, there are significant differences between the time paths produced by the various outliers. For example, the nominal interest rate is substantially more volatile under 0_3 than under 0_2.

Finally, the different time paths for non-traded goods prices and nominal wages, under the various outliers, have some bearing on

output, employment and investment in the farm sector. For example, the significant fall in non-traded goods prices and nominal wages which occurs under outlier 0_3 is associated with a more marked overshooting of farm output in the first recovery period. Conversely, the less marked fall in prices and wages under 0_2 is sufficient to hold farm investment at zero in both drought periods.

V(9) Outlying Results for k^1

An outlying parameter combination was formed by changing k^1, the coefficient on the nominal interest rate differential in the equation explaining net capital inflow (equation (38)), from its best-bet value of -200 000 to -400 000. This was designed to have the effect of significantly increasing the sensitivity of net capital inflow to the interest rate differential.

The only variable significantly affected by this change was the nominal interest rate, which exhibited less volatility in the presence of the drought and subsequent recovery (see Table X(10)). Importantly, the time path of the balance of payments was only marginally different to that produced by the best-bet parameter combination. This observation provides a useful piece of information about the best-bet parameter combination which was not otherwise evident. In particular, it implies that, even under the smaller, best-bet, value for k^1, the size of the balance of payments deficit or surplus within a single period was, in general, sufficient to establish, within that period, a money stock consistent with balance of payments equilibrium. In terms of the earlier geometric variant of Model I, the balance of payments deficit or surplus which occurs in each period is large enough to shift the LM curve sufficiently to ensure that the point of intersection between IS_y and LM occurs at the same level of the

Table X(10): SELECTED OUTLYING RESULTS FOR k^1 = - 400 000

Variable	Model	Period					
		SS	1	2	3	4	5
BP	BB	0	-1 110	-360	1 910	670	-950
	O	0	-1 100	-330	1 920	640	-950
r	BB	0.05	0.048	0.050	0.061	0.058	0.046
	O	0.05	0.049	0.050	0.055	0.054	0.048

BB - best-bet parameter combination

O - outlying parameter combination produced by setting k^1 = - 400 000

interest rate as the point of intersection between IS_Z and TT. If this was not the case i.e. if, under the best-bet combination, only partial adjustment to a balance of payments equilibrium occurred within a single period, then the size of the balance of payments deficits or surpluses would have increased significantly as capital flows were made more responsive to interest rate differentials.

V(10) Other Outlying Combinations

In addition to the various outlying parameter combinations reported above, a number of others were also examined, as set out in the relevant column of Table X(1). The marginal propensity to consume out of that part of farm value added which accrues to non-farm households, C^1_{NF}, was set equal to its farm counterpart C^1_F, to form one outlying combination. Another was formed by setting the marginal propensity to import out of private consumption expenditure, M^1, to 0.25. Thirdly, Y^{*1}_{NF} was set to zero in order to remove the effect on Y^*_{NF} of changes in the real wage as a cost to non-farm employers.

In general, the main conclusion to emerge from these outliers was that the time paths of the main variables of interest did not diverge significantly from their best-bet time paths, indicating that, unlike some of the outliers discussed previously, the results are not particularly sensitive to the choice of value for these parameters.

V(11) Results Obtained Using Non-Zero Values for g and q

As noted in Section V(2), the rate of growth of optimal non-farm output, g, and the rate of growth of the natural level of employment, q, were set to zero in all of the preceding simulations with the model. This was done in order to avoid the additional complexities associated with ongoing economic growth in these early

experiments with the model. It was considered to be interesting and useful, however, to briefly consider some results obtained for non-zero values of g and q in the present context, as a prelude to future work. In particular, with all the parameters set to their best-bet values, the exogenous variable g was set to a value of .02, and q to .01.

In this growth framework, there is no stationary state for the endogenous variables in absolute terms (although a quasi-stationary state may exist in which the rates of change of the relevant variables are constant). In other words, the values of many of the important variables change significantly over time, even in the absence of the drought. It is necessary, therefore, to contrast the time paths of the variables with and without the drought shock.

It is evident from Table X(11) that, in the absence of the drought, there is substantial upward pressure on non-farm and total output, and downward pressure on nominal wages, non-traded goods prices and nominal interest rates. With less than perfectly flexible wages and non-traded goods prices, however, actual non-farm output grows at a rate considerably less than the rate of .02 imposed on g. Reflecting this, non-farm employment actually falls over time, despite the fact that the 'natural' level of employment is exogenously set to grow at a rate of .01. These results clearly suggest that, in the presence of ongoing technological change, capital deepening and population growth, and in the absence of growth in the exogenous components of aggregate demand, a disequilibrium of the 'Popular Keynesian' type gradually emerges. This outcome is important, because it is consistent with the corresponding results obtained in theoretical work on fixed price rationed equilibrium models, where such work has been extended to

Table X(11): BEST-BET RESULTS FOR NON-ZERO VALUES OF g AND q

Variable	Model	Period					
		SS	1	2	3	4	5
O_F	BBG	100	101.1	102.9	104.9	107.3	110.3
	BBGD	100	86.0	87.5	105.0	105.9	106.1
K_F	BBG	450	449	452	457	464	472
	BBGD	450	436	429	452	463	467
L_F	BBG	250 000	250 000	253 000	260 000	269 000	279 000
	BBGD	250 000	215 000	220 000	269 000	276 000	277 000
J_F	BBG	30	30.0	30.7	31.7	32.7	34.1
	BBGD	30	25.8	27.0	33.2	33.0	33.1
I_F	BBG	13.5	13.1	16.4	18.8	20.4	22.3
	BBGD	13.5	0	6.6	35.7	24.4	18.2
y_F^F	BBG	4 000	4 010	4 080	4 090	4 140	4 260
	BBGD	4 000	3 420	3 600	4 190	3 750	3 920
Y_{NF}	BBG	1 000	1 002	1 012	1 024	1 033	1 040
	BBGD	1 000	980	984	1 043	1 064	1 041
Y	BBG	1 070	1 072	1 083	1 095	1 105	1 113
	BBGD	1 070	1 040	1 044	1 114	1 136	1 113
p_{NT}	BBG	100	98.0	96.1	94.1	91.7	89.0
	BBGD	100	95.7	92.4	94.2	94.1	89.7
w	BBG	0.01	0.00998	0.00988	0.00976	0.00963	0.00948
	BBGD	0.01	0.00996	0.00976	0.00959	0.00959	0.00956

Table X(11) (continued)

Variable	Model	Period					
		SS	1	2	3	4	5
L_{NF}	BBG	$6x10^6$	$5.95x10^6$	$5.92x10^6$	$5.89x10^6$	$5.85x10^6$	$5.81x10^6$
	BBGD	$6x10^6$	$5.88x10^6$	$5.83x10^6$	$5.94x10^6$	$5.94x10^6$	$5.81x10^6$
BP	BBG	0	-190	-20	20	-120	-200
	BBGD	0	-1 300	-390	1 930	530	-1 170
m^S	BBG	53 200	52 800	52 700	52 800	52 600	52 100
	BBGD	53 200	50 600	49 800	53 700	54 700	52 400
Y^*_{NF}	BBG	1 000	1 019	1 040	1 060	1 081	1 103
	BBGD	1 000	1 019	1 039	1 061	1 083	1 103
r	BBG	0.05	0.048	0.049	0.048	0.046	0.044
	BBGD	0.05	0.046	0.049	0.059	0.054	0.040

BBG - best-bet parameter combination, non-zero values for g and q, no drought
BBGD - best bet parameter combination, non-zero values for g and q, drought.

include medium term issues such as technological change (the most notable of this material is Malinvaud (1977) - particularly Chapter 3).

It is clear from a comparison of the time paths of the main variables, with and without the drought, that the main qualitative conclusions, established earlier, remain valid. The levels of non-farm and total output during the drought are significantly below their corresponding levels in the absence of the drought, and there is a marked overshooting of these variables in the first two recovery periods. The drought imposes additional downward pressure on non-traded goods prices, and sufficient upward pressure during the recovery phase to more than offset the ongoing downward pressure on prices. However, the impact of the drought on nominal wages, particularly during the recovery phase, is less marked. By comparing the time paths for the variable Y^*_{NF}, it is clear that there remains a modest tendency for real wages to rise during the drought and to fall during the first two recovery periods, relative to the level of real wages in the absence of the drought. Similarly, the drought continues to produce marked weakness in the balance of payments, followed by marked strength in the first two recovery periods, with an overall net surplus for periods 1 to 4 taken together. Finally, farm output and the usage of primary and non-primary inputs are significantly influenced by the more substantial falls in wages, and the prices of non-primary inputs and capital equipment which occur in this growth framework - particularly from the second drought period onwards.

It is interesting to note that this particular set of simulations illustrates clearly the importance of the distinction between 'Popular Keynesian' and 'Classical' assumptions in the type

of analysis being attempted in the present thesis. In particular, optimal non-farm output, Y_{NF}^*, grows quite steadily over time, under the 'Classical' influences of capital deepening, technological advancement and movements in the level of the real wage as a cost to non-farm employers. If nominal wages and non-traded goods prices were sufficiently flexible to ensure that $Y_{NF} = Y_{NF}^*$ at all times, then it is clear that any attempt to assess the role of the farm sector as a source of change in Y_{NF} would need to concentrate on the 'Classical' channels of influence. In other words, the focus of attention would need to be on the impact which developments in the farm sector may have on the level of the real wage in the non-farm sector and the (probably less important) impact on technological advancement and capital deepening. On the other hand, with a degree of rigidity in the movement of nominal wages and non-traded goods prices, such as incorporated into the present model, it is clear from Table X(11) that Y_{NF} and Y_{NF}^* can diverge substantially in the short run. Given such a divergence, effective demand considerations become much more important in determining Y_{NF} in the short run.

Finally, it should be noted that in the earlier simulations, which were undertaken with g and q set at zero, it was common for Y_{NF} to exceed Y_{NF}^* during the first few periods of recovery from the drought. However, in the present case, with positive values for g and q, and hence with ongoing growth in Y_{NF}^*, Y_{NF} remains below Y_{NF}^* throughout. Such a configuration, of course, is consistent with the assumption adopted in Chapters III to VII (i.e. that the actual level of output in the non-traded goods sector is always and everywhere less than its optimal level), and again in the simple empirical version of the model in Chapter IX.

V(12) Results Obtained in the Presence of an Endogenous Real Interest Rate

In the theoretical simulation variant of Model I, as set out in Appendix A, the real interest rate was treated as an exogenous variable. This could be interpreted as an assumption that relatively short term variations in the real interest rate are largely ignored by consumers and investors in making their consumption and investment decisions. This assumption will now be relaxed.

In principle, two alternative approaches could be adopted in order to endogenise the real interest rate in macroeconomic models. Firstly, in closed economy models with fixed real output, the real interest rate could be determined as a mechanism for equating saving and investment. The nominal interest rate could then be determined from the Fisherian identity. However, in models such as the present model, where output is variable, as is the level of net capital inflow or outflow, it is sensible to conceive the nominal interest rate being determined in the money market and the real interest rate being determined from the Fisherian identity.

In view of the above discussion, the model was modified to include the following additional equation:

$$(44) \quad i_t = r_t - p^{\cdot E}_{c,t}$$

with the real interest rate, i, being the additional endogenous variable.

It should be noted that farm investment expenditure, I_F, proved to be implausibly sensitive to variations in the real interest rate, via its impact on the optimal farm capital stock. Therefore, this channel of influence on farm investment was closed off, i.e. the real interest rate, as it affected farm investment, was held fixed at .05, as in the preceding simulations. This still

permitted variations in the real interest rate to influence farm consumption expenditure and non-farm consumption and investment expenditure.

In Table X(12), the results obtained from the model in the presence of an endogenous real interest rate, using the best-bet parameter combination, are listed, along with the means and standard deviations of the results obtained using the twenty sets of random parameter combinations. For purposes of comparison, the results obtained using the best-bet parameter combination and a fixed real interest rate are also reproduced in the table.

While significant movements in the real interest rate occur under the BB_2 combination, the deviations from the stationary state level would not seem to be implausibly large. The expected negative change in prices during the drought more than offsets the decline in nominal interest rates, to produce a higher average level of the real interest rate during the drought - a situation which is gradually reversed during the recovery phase.

As a consequence of the rise in the real interest rate, non-farm and total output decline more during the drought under BB_2 than under BB_1, and remain below the BB_1 levels during the first two recovery periods. A substantial overshoot during the recovery remains evident. With the generally weaker performance of non-farm output and employment under BB_2, non-traded goods prices and nominal wages tend to fall below their BB_1 levels. It is evident, however, from the time path for Y_{NF}^* that the BB_2 time paths for nominal wages and non-traded goods prices continue to produce a rise in the real wage during the drought, and a fall during the recovery phase.

TABLE X(12): SELECTED RESULTS WITH AN ENDOGENOUS REAL INTEREST RATE

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
O_F	BB_1	100	86.0	86.5	102.1	100.9	98.9
	BB_2	100	86.0	86.4	102.3	102.3	100.4
	RM	100	86.7	87.0	102.1	101.9	100.3
	S.D.	-	3.1	3.1	1.3	1.2	1.2
L_F	BB_1	250 000	215 000	217 000	258 000	257 000	248 000
	BB_2	250 000	215 000	217 000	259 000	262 000	255 000
	RM	250 000	217 000	218 000	258 000	259 000	254 000
	S.D.	-	7 700	7 700	4 000	4 600	5 000
J_F	BB_1	30	25.8	26.3	31.4	30.3	29.2
	BB_2	30	25.8	26.3	31.7	31.2	30.0
	RM	30	26.0	26.4	31.5	30.9	30.0
	S.D.	-	1.0	0.9	0.8	0.6	0.6
I_F	BB_1	13.5	0	3.9	30.0	17.5	9.7
	BB_2	13.5	0	2.7	30.2	20.7	10.9
	RM	13.5	0.6	2.8	29.8	18.2	10.5
	S.D.	-	2.6	4.2	11.3	4.5	4.7
y_F^F	BB_1	4 000	3 370	3 450	3 970	3 430	3 430
	BB_2	4 000	3 400	3 470	4 120	3 750	3 480
	RM	4 000	3 370	3 450	4 060	3 650	3 460
	S.D.	-	160	160	150	350	320
C_F	BB_1	20	18.8	19.1	19.9	18.8	18.8
	BB_2	20	18.9	18.9	19.7	19.4	19.3
	RM	19.9	18.8	18.7	19.5	19.0	18.9
	S.D.	2.7	2.5	2.6	2.7	2.4	2.3

Continued on next page

TABLE X(12) (continued)

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
t_F	BB_1	1 500	1 340	1 360	1 490	1 360	1 360
	BB_2	1 500	1 350	1 370	1 530	1 440	1 370
	RM	1 710	1 560	1 580	1 730	1 630	1 590
	S.D.	800	800	790	790	760	770
R	BB_1	500	170	230	480	170	180
	BB_2	500	190	270	650	370	160
	RM	300	-40	40	400	110	-30
	S.D.	820	870	870	880	1 030	980
Y_{NF}	BB_1	1 000	978	972	1 019	1 030	1 001
	BB_2	1 000	978	965	998	1 024	1 022
	RM	1 000	981	967	998	1 017	1 016
	S.D.	-	5.1	11.4	10.2	9.6	11.6
Y	BB_1	1 070	1 038	1 032	1 089	1 101	1 071
	BB_2	1 070	1 038	1 025	1 068	1 095	1 093
	RM	1 070	1 041	1 028	1 068	1 088	1 086
	S.D.	-	7.0	13.0	10.6	10.2	12.0
P_{NT}	BB_1	100	97.7	96.2	99.9	102.5	100.9
	BB_2	100	97.6	95.4	97.5	100.6	102.0
	RM	100	98.0	95.9	98.0	100.5	101.3
	S.D.	-	0.9	1.6	1.3	1.3	1.3
w	BB_1	0.01	0.00998	0.00988	0.00982	0.00995	0.01008
	BB_2	0.01	0.00997	0.00987	0.00977	0.00984	0.00998
	RM	0.01	0.00999	0.00989	0.00982	0.00988	0.00998
	S.D.	-	0.00002	0.00004	0.00007	0.00009	0.00007

Continued on next page

TABLE X(12) (continued)

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
L_{NF}	BB_1	$6x10^6$	$5.93x10^6$	$5.92x10^6$	$6.06x10^6$	$6.09x10^6$	$6.00x10^6$
	BB_2	$6x10^6$	$5.93x10^6$	$5.89x10^6$	$5.99x10^6$	$6.07x10^6$	$6.07x10^6$
	RM	$6x10^6$	$5.94x10^6$	$5.91x10^6$	$5.99x10^6$	$6.05x10^6$	$6.04x10^6$
	S.D.	-	28 000	43 000	36 000	26 000	36 000
BP	BB_1	0	-1 110	-360	1 910	670	-950
	BB_2	0	-1 040	-620	1 350	1 100	170
	RM	0	-1 120	-690	1 420	890	60
	S.D.	-	400	420	860	440	570
m^S	BB_1	53 200	51 000	50 300	54 100	55 400	53 500
	BB_2	53 200	50 900	49 700	52 400	54 600	54 900
	RM	53 200	51 300	50 000	52 600	54 300	54 400
	S.D.	-	570	1 090	800	800	940
Y^*_{NF}	BB_1	1 000	999.31	999.30	1000.86	1001.03	999.90
	BB_2	1 000	999.31	999.07	1000.29	1001.00	1000.75
	RM	1 000	999.45	999.22	1000.26	1000.73	1000.53
	S.D.	-	0.29	0.46	0.25	0.44	0.48
r	BB_1	0.05	0.048	0.05	0.061	0.058	0.046
	BB_2	0.05	0.048	0.047	0.054	0.057	0.055
	RM	0.05	0.048	0.047	0.054	0.056	0.053
	S.D.	-	0.002	0.003	0.004	0.004	0.004

Continued on next page

TABLE X(12) (continued)

Variable	Model/ Moment	Period					
		SS	1	2	3	4	5
i	BB_1	0.05	0.05	0.05	0.05	0.05	0.05
	BB_2	0.05	0.049	0.057	0.066	0.052	0.040
	RM	0.05	0.048	0.056	0.065	0.051	0.043
	S.D.	-	0.003	0.004	0.006	0.009	0.005

BB_1 - best-bet parameter combination, fixed real interest rate
BB_2 - best bet parameter combination, endogenous real interest rate
RM - means of the random results, endogenous real interest rate
S.D. - standard deviations of the random results.

While the BB_1 and BB_2 time paths for the balance of payments are somewhat different, the result that a substantial deficit occurs during the drought, followed by a substantial surplus during the recovery, remains valid. The lower level of output and prices during the drought and first two recovery periods under BB_2 are also reflected in the time path for the nominal interest rate, r, which tends to track below the corresponding path under BB_1.

In general, the differences in the time paths for the main farm sector variables under BB_1 and BB_2 are relatively minor, and can be attributed to the different time paths for w, p_j, p_i and r. For example, the sharp fall in farm output during the drought remains evident, as does the modest overshoot during the recovery - a pattern which is reflected, as before, in the time paths for L_F and J_F.

With only a few minor exceptions, (for example, non-farm output in the second and third recovery periods), the means of the random results are quantitatively and qualitatively very similar to the BB_2 results. This parallels the corresponding conclusion under fixed real interest rates. Also, as before, the main qualitative conclusions are reasonably robust to one, and sometimes two, standard deviations either side of the random mean. Importantly, the result that, during the drought, the average level of the nominal interest rate falls below its stationary state level (which is suggested by both the BB_1 and BB_2 results), is not particularly robust, even for one standard deviation. This, of course, supports the earlier evidence as to the ambiguity of the impact of the drought on the nominal interest rate.

In addition, all of the outlying parameter combinations examined in the original version of the model, with fixed real interest rates, were re-examined in this modified version of the model. In

general, only three of the earlier results and conclusions required any significant modification in the light of the results obtained with the endogenous real interest rate. Firstly, for the five outliers: (I) $\Theta_o = 0.1$, (II) $\Theta_o = 0.1$, $\Theta_1 = 0$, (III) $\Theta_o = 0.1$, $\Theta_1 = 1$, (IV) $\Theta_o = 0.1$, $C_F^1 = 0$, and (V) $\Theta_o = 0.1$, $C_F^1 = 0.4$, the real wage remained above its stationary state level in the first recovery period. Such an outcome was not evident in the corresponding results obtained for a fixed real interest rate - in that case, the real wage was above its stationary state level in the two drought periods, and below it during the first two recovery periods. This is further testimony of the variety of time paths for the real wage which can emerge from this model.

Secondly, for the outlier produced by setting $I_{NF}^1 = 0$, the average level of the nominal interest rate during the drought is lower than in the initial stationary state. This is the converse of the result obtained from the corresponding outlier with the real interest rate fixed, and further highlights the uncertainty as to the nature of the impact of the drought on the nominal interest rate.

Finally, it will be recalled from Section V(8), that, with the real interest rate fixed, the outlier formed by setting $p_{NT}^1 = .01$ produced a time path for the balance of payments which was somewhat different to that produced by most of the other paramter combinations examined. Whereas the conventional result was for balance of payments deficits in periods 5 and 6, followed by surpluses in periods 7 and 8, this outlier produced a modest surplus in period 6, and a marked deficit in period 8. However, with the real interest rate variable, the time path for the balance of payments produced by this outlier returns to the more conventional pattern noted above.

Section VI Concluding Comments on Chapter X

In Chapter X, a theoretical simulation variant of Model I has been presented, and used to undertake some further analysis of the first paradigm. This material represents an extension and refinement of the analysis presented in Chapter III.

As far as was practicable, the ranges of values for the parameters were based on the existing empirical and theoretical literature and a priori reasoning. Similarly, an attempt was made to ensure that the relative magnitudes of the main variables, in the initial stationary state, bore at least some broad resemblance to the relevant Australian data. Such an approach would seem sensible if, as suggested in Section II, the theoretical simulation variant of the model is seen as a forerunner for the eventual development of an empirical version of the model of direct relevance to the Australian economy. It was emphasised, however, that at the present stage of development, little, if any, store should be placed on any of the specific numerical results which emerged from the model. Rather, the emphasis should be on the qualitative results which emerge, and the robustness or sensitivity of such results to the various combinations of parameter values used.

The best-bet results and certain aspects of the random and outlying results would seem, on reflection, to accord with intuition. Nevertheless, to date, they have not been clearly or explicitly stated in the relevant Australian literature, at least in the context of a reasonably large and consistent macroeconomic model. Some of the more important of these results are summarised below.

Under the best-bet parameter combination, the drought shock was associated with a fall in output and employment in <u>both</u> the farm and

non-farm sectors of the model. The nominal interest rate fell, nominal wages and non-traded goods prices fell, the overall balance of payments went into deficit and the real wage as a cost to non-farm employers increased. The latter result is a reflection of the fact that the decline in economic activity exerted more downward pressure on non-traded goods prices than on nominal wages in the short run. Further, during the early part of the recovery phase, most of these results were reversed. It is also noteworthy that farm and non-farm output and employment temporarily overshot their initial stationary state levels, as did the nominal interest rate, nominal wages and non-traded goods prices.

When the best-bet parameter combination was modified to make non-traded goods prices and nominal wages more responsive to the level of excess demand or supply in the respective markets, the cyclical movement of non-farm output and employment became less marked, and conversely. This, of course, clearly illustrated the importance of the distinction between 'Popular Keynesian' and 'Classical' assumptions with respect to the degree of wage and price flexibility in a practical context.

In the presence of ongoing technological advancement and capital deepening in the non-farm sector, the results were suggestive of a gradual emergence of 'Popular Keynesian' type unemployment in the non-traded goods sector, in the absence of growth in the exogenous components of aggregate demand. Such a result is consistent with the relevant theoretical literature in this area. The effect of the drought was to further reinforce the emergence of this 'Popular Keynesian' unemployment, while the sharp recovery in the demand for non-farm output following the breaking of the drought had the effect of reducing, but not eliminating, that unemployment. This set of

results brought into sharp focus the alternative groups of variables which are emphasised under the 'Popular Keynesian' and 'Classical' philosophies.

In the first instance, the simulations were undertaken with the real interest rate fixed exogenously. In later simulations, the real interest rate was determined endogenously, via the Fisherian identity. It was observed that the real interest rate tended to move countercyclically, which (given the assumed negative relationship between the real interest rate and aggregate demand) reinforced the cyclical swings in non-farm output and employment.

The random and various outlying parameter combinations also pointed towards the potential relevance of several less conventional or more counterintuitive results - results which have not been widely recognised, if at all, in the relevant Australian literature. In each case, however, such results were consistent with, and served to reinforce, tentative results which had emerged from the earlier analysis with the geometric characterisation of Model I. For example, the nominal interest rate may <u>increase</u> during the drought if the <u>net</u> effect of the fall in farm exports and the decline in economic activity (and hence in the demand for traded goods) is to worsen the current account.

Further, it was demonstrated that, while the real wage as a cost to non-farm employers increased during the drought under the best-bet combination, it was also possible that that measure of the real wage could <u>fall</u> during the drought. Perhaps more importantly, despite such a fall in the real wage, the decline in non-farm output and employment could, in fact, be <u>greater</u> than that implied by the best-bet combination. Such an outcome represented a striking illustration of the fact that, in this 'Popular Keynesian' (or

rationed equilibrium) framework, variations in non-farm output and employment do not necessarily require a countercyclical movement of the real wage. Further, even in those instances where the time paths followed by non-traded goods prices and nominal wages are consistent with a countercyclical movement of the real wage, it does not necessarily imply that such real wage movements are the prime cause of the change in actual output and employment (although they will influence the optimal level of output and employment, in the conventional direction).

Moving on to some avenues for future research, it was noted that various procedures exist for further developing and refining the theoretical simulation variant of the model and the associated analysis of the first paradigm. For example, a more complete and consistent approach to sensitivity analysis would be to treat each parameter as an outlier in turn, using two values drawn from opposite extremes in the range of plausible values specified for each parameter. Another potentially useful option would be to form a linear approximation of the model and hence call on the various, more efficient, procedures which are available for undertaking sensitivity analyses within the context of a linear model.

It may also be useful to further explore the issues raised by ongoing economic and population growth ie. non-zero values for the variables g and q. For example, the various simulations undertaken using the outlying and random parameter combinations could be repeated in the presence of non-zero values for g and q.

The issue raised by the apparent ambiguity surrounding the choice of scale argument in the demand for money function could also be investigated further. In particular, the simulations undertaken for some or all of the various parameter combinations could be

repeated, with real effective income in the demand for money function replaced by real expenditure.

It is also important to note that, in O'Mara et al (1985), the theoretical simulation variant of Model I is suitably modified to form a theoretical simulation variant of Model II. The latter is then used to undertake some further analysis of the second paradigm. In analysing the second paradigm, precisely the same shock to the volume of farm production is assumed as was used in the present chapter. The advantage of using an identicial volume shock in both cases is that it permits the simulation results from the two models to be directly compared, in the knowledge that any differences which are apparent in the results can be directly attributed to the differences in the marketing and institutional arrangements for farm commodities, as dictated by the two paradigms.

Unfortunately, space limitations preclude a detailed consideration of the O'Mara et al analysis within the thesis. It is important, however, to briefly note some of the main results reported in that study, as follows:

(1) for a number of important variables, including several in the non-farm and macroeconomic aggregates sector of the model, the results obtained from Model II were, in fact, significantly different to those obtained from Model I. In other words, while the supply side shock in the farm sector was identical in both cases, the alternative arrangements for absorbing that shock, as dictated by the first and second paradigms, proved to be of some consequence at a macroeconomic level;

(2) a number of the insights gained from the analysis undertaken using the earlier variants of Model II, in Chapter IV, were

confirmed in the simulation analysis, and also proved helpful in interpreting and intuiting some of the simulation results. For example:

(a) the simulation results served to confirm the tentative conclusion reached in Chapter IV that the relative impact of the supply side shock in the farm sector on non-farm output and employment is highly uncertain. In particular, a given drought induced decline in farm output could have either a more severe, or a less severe, impact on non-farm output and employment in Model II than in Model I. The simulation results also provided a degree of support for the hypothesis, put forward in Chapter IV, that, under certain circumstances, the adverse shock to farm production could have a beneficial impact on output and employment in the non-farm sector;

(b) similarly, the simulation results served to confirm that substantial uncertainty exists as to the impact of the adverse shock to farm production on the state of the balance of payments in the Model II framework. It was common for the balance of payments to deteriorate further in Model II than in Model I, despite the fact that, in Model II, the value and volume of farm exports were largely unaffected by the decline in farm production. On the other hand, however, there was also ample evidence that the balance of payments could deteriorate less in Model II than in Model I - a result which is, perhaps, more intuitively appealing. There was also a degree of support for the hypothesis, put

forward in Chapter IV, that a decline in farm production in the Model II framework could have a beneficial impact on the balance of payments in some circumstances;

(c) the simulation results commonly implied a procyclical movement of the nominal interest rate in Model II - an outcome qualitatively similar to that in Model I. However, the relative magnitudes of the movements in the nominal interest rate in the two models proved uncertain. There was also some evidence that in Model II, as in Model I, the nominal interest rate could move countercyclically in some circumstances. Again, such results are quite consistent with the insights gained in Chapter IV;

(d) as suggested in Chapter IV, the uncertainties surrounding the outcome for non-farm production, the state of the balance of payments and the nominal interest rate, as noted in (a), (b) and (c) above, were shown to hinge substantially on the size of the own price elasticity of demand for farm commodities on the domestic market;

(3) in the theoretical simulation variant of Model II, it was possible to consider movements in several important variables which were held fixed in the analysis in Chapter IV - for example, non-traded goods prices and nominal wages. The movements which occurred in these variables resulted, in turn, in movements in the real wage as a cost to non-farm employers and hence in the optimal level of non-farm output. It was also possible to distinguish between the real and the nominal interest rate. It was

noted that the endogeneity of farm prices in the Model II framework opened up several channels of influence from the farm sector to the non-farm sector which were not operative in Model I. In particular, changes in farm prices influence expected consumer prices and hence nominal wages, real wages as a cost to non-farm employers and real interest rates. These additional channels of influence in the Model II framework were shown to have some bearing on the simulation results.

Finally, the successful application of the theoretical simulation technique to Models I and II has laid the groundwork for the ready extension of the technique to Models III, IV and V as part of a future research project. It should also facilitate the eventual development of an empirical version of the model structure developed in the present thesis.

Appendix A

Notation

The following notation is used in the model. As far as is practicable, it is identical to the notation used in the earlier descriptions of the theoretical model:

O_F - the gross volume of farm production

K_F - farm 'capital' stock, defined to include a partial land component

L_F - the aggregate farm labour input

$\bar{L}_F$ - farm labour input supplied by owner operators

J_F - non-primary (intermediate) inputs used in the farm sector

* - denotes the unconstrained profit maximising levels of O_F, K_F, L_F, and J_F

Y_F - real value added in the farm sector

y_F - nominal value added in the farm sector

y_F^{NF} - that part of y_F accruing to non-farm households

y_F^{F} - that part of y_F accruing to farm households

Y_{NF} - the volume of non-farm production

y_{NF} - the nominal value of non-farm production

Y - the aggregate volume of production

Y_{NF}^{*} - the 'optimum' level of non-farm production

L^N - the 'natural' level of employment

L - aggregate employment

L_{NF} - non-farm employment

C_F - the volume of consumption by farm households

C_{NF} - the volume of consumption by non-farm households

C - the aggregate volume of private consumption

I_F - the volume of investment expenditure in the farm sector

R - farm 'residual funds'

D - farm debt held by the non-farm sector

I_{NF} - the volume of private investment expenditure in the non-farm sector

I - the aggregate volume of investment expenditure

M - the volume of imports

X_{NF} - the volume of non-farm sector exports

X_F - the volume of farm exports

X - the aggregate volume of exports

G - the volume of government expenditure

t_F - nominal tax payments by the farm sector

m^d - the demand for nominal money balances

m^s - the supply of nominal money balances

BP - the balance of payments deficit or surplus

r^w - the 'world' nominal rate of interest

k - net capital inflow

r - the nominal rate of interest

i - the real rate of interest

p_F - the implicit deflator for gross farm production

p_i - the implicit investment deflator

p_j - the implicit deflator for non-primary inputs used in the farm sector

p_{NT} - the price of non-traded goods

p_{NF} - the implicit non-farm deflator

p_{NF-NFX} - the deflator for non-farm commodities other than non-farm exportables

p_c - the implicit consumption deflator

p_m - the implicit import deflator

p_{NFX} - the implicit deflator for non-farm exports

w - the nominal wage rate

p_c^E - the expected level of p_c

σ - the rate of economic depreciation of the farm capital stock

σ_{ED} - the rate of decay of the farm capital stock

σ_{CG} - the rate of real capital gains on the farm capital stock, (with capital loss being defined as positive)

g - the rate of growth of the optimal level of non-farm output, Y_{NF}^*, given an unchanged real wage rate

q - the rate of growth of L^N

Model Specification

Farm Sector

It is assumed that rural producers make decisions with respect to the optimal level of output, and the associated inputs of capital, labour and non-primary inputs, in a manner consistent with classical optimising behaviour. More formally, it is assumed that, at the start of each period (the length of which is not strictly defined, but could be thought of as, say, six to twelve months), rural producers determine the optimal capital stock, and the optimum usage of labour and non-primary inputs during the period, so as to equate the value of the marginal product of each input to its cost simultaneously. The farm sector production function is assumed to take a conventional Cobb-Douglas form, with decreasing returns to scale.

(1) $O^*_{F,t} = A.(K^*_{F,t})^{\alpha}.\ (L^*_{F,t})^{\beta}.\ (J^*_{F,t})^{\gamma}$ where $\alpha + \beta + \gamma < 1$

It is assumed that the stock of unimproved land is fixed and incorporated into A, and investment in land improvements is included in K. The assumption of a fixed stock of unimproved land can be argued to provide a justification for assuming that returns to scale for the remaining inputs are decreasing.

The unconstrained profit-maximising demand functions for capital, labour and non-primary inputs are:

(2) $\dfrac{\delta O^*_{F,t}}{\delta K^*_{F,t}} \cdot p_{F,t-1} = (i_{t-1} + \sigma)\ p_{i,t-1} \cdot K^*_{F,t}$

(3) $\dfrac{\delta O^*_{F,t}}{\delta L^*_{F,t}} \cdot p_{F,t-1} = w_{t-1}$

(4) $\dfrac{\delta O^*_{F,t}}{\delta J^*_{F,t}} \cdot p_{F,t-1} = p_{j,t-1}$

It is assumed, for simplicity, that the output and input prices on which the input demand functions are based for period t are those ruling in period t-1. Given the values of $p_{F,t-1}$, w_{t-1}, $p_{j,t-1}$, i_{t-1} and $p_{i,t-1}$, equations (1) to (4) can be solved simultaneously to obtain the unconstrained optimal capital stock $K^*_{F,t}$; labour input $L^*_{F,t}$, usage of non-primary inputs $J^*_{F,t}$ and volume of farm production $O^*_{F,t}$. However, the problem with equations (2) to (4), for present purposes, is that they are unconstrained, i.e. they are based on the assumption that the usage of each of the inputs can be adjusted fully to its optimal level within one period. While such an assumption may be acceptable

for labour and non-primary inputs, it seems less reasonable for the capital stock. For example, it is a common procedure in the literature on investment demand functions to assume a partial adjustment process for the movement of the actual capital stock toward its optimal level (somehow defined). Further, the specification, in its present form, allows no role for farm 'residual funds' to influence the level of farm investment expenditure.

In view of the above discussion, the equation for actual gross investment is specified to allow a role for the optimal capital stock, a partial adjustment process, and farm 'residual funds'.

$$(5)\ I_{F,t} = \Theta_o \left[K^*_{F,t} - (1-\sigma_{ED})\, K_{F,t-1} \right] + \Theta_1 \left(\frac{R_{t-1}}{p_{i,t}}\right)$$

where $(6)\ \sigma_{ED} = \sigma - \sigma_{CG}$

It is clear that, in equation (5), a positive level of residual funds would serve to increase the speed of adjustment of the actual capital stock to its optimal level, and conversely. There are two further points to note about equations (5) and (6). Firstly, as was the case for output and input prices in equations (2) - (4), it is assumed that actual investment decisions are based on the previous period's residual funds. Secondly, in equation (6), it is assumed that the rate of economic depreciation, σ, is made up of two components - a rate of physical decay, σ_{ED}, and a rate of pure capital gain or loss over and above that associated with the ongoing physical decay, σ_{CG}. It is assumed that only σ_{ED} is relevant for the determination of the gap between the desired and the actual capital stock.

The following constraint is imposed upon $I_{F,t}$:

$$(5') \quad I_{F,t} = 0 \; ; \; K^*_{F,t} \leq (1-\sigma_{ED}) \, K_{F,t-1}$$

$$I_{F,t} \leq K^*_{F,t} - (1-\sigma_{ED}) \, K_{F,t-1} \; ; \; K^*_{F,t} > (1-\sigma_{ED}) \, K_{F,t-1}$$

This constraint simply formalises the common sense notion that gross investment expenditure is unlikely to be negative (at least for the sector as a whole), nor can it be more than sufficient to completely eliminate the gap between the actual and the desired capital stock.

It is clear that, given gross investment during period t, $I_{F,t}$, the actual level of the capital stock during period t can be obtained from:

$$(7) \quad K_{F,t} = K_{F,t-1} \, (1-\sigma_{ED}) + I_{F,t}$$

It is also clear that, at most points in time, $K_{F,t} \neq K^*_{F,t}$. It is assumed that rural producers reassess their input decisions with respect to L_F and J_F in the light of the actual capital stock given by equation (7). In other words, the actual inputs of L_F and J_F and the actual level of farm output are assumed to be consistent with profit maximisation, subject to the constraint implied by the actual capital stock given by (7).

$$(1') \quad O_{F,t} = A.(K_{F,t})^{\alpha}. \, (L_{F,t})^{\beta}. \, (J_{F,t})^{\gamma}$$

$$(8) \quad \frac{\delta O_{F,t}}{\delta L_{F,t}} \cdot p_{F,t-1} = w_{t-1}$$

$$(9) \quad \frac{\delta O_{F,t}}{\delta J_{F,t}} \cdot p_{F,t-1} = p_{j,t-1}$$

Given $p_{F,t-1}$, w_{t-1}, $p_{j,t-1}$ and $K_{F,t}$ from (7), equations (1') (8) and (9) can be solved simultaneously to obtain $O_{F,t}$, $L_{F,t}$ and $J_{F,t}$.

The value added in the farm sector, Y_F, is obtained simply by subtracting the usage of non-primary inputs from the gross volume of farm production.

$$(10)\ Y_{F,t} = O_{F,t} - J_{F,t}$$

Farm value added is converted to nominal terms using the double deflation procedure:

$$(11)\ y_{F,t} = p_{F,t} \cdot O_{F,t} - p_{j,t} \cdot J_{F,t}$$

The next step is to recognise that farm value added accrues partly to farm households, y_F^F, (essentially the income of farm unincorporated enterprises), and partly to non-farm households, y_F^{NF}. It is assumed that the only two components of y_F^{NF} are (1) wages, salaries and supplements paid to hired farm labour, and (2) interest payments by the farm sector.

$$(12)\quad y_{F,t}^{NF} = w_t\,(L_{F,t} - \bar{L}_F) + r_{t-1}\,D_{t-1}$$

It is assumed that farm labour supplied by owner operators is fixed at L_F, so that all variations in farm labour input, L_F, fall on hired labour in the short to medium term.

$$(13)\ D_t = D_{t-1} + p_{i,t} \cdot I_{F,t} - R_t$$

In (13), it is assumed that the change in farm debt during period t is equal to the difference between gross investment and residual funds during the period. Implicit in (13) is the assumption

that, if $I_{F,t} > R_t$, then all residual funds are utilised to finance $I_{F,t}$ prior to any additional off-farm borrowing being undertaken and, if $I_{F,t} < R_t$, the surplus residual funds are used exclusively to retire existing farm debt.

Given y_F^{NF}, then y_F^F can be readily obtained from the identity

$$(14)\quad y_{F,t}^F = y_{F,t} - y_{F,t}^{NF}$$

The volume of consumption expenditure by farm households is assumed to be a simple function of y_F^F and the real interest rate, i:

$$(15)\quad C_{F,t} = C_F^o + C_F^1 \frac{(y_{F,t}^F)}{p_{c,t}} + C_F^2\, i_t$$

Similarly, nominal farm tax payments are assumed to be a simple linear function of y_F^F

$$(16)\quad t_{F,t} = \eta^o + \eta^1 \cdot y_{F,t}^F$$

Given the values of $y_{F,t}^F$, $C_{F,t}$ and $t_{F,t}$, from equations (14), (15) and (16), and the value of $p_{c,t}$ from the non-farm and macroeconomic aggregates sector of the model, then farm residual funds can be obtained from

$$(17)\quad R_t = y_{F,t}^F - p_{c,t} \cdot C_{F,t} - t_{F,t}$$

Finally, it is assumed that the volume of farm exports is simply equal to the difference between the volume of farm production and the volume of consumption of farm commodities. The latter is assumed to be a simple function of, firstly, the volume of consumption expenditure, and secondly, the consumption deflator relative to the farm deflator.

$$(18)\ X_{F,t} = 0_{F,t} - (x^{o} + x^{1}\ (\frac{p_{c,t} \cdot C_{t}}{p_{F,t}}))$$

Implicit in this specification is the assumption that a perfect residual export market exists for farm commodities. This abstracts from complications associated with overseas import quotas on farm commodities, shipping constraints, stockholding by statutory marketing authorities, and the fact that some farm commodities are intrinsically non-tradeable. In other words, the specification is consistent with the circumstances postulated by the first paradigm.

The farm sector of the model therefore contains 19 equations (including (1) and (1') as separate equations). The 19 variables which are treated as endogenous to the farm sector are:

1: 0_F^* 2: K_F^* 3: L_F^* 4: J_F^* 5: I_F 6: σ_{CG} 7: K_F 8: L_F

9: J_F 10: 0_F 11: Y_F 12: y_F 13: y_F^{NF} 14: y_F^F 15: D_F

16: C_F 17: t_F 18: R 19: X_F

The variables which are exogenous to the farm sector but endogenous to the non-farm sector of the model are:

1: p_i 2: p_j 3: p_c 4: w 5: r 6: C

The variables incorporated into the farm sector which are exogenous to the model as a whole are:

1: p_F 2: σ 3: σ_{ED} 4: i 5: $\bar{L}_F$

The Non-Farm Sector and Macroeconomic Aggregates

Consumption expenditure generated in the non-farm sector is assumed to be a function of real income and the real interest rate:

$$(19)\ C_{NF,t} = C^{o}_{NF} + C^{1}_{NF}\left(\frac{y^{NF}_{F,t}}{p_{c,t}}\right) + C^{2}_{NF}\left(\frac{y_{NF,t}}{p_{c,t}}\right) - C^{3}_{NF}\, i_t$$

Reflecting the Keynesian philosophy of the specification of the non-farm sector, non-farm investment expenditure is assumed to be a simple linear function containing an accelerator effect and a real interest rate effect:

$$(20)\ I_{NF,t} = I^{o}_{NF} + I^{1}_{NF}\,(Y_{NF,t-1} - Y_{NF,t-2}) - I^{2}_{NF}\,(i_{t-1})$$

Non-farm consumption and investment expenditure are then added to their farm counterparts to generate the aggregate volumes of consumption and investment expenditure.

$$(21)\ C_t = C_{F,t} + C_{NF,t}$$

$$(22)\ I_t = I_{F,t} + I_{NF,t}$$

It is assumed that the volume of imports is a function of the volume of consumption expenditure, the volume of investment expenditure, and relative prices. For simplicity, it is assumed that no government expenditure is directed onto imports at the margin.

$$(23)\ M_t = M^{o} + M^{1}\left(\frac{p_{c,t}\cdot C_t}{p_{m,t}}\right) + M^{2}\left(\frac{p_{i,t}\cdot I_t}{p_{m,t}}\right)$$

Exports from the farm sector are added to an exogenously given volume of non-farm exports to generate aggregate exports:

$$(24)\ X_t = X_{F,t} + X_{NF,t}$$

Aggregate production in the economy can then be obtained from the national accounting identity

$$(25)\ Y_t = C_t + I_t + G_t + X_t - M_t$$

The non-farm component of Y is obtained by subtracting Y_F from Y

$$(26)\ Y_{NF,t} = Y_t - Y_{F,t}$$

Y_{NF} is converted to nominal terms by taking the product of Y_{NF} and p_{NF}

$$(27)\ y_{NF,t} = p_{NF,t} \cdot Y_{NF,t}$$

It is assumed that non-traded goods prices in the non-farm sector are influenced partly by wage costs and partly by the level of excess demand for non-farm commodities, represented by the gap between the actual level of non-farm production and its classical or profit-maximising level:

$$(28)\ p_{NT,t} = p_{NT}^{o}\ (w_t) + p_{NT}^{1}\ (p_{NT,t-1})\ (Y_{NF,t} - Y^{*}_{NF,t})$$

where

$$(29)\ Y^{*}_{NF,t} = Y^{*}_{NF,t=0}\ (1+g)^t - Y^{*1}_{NF}\ \left(\frac{w_t}{p_{NF-NFX,t}} - \frac{w_{t=0}}{p_{NF-NFX,t=0}}\right)$$

In (28), $p_{NT,t-1}$ is included on the RHS to prevent the scaling problems that would otherwise emerge as p_{NT} changes over time. The logic of (29) is that, firstly, optimal non-farm output would grow

over time at a rate g relative to its level in (say) an initial stationary state, provided that the level of the real wage as a cost to non-farm employers did not change relative to its level in the base period. This growth would capture the effect of ongoing capital deepening and technological advancement. If, however, the real wage as a cost to non-farm employers were to change relative to the base period level, the growth in the optimal level of non-farm output would be modified accordingly. In particular, if the real wage were to rise relative to its base period level, the growth in the optimal level of non-farm output would be reduced, and vice versa.

Two further points should be noted about the specification of (29). Firstly, it is clear from the second term on the RHS of (29) that non-farm export production has been excluded from consideration. This is felt to be the assumption most consistent with the earlier assumption that the level of non-farm exports is exogenously given. Further, in an Australian context, non-farm exports could be broadly interpreted as minerals, and an assumption that mineral production is not significantly affected by real wage movements in the short to medium term would seem reasonable as a first approximation. Secondly, it would have been preferable to define the 'gap' term on the RHS of (28) purely in terms of non-traded goods, rather than the broader category of non-farm goods. However, in order to avoid the need to specify additional equations to isolate the actual production of non-traded goods, it was assumed that a gap defined in terms of non-farm goods would suffice.

Having specified p_{NT}, we can now proceed to examine the various other price variables in the model:

(30) $p_{NF,t} = \lambda_1 p_{NT,t} + \lambda_2 p_{M,t} + \lambda_3 p_{NFX,t}$

where $\lambda_1 + \lambda_2 + \lambda_3 = 1$

In principle, of course, as p_{NF}, the price of non-farm commodities, is to be used as an implicit deflator, λ_1, λ_2 and λ_3 should be flexible and endogenous. In practise, this complication is ignored in the present specification of the model. From (30), the price of non-farm commodities other than non-farm exports can be defined as:

(31) $$p_{NF-NFX,t} = \frac{\lambda_1}{\lambda_1 + \lambda_2} \cdot p_{NT,t} + \frac{\lambda_2}{\lambda_1 + \lambda_2} \cdot p_{M,t}$$

As noted earlier, it is assumed that non-farm exports are exogenously given. An assumption consistent with that would be that no local expenditure is directed onto non-farm exportables. A weaker assumption, which would also be consistent, would be that no local expenditure is directed onto non-farm exportables <u>at the margin</u>. Adopting the former assumption:

(32) $p_{j,t} = p_{NF-NFX,t}$

(33) $p_{i,t} = p_{NF-NFX,t}$

(34) $p_{c,t} = \lambda_4 \cdot p_{NT} + \lambda_5 \cdot p_M + \lambda_6 p_F$

where $\lambda_4 + \lambda_5 + \lambda_6 = 1$, and $\lambda_5 > \lambda_2$

Again, as p_c is to be used as an implicit deflator, λ_4, λ_5 and λ_6 should be flexible - but, as before, this complication is ignored in the current specification. The condition that $\lambda_5 > \lambda_2$

reflects the fact that the importance of importables in consumption should, in general, exceed their importance in production.

Consistent with both the Keynesian and the Monetarist approaches to the Phillips Curve, nominal wages are assumed to move partly in response to expected price movements (which may or may not be formalised into a process of wage indexation) and partly in response to the level of unemployment.

$$(35)\ w_t = w^o \cdot p^E_{c,t} + w^1(w_{t-1})\ (L_t - L^N_{t=0}\ (1+q)^t)$$

The term w_{t-1} appears on the RHS of (35) in order to avoid scaling problems which would otherwise emerge as w_t moves over time. The 'natural' level of employment in the base period or initial stationary state, $L^N_{t=0}$, is assumed to grow over time at a rate q to reflect the ongoing growth of the workforce. Note that, if the actual level of employment equals its 'natural' rate, the second term on the RHS of (35) would disappear, and nominal wages would be influenced only by expected price movements - the extent of that influence depending on the value of the coefficient w^o.

Total employment is the sum of the employment levels in the farm and non-farm sectors:

$$(36)\ L_t = L_{F,t} + L_{NF,t}$$

As noted previously, because non-farm prices are assumed to be imperfectly flexible in the short run, the level of aggregate demand for non-farm output, rather than the level of the real wage, will,

in general, be the effective short run constraint on non-farm output. It is consistent, therefore, to specify non-farm employment essentially as a function of non-farm output, rather than the more classical specification which would focus on the level of the real wage relative to the marginal productivity of labour.

$$(37)\ L_{NF,t} = L_{NF,t=0} + L^{1}_{NF}\ (Y_{NF,t} - (Y_{NF,t=0})\ (1+g)^{t})$$

This specification simply says that non-farm employment is equal to its level in the base period or initial stationary state, adjusted for any change in the level of non-farm output over and above that which could be accounted for by the change in average productivity. Note that, while, in general, there is no necessary relationship between the rate of growth of average labour productivity and g, it is assumed, for simplicity, that the two growth rates are equal.

It is assumed that international capital flows are responsive to interest rate differentials, but not sufficiently so to ensure nominal interest rate parity at all times. The nominal exchange rate is assumed to be fixed, and expected exchange rate movements are assumed to be zero.

$$(38)\ k_t = k^{o} + k^{1}\ (r^{w}_{t} - r_t) \quad \text{where } k^{1} < 0$$

Given k, the state of the balance of payments can be readily represented as

$$(39)\ BP_t = p_{F,t} \cdot X_{F,t} + p_{NFX,t} \cdot X_{NF,t} - p_{M,t} \cdot M_t + k_t$$

It is assumed that, at the margin, the only source of change in the high powered money stock is the balance of payments:

(40) $m_t^s = m_{t-1}^s + \lambda_7 . BP_t$, where λ_7 can be interpreted as the money supply multiplier.

The demand for nominal money balances is assumed to take a Cobb-Douglas form:

(41) $m_t^d = m^{d^1} . \left(\frac{y_{NF,t} + y_{F,t}}{P_c}\right)^{\lambda_8} . (p_{NF})^{\lambda_9} . \exp(r . \lambda_{10})$

The money market is closed with the simple equilibrium relationship:

(42) $m_t^d = m_t^s$

Finally, a simple extrapolative mechanism is assumed for the formation of the expected movement in consumer prices:

(43) $\dot{p}_{c,t}^E = a_1 \dot{p}_{c,t-1} + a_2 \dot{p}_{c,t-2} + a_3 \dot{p}_{c,t-3}$

The non-farm sector of the model therefore contains 25 equations. The variables which are assumed to be endogenous to the non-farm sector are:

1: Y 2: Y_{NF} 3: y_{NF} 4: p_{NF} 5: p_{NT} 6: p_{NF-NFX} 7: p_c

8: p_i 9: p_j 10: C 11: I 12: X 13: M 14: C_{NF}

15: I_{NF} 16: w 17: Y^*_{NF} 18: BP 19: k 20: r 21: L

22: L_{NF} 23: m^d 24: m^s 25: $p_c^{\cdot E}$

The variables which are exogenous to the non-farm sector, but endogenous to the farm sector are:

1: Y_F 2: y_F 3: y_F^{NF} 4: X_F 5: C_F 6: I_F 7: L_F

The variables which are incorporated into the non-farm sector of the model and which are exogenous to the model as a whole are:

1: G 2: X_{NF} 3: p_F 4: p_{NFX} 5: p_m 6: r^w 7: $L^N_{t=o}$ 8: $L_{NF,t=0}$

9: $Y_{NF,t=0}$ 10: $Y^*_{NF,t=0}$ 11: g 12: q 13: i

Appendix B

In Table X(1), the 'best best' values for all of the parameters in the model are listed, along with the assumed standard deviations of these parameter values, and various outlying values. Some explanatory notes on the choice of these parameter values are set out below. As an introductory point, it should be recalled that, in obtaining the initial stationary state solutions for the model, some endogenous variables were interchanged with some exogenous variables and parameters. This was done in order to ensure that a number of the main endogenous variables took common and convenient values in the initial stationary states obtained for the various parameter combinations. For example, in the initial stationary state solution for each parameter combination, Y_{NF} took the value of 1000 (see Section V(2)). For present purposes, the important point is that the assignment of numerical values to the parameters was done in the knowledge of the numerical values which many of the important variables would take in the initial stationary state, and hence the approximate orders of magnitude of those variables during the dynamic simulations. In this way, much of the process of assigning numerical values to the parameters collapsed to a process of finding values with a sensible order of magnitude relative to the value of the variables with which they were associated.

α, β, γ - the elasticities in the farm production function. The values of these parameters were determined endogenously in the initial stationary states, as noted above, and took common values across each of the parameter sets.

A - the constant term in the farm production function. A 'best-bet' value of 0.8 was determined by trial and error, given known values for K_F, L_F, J_F and O_F. No standard deviation was specified for this parameter. Rather, it was varied systematically in order to simulate the effects of the drought.

Θ_o - the partial adjustment coefficient in the farm investment equation. Given the considerable uncertainty which surrounds the choice of this parameter, it was considered that the most neutral assumption was a value of 0.5, with a relatively wide standard deviation of 0.2, which produced a 95 per cent confidence interval of around 0.1-0.9. The small outlying value of 0.1 was considered interesting because, in reality, much of the effect of a drought on the marginal productivity of farm capital might be discounted by farmers in making longer term investment decisions.

Θ_1 - the marginal propensity to invest out of farm residual funds. The implied 95 per cent confidence interval of around 0.2-0.6 would seem to satisfactorily capture most of the range of values for this parameter suggested by the empirical literature reviewed at some length in Chapter VIII. The outlying value of zero is consistent with the approach taken in, for example, the N.I.F. and R.B.A. models (see Chapter VIII). The outlying value of 1 is, in turn, consistent with the argument, put forward in Chapter VIII, that existing empirical work may have understated the value of this parameter, and that the theoretical model developed in that chapter suggested that a value of unity or greater is not implausible.

$\lambda_1, \lambda_2, \lambda_3$ - the weights in the non-farm production deflater (which should, in theory, be variable). A weight of 0.6 for non-traded (tertiary) industries seemed reasonable, along with 0.3 for import competing (manufacturing) industries, and 0.1 for non-farm exportables (minerals). Of course, the randomly determined values for these parameters would need to be consistent with the constraint that

$$\sum_{i=1}^{3} \lambda_i = 1$$

C_F^o - the constant term in the farm consumption function. The stationary state level of real income accruing to farm households is 40. On that basis, a best-bet value for C_F^o of 14 seems reasonable, with a 95 per cent confidence interval of around 10-18.

C_F^1 - the marginal propensity to consume by farm households. A 95 per cent confidence interval of around 0.1-0.3 seemed to capture most of the values suggested by the empirical and theoretical literature reviewed in Chapter VIII, (noting that, in this case, the consumption function utilises before tax income). The outliers of 0 and 0.4 capture the more extreme positions adopted in some of the other macro-models in Australia (as reviewed in Chapter VIII). For example, the outlier of 0 captures the N.I.F. and Nevile position, while the outlier of 0.4 (ie. equal to its non-farm counterpart) captures the R.B.A. position.

C_F^2 - the interest rate coefficient in the farm consumption function. With the level of the real interest rate at .05, the best-bet value of -40 implies that 2 units are subtracted from the level of farm consumption in the initial stationary state, relative

to the level implied by the constant term and the marginal propensity to consume alone. The stationary state level of farm consumption of 20 implies an average propensity to consume by farm households of 0.5, and a real interest elasticity of farm consumption of around -.1.

η_o - the constant term in the farm tax equation. For an income tax system in isolation, this parameter would be negative, in order to capture the presence of an initial tax threshold. In the present case, however, it was given a positive value to reflect the presence of substantial land taxes which would be likely, on average, to more than offset the initial tax threshold.

η_1 - the farm marginal rate of tax. In an Australian context, with farm tax averaging provisions, coupled with an opting in and out provision (at least up until recently), it seems likely that the effective marginal tax rate would be a little below the standard rate faced by the non-farm sector (see, for example, Minnis (1982)). On this basis, a 95 per cent confidence interval around .15-.35 seems plausible. With y_F^F in the initial stationary state taking a value of 4000, the best-bet values for η_o and η_1 would imply a combined income and land tax payment of 1500.

x_o - the constant term in the equation explaining local consumption of farm commodities. The choice of value for this parameter needs to be considered in conjunction with the value for x_1.

x_1 - the marginal propensity to consume farm commodities out of aggregate private consumption expenditure, C. While C was not one of the variables whose value was set exogenously in the initial stationary state, a typical value was around 500. On that basis, the best-bet values for x_o and x_1 would imply a level of local consumption expenditure directed onto farm commodities of around 30 (valued at the farm gate), absorbing about 30 per cent of the volume of farm production.

C_{NF}^{o} - the constant term in the consumption function for the non-farm sector. With y_{NF} equal to 100,000 in the initial stationary state, y_F^{NF} equal to 3000, p_c equal to 100, and the marginal propensity to consume around 0.4, the best-bet value of 100 for the constant term is consistent with an aggregate level of C around 500 or about 50 per cent of Y_{NF}.

c_{NF}^{1} - the marginal propensity to consume out of y_F^{NF}. The best-bet value and standard deviation are equal to the corresponding values for the marginal propensity to consume out of y_{NF}. The outlying value of 0.2 is equal to the farm marginal propensity to consume. This was considered to be of interest because a substantial proportion of the wages, salaries and supplements component of y_F^{NF} would, in fact, accrue to households which might more closely resemble farm households than non-farm households eg wages paid to casual farm employees who are, themselves, also farm operators in their own right.

C_{NF}^{2} - the marginal propensity to consume out of y_{NF}. A best-bet value of 0.4, with a 95 per cent confidence interval of around 0.2-0.6 would seem to capture most reasonable values

suggested by the empirical literature (noting that, while non-farm tax payments have not been explicitly specified, it is sensible to attempt to take the effect of tax payments on the marginal propensity to consume implicitly into account).

C_{NF}^{3} - the coefficient on the real interest rate in the non-farm consumption function. The implied real interest elasticity of non-farm consumption expenditure, in the initial stationary states, is similar to that incorporated into the farm consumption function.

I_{NF}^{o} - the constant term in the non-farm investment function. With Y_{NF} equal to 1000 in the initial stationary state, a value of 200 for this parameter seems reasonable.

I_{NF}^{1} - the accelerator coefficient in the non-farm investment function. Given the uncertainty evident in the empirical literature as to the appropriate value of this paramater (and, indeed, the uncertainty in the theoretical literature as to its theoretical basis), it was decided to specify a relatively wide 95 per cent confidence interval of around 0.1-0.9, as well as an outlying value of zero.

I_{NF}^{2} - the coefficient on the real interest rate in the non-farm investment function. The empirical literature is suggestive of a rather small real interest elasticity of investment. The best-bet value for I_{NF}^{2} implies an elasticity of around -.05 in the initial stationary state.

M^o - the constant term in the import equation. With Y equal to 1070 in the initial stationary state, an import volume around 150-200 would seem sensible. With the marginal propensity to import out of consumption expenditure of .15, and out of investment expenditure of .20, then, given C around 500 and I around 200, a value of M^o around 50 would be consistent with the desired outcome noted above.

M^1 - the marginal propensity to import out of consumption expenditure, as noted above. For simplicity, it is assumed in the present model that the marginal propensity to spend on non-farm exportables is zero (ie. that the volume of non-farm exports is given). To the extent that, in reality, such an assumption is not valid, the multiplier effects implied by the model would tend to be overstated (because any change in expenditure on non-farm exportables would influence X_{NF} in the national accounting identity, whereas in the present specification, that component of the identity is fixed). It is clear that the effect on the national income multiplier of some expenditure being directed onto non-farm exportables can be approximated by utilising an inflated value for M^1. Therefore, an outlying value of 0.25 for M^1 was included - which might be interpreted as the best-bet value for M^1 coupled with a marginal propensity to consume non-farm exportables of 0.1.

M^2 - the marginal propensity to import out of investment expenditure - the best-bet value was set slightly higher than for M^1 to reflect the casual observation that much of the capital equipment used in Australia is imported.

p_{NT}^{1} - the coefficient on the 'gap' between the actual level and the 'optimal' level of non-farm output, in the equation explaining the price of non-traded goods. With Y_{NF} around 1000, a 'gap' equal to 1 per cent of 'optimal' non-farm output would be about 10 units. With the best-bet value of p_{NT}^{1} equal to .001, the implication is that a 1 per cent gap would add or subtract about 1 per cent to non-traded goods prices, over and above the usual mark-up on wage costs, - with a 95 per cent confidence interval of around 0-2 per cent. The outlying value of $1x10^{-6}$ is even more consistent with the 'Popular Keynesian' approach - see Corden (1978) - and is also consistent with the approach adopted in the simple empirical version of the model developed in Chapter IX, while the outlying value of .01 provides a more 'Classical' flavour.

Y_{NF}^{*1} - the coefficient on the real wage 'gap' in the equation explaining optimal non-farm output. With prices in the initial stationary state equal to 100, nominal wages .01 and optimal non-farm output 1000, the real wage elasticity of optimal non-farm output, implied by the best-bet value for Y_{NF}^{*1}, is -.05., with a 95 per cent confidence interval of around 0 to -0.1.

λ_4, λ_5, λ_6 - the weights on non-traded, importable and farm commodities in the consumption deflator (these weights, should in principle, be flexible). The weights are felt to be broadly plausible. The weight given to λ_6 is consistent with the proportion of consumption expenditure directed onto farm commodities, as discussed above. Further, λ_5 exceeds λ_2, which seems sensible ie. the importance of importables in consumption exceeds their importance in production. Of course, the constraint

that $\sum_{i=4}^{6} \lambda_i = 1$ was maintained across the various random parameter combinations, as was the constraint that $\lambda_5 > \lambda_2$.

λ_7 - the money supplier multiplier. The 95 per cent confidence interval of around 1-3 would seem to capture most reasonable, short to medium term values for this parameter.

λ_8 - the effective real income elasticity of the demand for money balances. The best-bet value of unity receives some (albeit not universal) support in the empirical literature. It was decided not to specify a confidence interval around this parameter (or the other parameters in the money demand function) because money demand proved to be sensitive to small changes in these parameters, making comparisons across parameter combinations very difficult.

w^1 - the coefficient on the 'gap' between the actual and the 'natural' level of employment in the equation explaining nominal wages. Given that L^N in the initial stationary states is 6.25×10^6 and w is .01, the best-bet value for w^1 would imply that a 'gap' of 1 per cent would add or subtract about 1 per cent to nominal wages, over and above that implied by expected prices, with a 95 per cent confidence interval of around 0-2 per cent. As for P^1_{NT}, the outlier of $.17 \times 10^{-11}$ is designed to capture a strong 'Popular Keynesian' tendency towards real wage rigidity, and the outlier of $.17 \times 10^{-6}$ caters for a greater degree of wage flexibility.

L^1_{NF} - the coefficient associated with the change in non-farm output in the equation explaining non-farm employment. Given the

observed tendency towards labour hoarding and procyclical movements in average labour productivity, it seems reasonable to suppose that variations in non-farm output should have a less than proportionate effect on non-farm employment. The best-bet value for L_{NF}^{1} implies that, with other factors unchanged, a 1 per cent change in non-farm output would be associated with a 0.5 per cent change in non-farm employment in the same direction, with a 95 per cent confidence interval of around 0.1 per cent to 0.9 per cent.

a_1, a_2, a_3 - the weights given to the level of prices in previous years in the formation of extrapolative price expectations. The values here are arbitrary, but not implausible.

k^o - the constant term in the equation explaining net capital inflow. The best-bet value of 5000 implies that, in the absence of any nominal interest rate differential, the economy would be a net importer of foreign capital, equal in magnitude to about 5 per cent of G.D.P., or about 25 per cent of aggregate investment expenditure.

k^1 - the coefficient on the interest rate differential in the equation explaining net capital inflow. The best-bet value for k^1 implies that a 1 per cent interest rate differential would add or subtract 2000 to net capital inflow per period, or about 2 per cent of G.D.P.

λ_9 - the price elasticity of demand for money balances. The value of unity for this parameter, used in all parameter combinations, receives strong empirical and theoretical support.

λ_{10} - the nominal interest elasticity of demand for money balances. The empirical literature clearly suggests a relatively small value for this parameter, so that the value of -0.1, used in all parameter combinations, was felt to be sensible.

m^{d1} - the constant term in the money demand function. The chosen value of 0.5 produced a demand for money balances around 50 per cent of the nominal value of G.D.P., which seemed sensible.

w^o - the coefficient on expected prices in the wage equation. With expected prices in the initial stationary state equal to 100, and with the 'gap' term in the equation set to zero, the desired value of .01 for nominal wages in the stationary states could be achieved by setting w^o to .0001. The specification clearly implies that expected price movements are approximately (but not necessarily exactly) reflected in wage movements ie. the Phelps-Friedman hypothesis may or may not hold.

p^o_{NT} - the coefficient on the wage term in the price equation for non-traded commodities. With nominal wages in the initial stationary state equal to .01, the desired value of 100 for p_{NT} in the stationary state could be achieved by setting p^o_{NT} equal to 10,000.

PART E

Conclusion

CHAPTER XI

A REVIEW OF THE THESIS, SOME MAJOR RESULTS AND AVENUES FOR FURTHER RESEARCH

Introduction

In this final chapter, the discussion will focus on three main areas. In Section II, the objective of the thesis is re-iterated and used as the basis for a review of the central elements of the analysis. In Section III, some of the more important theoretical and empirical results and implications to emerge from the thesis are listed and discussed briefly. Finally, the avenues for future research which have been opened up or suggested by the analysis in the thesis are reviewed in Section IV.

Section II A Review of the Thesis

The objective of the thesis was to assess the short to medium term impact of production and price shocks in the farm sector on some important macroeconomic variables in Australia - such as non-farm and total G.D.P., employment, the price level, nominal and real wages, the interest rate and the state of the balance of payments. As part of that analysis, it was also desired to assess the extent to which the macroeconomic implications of shocks in the farm sector are influenced by the marketing and institutional environment in which the relevant farm industries operate.

It was noted that no fully suitable model framework has been developed for undertaking such an analysis in an Australian context, either at a theoretical or at an empirical level. This is reflected in a paucity of relevant studies in the Australian literature. Therefore, it was suggested that the objective of the thesis could also be interpreted as that of making important progress towards the development of a suitable model framework in which farm/macro linkages are emphasised, and of undertaking some of the associated analysis.

To that end, in the thesis the actual marketing and institutional environment in which the major Australian farm industries have operated over recent decades was reviewed. On the basis of that review, five paradigms were identified as having some degree of commodity relevance. These paradigms differed either in terms of the marketing and institutional environment in which the relevant farm industries were assumed to operate, or in the nature of the shock which was assumed to affect the farm sector ie. either a production shock, a price shock or a combination of the two.

A relatively large theoretical macroeconomic model was then developed in which the linkages between the farm sector and the

macroeconomy were emphasised. Three sectors were distinguished in the model - the farm sector, a non-farm traded goods sector and a non-traded goods sector. The specification of the farm sector of the model was largely Classical in philosophy, with relatively minor modifications made in order to capture the essential features of the five paradigms in turn, or to facilitate the analysis of those paradigms. A Classical specification was also assumed throughout for the non-farm traded goods sector while a 'Popular Keynesian' philosophy was employed in the specification of the non-traded goods sector.

Some of the macroeconomic implications of the five paradigms were analysed within this theoretical structure. The model proved to be too large and complex to be tractable using formal algebraic techniques. Therefore, in the first instance, a slightly less rigorous geometric characterisation of the model was developed, and the analysis was able to proceed some distance within that geometric framework. A number of insights were gained as to the properties and characteristics of the model and a range of tentative theoretical results and implications were put forward.

Having fully exploited the geometric mode of analysis, it was considered that the next logical step was to proceed to a theoretical simulation mode of analysis. In particular, a theoretical simulation variant of the model was developed and used to undertake some further analysis of two of the five paradigms. This theoretical simulation analysis was more formal and rigorous than the geometric analysis and permitted a wider range of variables to be explicitly considered - while also serving to clarify and reaffirm some of the results which had been suggested by the geometric analysis.

Because of the time and resources that were required to develop this relatively large theoretical simulation model and to undertake the associated simulations, it was not possible, in the context of the thesis, to analyse each of the five paradigms using that approach. Further, space limitations permitted the detailed reporting of the results obtained from only one of the two simulation exercises attempted. The other is presented in O'Mara et al (1985) and was summarised very briefly in Chapter X. Nevertheless, given that a theoretical simulation variant of the model has been developed in the thesis and that the simulation approach has been successfully applied to two of the paradigms, the approach can be readily extended to the three remaining paradigms at a later date.

There are also several important respects in which these existing and future theoretical simulation analyses will serve to facilitate the eventual development of an empirical version of the model. In particular, they permit an assessment - across a wide range of parameter values - of some of the more general properties and characteristics of the model before attention becomes focussed on a particular set of estimated parameters. They also permit an abstraction from various institutional and other detail which may not be of central importance, but which may need to be catered for once an attempt is made to obtain unbiased econometric estimates of the parameters.

Further, given the existence of the theoretical simulation version of the model, it is likely that the emergence of the empirical version will not be distinct or discrete. Rather, some reliance will probably be placed on the numerical results obtained from the model even before all of the behavioural equations are estimated. In other words, as some of the more sensitive equations and parameters are estimated and hence as the empirical version of

the model becomes better able to replicate some actual historical episodes, then it is likely that gradually increasing reliance will be placed on the specific numerical results obtained.

It was recognised that some further post-thesis research would be required in order to complete the theoretical simulation analyses and to proceed to the development of an empirical version of the model and the associated analysis. Therefore, as an interim measure, it was considered desirable to seek some tentative and preliminary quantitative results for the Australian economy. In particular, a very simple quantitative version of the model was developed and used to assess the contribution made by the farm sector to the annual variations in non-farm and total G.D.P. over the period 1953-54 to 1982-83. Amongst other things, the results of this analysis suggested that the farm sector may not have declined in relative importance as a source of change in non-farm output over this period, and may even have increased in importance. This result was argued to provide an additional motivation for persisting with the line of research commenced in the thesis.

In general, then, the stated objective of the thesis has been largely accomplished. A macroeconomic model framework has been developed in which the linkages between the farm sector and the macroeconomy are emphasised. That framework has been used to undertake some theoretical and empirical analysis of the implications of production and price shocks in the farm sector on the macroeconomy. Within that analysis, some emphasis has been given to the implications of the alternative marketing and institutional arrangements under which the various Australian farm industries operate. In addition, the analysis contained in the thesis has served to identify numerous avenues for useful future research and, in the majority of such cases, has also provided a foundation or framework capable of greatly facilitating such research.

Section III Some General Results and Conclusions

In each chapter in the thesis, space was set aside to draw together and summarise the results and implications which had emerged from the analysis in that chapter. Little would be gained by repeating all of that material here. Rather, the focus of attention will be on some of the more general results and conclusions which would seem to emerge from a consideration of the thesis as a whole.

Perhaps the first general conclusion to emerge is that the nature of the macroeconomic implications of a shock in the farm sector can depend substantially on the marketing and institutional environment in which the relevant farm industries operate. This conclusion has important implications for quantitative analysis. In particular, it implies that any concerted attempt to assess the actual macroeconomic implications of shocks in the farm sector using historical data, or to make macroeconomic forecasts or projections in the presence of a significant farm sector shock, would need to make due allowance for the alternative marketing and institutional environment in which the various farm industries operate. The analysis in the thesis may provide some useful guidance in this respect - both in terms of the nature of the macroeconomic implications which might be expected under the various marketing and institutional environments, and in the broad commodity relevance of those environments.

Another important general conclusion to emerge from the theoretical analysis is that there is a high degree of ambiguity as to the direction of the impact of shocks in the farm sector on a number of important macroeconomic variables - such as non-farm and total G.D.P., the state of the balance of payments, the interest

rate and the real wage. This implies, of course, that, in a number of cases, results based on conventional wisdom or intuition are not necessarily valid, at least at a theoretical level, and hence should be used with due caution. It is useful to briefly review some of these areas in which the results are ambiguous or counterintuitive:

(1) an exogenous decline in the volume of farm production, which induces an increase in the price of farm commodities on the domestic market, could have either a deleterious or beneficial impact on non-farm economic activity. A similar conclusion also holds for an exogenous increase in the volume of farm production which induces a decline in the domestic price of farm commodities. In other words, the intuitive result that, for example, an exogenous (weather induced) decline in the volume of farm production would have a deleterious effect on non-farm economic activity may not hold under all circumstances;

(2) an exogenous increase in the price of farm commodities on overseas markets could have either a beneficial or a deleterious effect on non-farm economic activity. Here again, the intuitive or more conventional result would be that an exogenous increase in farm prices on overseas markets would have a beneficial impact on non-farm economic activity, and conversely;

(3) an exogenous increase in the price of farm commodities on overseas markets may be associated with either temporary balance of payments surpluses or deficits, as may an exogenous decline in the price on overseas markets. The intuitive result here, of course, would have been that an exogenous increase in the price of farm commodities on

overseas markets would lead to an improvement in the current account and hence in the overall state of the balance of payments, and conversely;[1]

(4) an exogenous decline in the volume of farm production, which is absorbed on the domestic market via a change in farm prices (thus leaving the volume and value of farm exports unchanged), may have either a more severe or less severe impact on the overall balance of payments than would have occurred if the volume and value of farm exports had fallen;[1]

(5) the ambiguity noted above with respect to non-farm and total G.D.P. and the state of the balance of payments owes much to the expenditure switching effects associated with changes in the price of farm commodities. The direction of change in the interest rate, however, tended to be uncertain even in those cases where such expenditure switching effects were absent;

(6) given the 'Popular Keynesian' philosophy underlying the specification of the non-traded goods sector in the model, there is no necessary relationship between variations in non-farm production and employment in response to shocks in the farm sector on the one hand, and the real wage as a cost to non-farm employers on the other. In other words, the real wage may remain unchanged or move either countercyclically or procyclically.

---

1. While a fixed nominal exchange rate was assumed throughout, it seems probable that this ambiguity will also be reflected in the direction of change of the nominal exchange rate when a flexible exchange rate is eventually incorporated into the model.

It should be noted that this significant ambiguity in the results obtained with respect to non-farm and total G.D.P., the state of the balance of payments, the interest rate and the real wage emerged not only from the purely theoretical (geometric) analysis, but also from the theoretical simulation analysis. This indicates that the ambiguity is not merely an academic curiosity, present only under extreme circumstances, but can also be demonstrated using plausible combinations of parameter values.

Given the importance placed on these macroeconomic variables in policy and forecasting circles, it is, perhaps, unfortunate that the results of the theoretical and theoretical simulation analyses were so equivocal. However, it may be possible to reduce the range of possibilities, from a practical or applied viewpoint, once an empirical version of the model is developed. In the interim, there is a clear implication that qualitative macroeconomic forecasts, projections or policy responses which are framed in the presence of a significant shock in the farm sector should make only sparing and cautious use of intuition and conventional wisdom with respect to farm/macro linkages. Appeal to the analysis contained in the thesis would do much to allow the range of theoretical possibilities to be explicitly recognised and taken into account.

Because it is potentially very important and perhaps somewhat counterintuitive, one of the empirical results obtained in the thesis is also worth reiterating here. It was tentatively established that the farm sector may not have declined in relative importance as a <u>source of variability</u> in non-farm output (and, by implication, in non-farm employment) over the period from 1953-54 to 1982-83 and, indeed, may have increased in relative importance. This is despite the fact that a sharp decline occurred over that period in the

relative contribution made by the farm sector to variables such as G.D.P. and employment. It was suggested that this result is due, in part, to the increased volatility which has occurred in farm prices, particularly since the early 1970s, which has, in turn, produced larger and more volatile expenditure switching effects.

It should be emphasised that the empirical analysis in the thesis was undertaken using a simplified quantitative version of the model which captured some, but not all, of the farm/macro linkages which are incorporated into the full model structure used in the various theoretical analyses. In that sense, the empirical results should be regarded as being tentative and preliminary. Nevertheless, the particular empirical result noted above serves to highlight the potential importance of the line of research commenced in the thesis.

Section IV Some Avenues for Future Research

IV(1) Some Introductory Comments

The avenues for future research which have been opened up or suggested by the analysis in the thesis can be conveniently discussed in two categories:

(1) a continuation of the main avenue of research commenced in the thesis; and

(2) a development and exploration of a range of other avenues which were recognised in the thesis as being potentially important but, primarily because of time and space limitations, were not developed further in the thesis.

IV(2) A Continuation of the Main Avenue of Research

The continuation of the main avenue of research which has been initiated in the thesis would involve the following:

(a) the application of the theoretical simulation technique to the analysis of the third, fourth and fifth paradigms. In each case, this should require only relatively minor modifications to be made to the theoretical simulation version of the model which has been developed in the thesis and used to analyse the first and second paradigms. This should serve to extend and refine the analyses of the third, fourth and fifth paradigms that were undertaken in the thesis using the geometric characterisation of the model;

(b) these theoretical simulation analyses will form an excellent foundation on which to develop an empirical version of the full model structure. This will require the econometric estimation of at least some of the more sensitive equations and parameters in the model. It will also be necessary to merge the essential features of Models I to V into a single

structure. As the differences between these models are relatively minor, and are limited primarily to the farm sector, this should be readily accomplished;

(c) validation of the empirical model will require an assessment of its ability to satisfactorily track historical data or certain significant historical episodes. It is quite possible that a reasonable capability in this regard will be achieved before all of the behavioural equations in the model are estimated. If so, then the emergence of the empirical version of the model would not be clear or discrete. Rather, the reliance placed on the actual numerical results obtained from the model would increase gradually, as the validation exercises become more convincing;

(d) once a satisfactory empirical version of the model is available, there are, of course, a range of interesting and important tasks to which it can be directed. For example:

- an examination of the hypothesis, suggested by the empirical analysis in the thesis, that, over the period since the early 1950s, the farm sector has not declined in relative importance as a source of change in non-farm output, and may even have increased in relative importance. If that hypothesis was accepted, then it would be of major importance for macroeconomic model builders, forecasters and policy makers. If, on the other hand, the hypothesis was rejected, it should prove instructive to ascertain which of the farm/macro linkages captured in the full model structure, but not

in the simple quantitative version of the model, contributed to that rejection;

- framing macroeconomic forecasts and projections, particularly in the presence of a significant shock in the farm sector. At the very least, such forecasts and projections should represent a valuable complement to those obtained from other macroeconomic and general equilibrium models in Australia.

IV(3) A Development and Exploration of Other Avenues

(1) In Chapter II, in addition to the five paradigms which were identified and carried forward into the subsequent analysis, there were several others which were noted but not developed further in the thesis. For example:

(a) the possibility that an exogenous change in the volume of wool production could, in some periods, result in a more than proportionate change in the wool price, so that the value of production and exports, and real farm incomes, would move in the opposite direction to the change in the volume of wool production and exports;

(b) the possibility that the value of farm exports may change, with no impact on the volume and value of production or domestic sales, or the level of real farm income. Such an outcome could be of relevance to the wool industry in some periods - for example, if an exogenous change in overseas demand for wool was met entirely out of A.W.C. stocks. It could also be relevant for the beef, mutton and lamb industries - for example, if a change in the local equivalent of the overseas price of those commodities was to occur in the presence of effective export quotas held by local residents.

Both the geometric characterisation and the theoretical simulation versions of the model could be readily modified to permit an examination of some of the macroeconomic consequences of these two remaining paradigms.

(2) In the theoretical and theoretical simulation analysis undertaken in the thesis, it was assumed that:

(a) the price of non-traded goods and nominal wages were imperfectly flexible; and

(b) the nominal exchange rate was fixed.

It should prove instructive to relax these assumptions, first separately and then in tandem, and repeat the analysis of the various paradigms.

Some attempt was made, of course, to introduce a degree of flexibility of non-traded goods prices and nominal wages into the geometric analysis in Chapter III, and various degrees of price and nominal wage flexibility were considered in the theoretical simulation analyses in Chapter X and in O'Mara et al (1985). However, the underlying 'Popular Keynesian' philosophy was broadly maintained in each case. The present suggestion is to move to the opposite extreme and adopt a 'Classical' philosophy, with non-traded goods prices and nominal wages made perfectly flexible.

The inherent complexity which would be likely once such assumptions are incorporated indicates that little would be gained by attempting anything more than a cursory examination within the geometric characterisation of the model. Rather, the issue should be taken up largely within the theoretical simulation version of the model.

The assumption of a fixed nominal exchange rate could be relaxed by introducing either a managed float or a freely floating exchange rate regime into the model. The former assumption would be of some relevance to the Australian experience over the period from the end of 1976 to the end of 1983, with the latter becoming relevant since the end of 1983.

The extent of the additional complexity that would be introduced into the analysis in the presence of a degree of exchange rate flexibility would depend, in large measure, on the assumptions made with respect to the formation of exchange rate expectations. In the case of static or extrapolative expectations, some useful analysis could probably be undertaken within the geometric structure in the first instance. However, as discussed in Chapter III, a variety of problems are likely to emerge in the presence of rationally formed exchange rate expectations. Amongst other things, that suggests that the analysis of the rational expectations case may best be undertaken exclusively within the theoretical simulation version of the model.

(3) Various procedures are available for further refining the application of the theoretical simulation technique to the analyses of the first and second paradigms, relative to that attempted in Chapter X and in O'Mara et al (1985):

(a) a more complete approach to sensitivity analysis could be adopted by treating <u>each</u> parameter as an outlier in turn, using two values drawn, in each case, from opposite extremes in the range of plausible values for that parameter;

(b) a linear approximation of the model could be developed (for example, by using the appropriate terms of a Taylor Series expansion). This would permit the use of the various relatively efficient procedures which are available for undertaking sensitivity analysis within a linear model. Amongst other things, sensitivity elasticities could be readily calculated for each endogenous variable with respect to each parameter;

(c) some experimentation could be undertaken with non-zero covariances between the parameters.

These procedures could, of course, also be used within the context of the theoretical simulation analyses of the third, fourth and fifth paradigms, as and when those analyses are undertaken.

(4) Given that the main avenue for further research, as set out above, is to be followed, leading to the eventual development of an empirical version of the full model structure, then there may be little to be gained by directing substantial resources to the further development and refinement of the simple, quantitative version of the model presented in Chapter IX. However, in the interim, it would seem sensible to regularly update the analysis undertaken with that simple model as more recent time series data becomes available.

Even after the empirical version of the full model is developed, there may still be a role for the simple quantitative model. For example, the simple model may be used to obtain timely 'order of magnitude' estimates of the impact of shocks in the farm sector on non-farm G.D.P., without the

need to update and simulate the full model structure. Of course, such a role for the simple model would be more likely if it was shown to be capable of producing results for non-farm G.D.P. which were tolerably similar to those which emerged from the full model.

References

Alaouze, C.M., Watson, A.S. and Sturgess, N.H. (1978), 'Oligopoly Pricing in the World Wheat Market', American Journal of Agricultural Economics, 60(2), 173-185

Albon, R. (1976), 'No Feeling for "Udders"? A Critical Note on the Report of the A.C.T. Milk Authority', Australian Journal of Agricultural Economics, 20(1), 44-51

Arndt, H.W. and Cameron, B. (1957), 'An Australian Consumption Function', Economic Record, 36(64), 108-115

Australian Financial System Inquiry (1982), 'Seasonal Fluctuations in Liquidity' in Commissioned Studies and Selected Papers: Part I Macroeconomic Policy: Internal Policy, A.G.P.S., Canberra 184-198

Australian Wool Corporation (A.W.C.), Annual Report, (various issues), Melbourne

Azariadis, C. (1981), 'A Reexamination of Natural Rate Theory', American Economic Review, 71(5), 946-960

Backhouse, R.E. (1980), 'Fix-Price Versus Flex-Price Models of Macroeconomic Equilibrium with Rationing', Oxford Economic Papers 32(2), 210-223

Bain, R.A. (1978), 'An Appraisal of a Buffer Fund Scheme for Beef: Comment'. Australian Journal of Agricultural Economics, 22(2), 135-137

——————— and Longmire, J. (1980), 'Prospects for the Beef Industry in the 1980's', Quarterly Review of the Rural Economy, 2(3), 278-283

Barrett, G. (1981),'Contraction in the New South Wales Dairy Industry: 1970-1980', Quarterly Review of the Rural Economy, 3(4), 345-350

Barro, R.J. and Grossman, H.I. (1971), 'A General Disequilibrium Model of Income and Employment', American Economic Review, 61(1), 82-93

——————————————— (1976), Money, Employment and Inflation, Cambridge University Press, Cambridge

Bates, W.R. (1976), 'National Economic Effects of Drought in Australia' in Chapman, T.G. (Editor), Drought, A.G.P.S., Canberra, 217-242

Beck, A.C. (1974), 'The Social Cost of Production Control in the Australian Egg Industry', Review of Marketing and Agricultural Economics, 42(4), 240-256

Beenstock, M. and Longbottom, J.A. (1981), 'The Term Structure of Interest Rates in a Small Open Economy', Journal of Money, Credit and Banking, 13(1), 44-59

Begg, D.K.H. (1982), 'Rational Expectations, Wage Rigidity and Involuntary Unemployment: A Particular Theory', Oxford Economic Papers, 34(1), 23-47

Bennett, C. (1982), 'The Changing Australian Pig Industry', Quarterly Review of the Rural Economy, 4(4), 313-320

Bhandari, J.S. (1981), 'Exchange Rate Overshooting Revisited', Manchester School of Economic and Social Studies, 49(2), 165-172

Bilson, J.F.O. (1978), 'The Monetary Approach to the Exchange Rate : Some Empirical Evidence', I.M.F. Staff Papers, 25(1) 48-75

——————————— (1979), 'Recent Developments in Monetary Models of Exchange Rate Determination', I.M.F. Staff Papers, 26(2), 201-223

Blinder, A.S. (1982), 'Inventories and Sticky Prices : More on the Microfoundations of Macroeconomics', American Economic Review, 72(3), 334-348

Brain, P. (1977), 'The Institute Multi-Purpose Model : An Outline', Australian Economic Review, 3rd Quarter, 47-64

Brecher, R.A. and Heady, C.J. (1979), 'Stagflation in an Open Economy', Oxford Economic Papers, 31(2), 165-176

Bureau of Agricultural Economics (1977), A Review of Credit in the Australian Rural Sector, A.G.P.S., Canberra, May

——————————— (1979), 'The Seasonal Financing of Rural Marketing Boards and Co-Operatives by the Rural Credits Department : A Submission to the Australian Financial System Inquiry', Canberra, November

——————————— (1980), Historical Trends in Australian Agricultural Production, Exports, Incomes and Prices : 1952-53 to 1978-79, A.G.P.S., Canberra

——————————— (1982), Papers on the Australian Beef Cattle Industry, Occasional Paper No. 63, A.G.P.S., Canberra

——————————— (1982), The Campbell Inquiry and the Rural Sector, Occasional Paper No. 62, A.G.P.S., Canberra

——————————— (1983), A Review of Egg Marketing Arrangements in Australia, Occasional Paper No. 82, A.G.P.S., Canberra

Burton, D. (1980), 'Expectations and a Small Open Economy with a Flexible Exchange Rate', Canadian Journal of Economics, 13(1), 1-15

Camilleri, A.P., Campbell, R.B. and Nguyen, D.T. (1980), 'A Theoretical Simulation Approach to a Dynamic Macro-Economic Model with Flexible Exchange Rates', Paper Presented to the Economic Society of Australia and New Zealand, Ninth Conference of Economists, University of Queensland, Brisbane, 25-29 August

Camilleri, A.P., Nguyen, D.T. and Campbell, R.B. (1981), 'Policy Changes and External Disturbances in a Small, Open Economy : Stability and Dynamic Responses', Paper Presented to the Economic Society of Australia and New Zealand, Tenth Conference of Economists, Australian National University, 24-28 August

Campbell, J.K. (Chairman), Coates, A.W., Halkerston, K.W., McCrossin, R.G., Mallyon, J.S. and Argy, F. (1981), Australian Financial System Inquiry : Final Report of the Committee of Inquiry, A.G.P.S., Canberra, Sept

Campbell, K.D. (1958), 'Some Reflections on Agricultural Investment', Australian Journal of Agricultural Economics, 2(2), 93-103

Campbell, R., Gardiner, B. and Haszler, H. (1980), 'On the Hidden Revenue Effects of Wool Price Stabilisation in Australia : Initial Results', Australian Journal of Agricultural Economics, 24(1), 1-15

Campbell, R., Crowley, P. and Demura, P. (1983), 'Impact of Drought on National Income and Employment', Quarterly Review of the Rural Economy 5(3), 254-257

Carlozzi, N. (1982), Economic Disturbances and Exchange Regime Choice, Working Paper 82-8, Federal Reserve Bank of Philadelphia, Sept.

Caves, D.W. and Feige, E.L. (1980), 'Efficient Foreign Exchange Markets and the Monetary Approach to Exchange Rate Determination', American Economic Review, 70(1), 120-134

Chapman, R. and Foley, K. (1973), 'A Note on Losses from Price Stabilisation', Australian Journal of Agricultural Economics, 17(2), 140-143

Clower, R.W. (1965), 'The Keynesian Counterrevolution : A Theoretical Appraisal', in Hahn, F. and Brechling, F. (Editors), The Theory of Interest Rates, Macmillan, London

Cooper, R.J. and McLaren, K.R. (1983), 'The Orani - Macro Interface : An Illustrative Exposition', Economic Record, 59(165), 166-179

Corden, W.M. (1978), 'Keynes and the Others : Wage and Price Rigidities in Macroeconomic Models', Oxford Economic Papers 30(2), 159-180

_____ (1978), 'Wages, Unemployment and Macro-Economic Policy : The Great Debate', Presidential Address to the Seventh Conference of Economists, Macquarie University, Sydney, Aug.

_____ (1979), 'Wages and Unemployment in Australia', Economic Record, 55(148), 1-19

Crowley, P.T., O'Mara, L.P. and Campbell, R. (1983), 'Import Quotas, Resource Development and Intersectoral Adjustment', Australian Economic Papers, 22(41), 384-410

Department of the Treasury (1981), The N.I.F. 10 Model of the Australian Economy, A.G.P.S., Canberra

Dickinson, D.G., Driscoll, M.J. and Ford, J.L. (1982), 'Rational Expectations, Random Parameters and the Non-Neutrality of Money', Economica, 49(195), 241-248

Dixit, A. (1978), 'The Balance of Trade in a Model of Temporary Equilibrium with Rationing', The Review of Economic Studies, 45(141), 393-404

Dixon, P.B., Ryland, G.J., Parmenter, B.R. and Sutton, J. (1977), Orani : A General Equilibrium Model of the Australian Economy, Volume 2, A.G.P.S., Canberra

Dixon, P.B., Parmenter, B.R., Powell, A.A. and Vincent, D.P. (1979), The Agricultural Sector of Orani 78 : Data and Application, Impact Project, Preliminary Working Paper, No. OP-25, Melbourne, June

Donald, J.R., Lowenstein, F. and Simon, M.S. (1963), The Demand for Textile Fibres in the United States, Technical Bulletin, No. 1301, United States Department of Agriculture, Washington, D.C.

Dornbusch, R. (1976), 'Expectations and Exchange Rate Dynamics', Journal of Political Economy, 84(6), 1161-76

Drazen, A. (1980), 'Recent Developments in Macroeconomic Disequilibrium Theory', Econometrica, 48(2), 283-306

Duesenberry, J.S., (1958), Business Cycles and Economic Growth, McGraw Hill, New York

Duloy, J.H. and Nevile, J.W. (1965), 'The Effects of a Reserve Price Scheme for Wool on the Balance of Payments and Gross National Product', Economic Record, 41(94), 254-261

Duloy, J.H. and Parish, R.M., (1964), An Appraisal of the Floor Price Scheme for Wool, New England Marketing Studies, No. 1, Faculty of Agricultural Economics, University of New England, Armidale, Dec.

Duloy, J.H. and Woodland, A.D. (1967), 'Drought and the Multiplier', Australian Journal of Agricultural Economics, 11(1), 82-86

Fane, G. (1981a), A Geometric Analysis of Open-Economy Exchange Rate Adjustment Under Static and Rational Expectations, Working Papers in Economics and Econometrics, No. 051, Australian National University, Canberra, Feb.

——————— (1981b), The Short-Run Macroeconomic Effects of Actual and Anticipated Monetary Expansion, Working Papers in Economics and Econometrics, No. 052, Australian National University, Canberra, July

——————— (1982), 'The Macro-Structure of the N.I.F.-10 Model: Discussion', Paper Prepared for the Treasury - C.E.P.R. Conference on the N.I.F. 10 Model, Australian National University, Canberra, 19 Oct.

Feldstein, M. and Horioka, C. (1980), 'Domestic Saving and International Capital Flows', Economic Journal, 90 (June), 314-329

Fellner, W. (1980), 'The Valid Core of Rationality Hypotheses in the Theory of Expectations', Journal of Money, Credit and Banking, 12(4), Pt 2, 763-787

Fisher, B.S. (1974), 'A Quarterly Model of Agricultural Investment in Australia', Australian Journal of Agricultural Economics, 18(1), 22-31

Fisher, M.R., Gruen, F.H., Sheehan, P.J. and Stammer, D.W. (1978), Real Wages and Unemployment, Paper No. 4, Centre for Applied Economic Research, University of New South Wales, March

Frankel, J.A. (1979), 'On the Mark : A Theory of Floating Exchange Rates Based on Real Interest Differentials', American Economic Review, 64(4), 610-622

Freebairn, J.W. (1977), 'Inflation and Stability of the Household Consumption - Savings Funtion', Economic Record, 53(142), 198-218

_____ (1978), Projections of Australia's World Trade Opportunities : Mid and Late 1980's, Impact Working Paper, No. 1-07, University of Melbourne, Dec.

_____ (1980), 'The Impact Project : A Review', Economic Record, 56(152), 17-35

_____ , Rausser, G.C. and de Gorter, H. (1981), 'Government Intervention and Food Price Inflation', Paper Presented at the American Economic Association Meetings, Washington, D.C. Dec.

Frenkel, J.A. (1981), 'Flexible Exchange Rates, Prices and the Role of "News" : Lessons from the 1970's', Journal of Political Economy, 89(4), 665-705

_____ and Johnson, H.G. (Editors) (1976), The Monetary Approach to the Balance of Payments, George Allen and Unwin Ltd, London.

Friedman, M. (1957), A Theory of the Consumption Function, Princeton University Press, Princeton, N.J.

Girao, J.A., Tomek, W.G. and Mount, T.O. (1974), 'The Effect of Income Instability on Farmers' Consumption and Investment', Review of Economics and Statistics, 56(2), 141-149

Glau, T.E. (1971), The Impact of Tax Policy on Agricultural Investment in Australia, Mimeographed Report No. 5, Department of Agricultural Economics, University of Sydney

Gordon, R.G. (1977), 'Interactions Between Domestic and International Theories of Inflation', in Aliber, R.Z. (Editor), The Political Economy of Monetary Reform, Macmillan, London, 126-154

——————————— (1981), 'Output Fluctuations and Gradual Price Adjustment', Journal of Economic Literature, 19(2), 493-530

Gray, M.R. (1982), 'The Macro-Structure of the N.I.F.-10S Model', Paper Prepared for the Treasury - C.E.P.R. Conference on the N.I.F.-10 Model, Australian National University, Canberra, 19 October

——————————— (1984), The Growth of Aggregate Demand in Australia : 1962-1982, Discussion Paper No. 99, Centre for Economic Policy Research, Australian National University, Canberra, June

——————————— and Gruen, F.H. (1981), Economic Stabilisation in Australia : Inflation and Unemployment, Discussion Paper No. 32, Centre for Economic Policy Research, Australian National University, Canberra, August

——————————— (1982), 'Inflation and Unemployment in Australia' in Mathews, R.L. (Editor), Public Policies in Two Federal Countries : Canada and Australia, Centre for Research on Federal Financial Relations, Australian National University, Canberra, 97-114

Gray, M.R. and Turnovsky, S.J. (1979), 'The Stability of Exchange Rate Dynamics Under Perfect Myopic Foresight', International Economic Review, 20(3), 643-660

Gregory, R.G. (1976), 'Some Implications of the Growth of the Mineral Sector', Australian Journal of Agricultural Economics, 20(2), 71-91

Griffith, G.R. (1977), 'A Note on the Pig Cycle in Australia', Australian Journal of Agricultural Economics, 21(2), 130-139

Grossman, H.I., Hanson, J.A. and Lucas, R.F. (1982), 'The Effects of Demand Disturbances Under Alternative Exchange-Rate Regimes', Oxford Economic Papers, 34(1), 78-97

Gruen, F.H. (1957), 'Capital Formation in Australian Agriculture', Australian Journal of Agricultural Economics, 1(1), 92-105

Hancock, K. (1982), 'Economic Stabilisation and Wage Policy in Australia', in Mathews, R.L. (Editor), Public Policies in Two Federal Countries : Canada and Australia, Centre for Research on Federal Financial Relations, Australian National University, Canberra, 115-118

Hargreaves Heap, S.P. (1980), 'Choosing the Wrong "Natural" Rate : Accelerating Inflation or Decelerating Employment and Growth?', Economic Journal, 90 (Sept), 611-620

Harris, S., Crawford, J.G., Gruen, F.H. and Honan, N. (1974), Rural Policy in Australia : Report to the Prime Minister by a Working Group, A.G.P.S., Canberra, May

Harrison, I. and Richardson, R. (1980), 'Table and Manufacturing Quality Beef Cattle Price Relationships in Australia', Review of Marketing and Agricultural Economics, 48(3), 153-168

Herr, W.McD. (1964), 'Capital Formation : Its Importance and Determinants', Australian Journal of Agricultural Economics, 8(2), 97-111

Hesser, L.F. (1960), 'Conceptual Models of Capital Rationing Among Farmers', Journal of Farm Economics, 42(2), 325-334

Hinchy, M. (1978), 'The Relationship Between Beef Prices in Export Markets and Australian Saleyard Prices', Quarterly Review of Agricultural Economics, 31(2, 3), 83-105

Horner, F.B. (1952), 'The Pre-War Demand for Wool', Economic Record, 28(54), 13-28

Houck, J.P. (1974), 'The Short-Run Impact of Beef Imports on U.S. Meat Prices', Australian Journal of Agricultural Economics, 18(1), 60-72

Hughes, B. (1981), 'Real Wages and Unemployment' in Committee for Economic Development of Australia (Editor), Growth 31, Inflation and Unemployment, April, 36-47

Hunt, B.F. and Valentine, T.J. (1978), 'The Interdependence of Monetary Policy and Capital Flows in Australia : A Comment', Economic Record, 54(146), 281-285

Hunter, R.D. (1981), 'The Commercial Egg Industry : Fewer Farms Supply Our Eggs', Quarterly Review of the Rural Economy, 3(4), 351-358

Industries Assistance Commission (I.A.C.) (1975), Dairy Industry A.G.P.S., Canberra, Oct.

——————————— (1976), Dairy Industry Marketing Arrangements, A.G.P.S., Canberra, Sept.

——————————— (1978), Industries Assistance Commission Report : Rural Income Fluctuations, No. 161, A.G.P.S., Canberra, Feb.

——————————— (1978), Wheat Stabilisation, No. 175, A.G.P.S., Canberra, June

——————————— (1979), The Sugar Industry, No. 209, A.G.P.S., Canberra, March

Johnston, H.N., Murphy, C.W. and Perazzelli, P.A. (1982), 'A Simulation Version of N.I.F. 10', Paper Prepared for the Treasury - C.E.P.R. Conference on the N.I.F. 10 Model, Australian National University, Canberra, 19 Oct.

Jones, H. (1982), 'An Overview of the Australian Potato Industry', Quarterly Review of the Rural Economy, 4(2), 123-133

Jonson, P.D. and Trevor, R.G. (1981), 'Monetary Rules : A Preliminary Analysis', Economic Record, 57(157), 150-167

Kmenta, J. (1966), 'An Econometric Model of Australia : 1948-61', Australian Economic Papers, 5(2), 131-164

Kreicher, L.L. (1981), 'Portfolio Capital Flows and Real Rates of Interest', Review of Economics and Statistics, 63(1), 20-28

Krugman, P.R. (1978), 'Purchasing Power Parity and Exchange Rates : Another Look at the Evidence', Journal of International Economics, 8(3), 394-407

Kuh, E., Hollinger, P. and Neese, J. (1983), Applications of Linear Analysis to Econometric Models, Technical Report No. 35, Alfred P. Sloan School of Management, Massachusetts Institute of Technology, Cambridge, Dec.

Laidler, D. (1981), 'Monetarism : An Interpretation and an Assessment', Economic Journal, 91(361), 1-28

_____ and Parkin, M. (1975), 'Inflation : A Survey', Economic Journal, 85 (Dec.), 741-809

Lawrence, M., Borrell, B. and Tsolakis, D. (1983), 'Sugar : B.A.E. Submission to an I.A.C. Inquiry : A Note', Quarterly Review of the Rural Economy, 5(3), 264-270

Levin, J.H. (1980), 'Devaluation, the J-Curve and Flexible Exchange Rates', Manchester School of Economic and Social Studies, 48(4), 355-377

Lewis, J.N. (1972), 'Milking the Australian Economy', in Throsby, C.D. (Editor), Agricultural Policy, Pelican Readings in Australian Economic Policy, Penguin Books, Vic, 282-296

Lipsey, R.G. (1981), 'The Understanding and Control of Inflation : Is there a Crises in Macro-economics?', Canadian Journal of Economics, 14(4), 545-576

Lloyd, A.G. (1972), 'Reserve Price for Wool : A Defense', in Throsby, C.D. (Editor), Agricultural Policy, Pelican Readings in Australian Economic Policy, Penguin Books, Vic., 177-202

Longworth, J.W. (1966), 'The Australian Wheat Industry Stabilisation Scheme : An Analytical Model', Economic Record, 42(98), 244-255

_____ (1967), 'The Stabilisation and Distribution Effects of the Australian Wheat Industry Stabilisation Scheme', Australian Journal of Agricultural Economics, 11(1), 20-35

———————— (1976), 'Institutions and Policies Influencing Japanese Beef Imports', Review of Marketing and Agricultural Economics, 44(1, 2), 19-43

———————— (1978), 'The Japanese Beef Market : Recent Developments and Future Policy Options', Review of Marketing and Agricultural Economics, 46(3), 167-195

———————— and Knopke, P. (1982), 'Australian Wheat Policy 1948-79 : A Welfare Evaluation', American Journal of Agricultural Economics, 64(4), 642-654

Lucas, R.E. Jr (1980), 'Methods and Problems in Business Cycle Theory', Journal of Money, Credit and Banking, 12(4), Pt 2, 696-715

———————— (1981), 'Tobin and Monetarism : A Review Article', Journal of Economic Literature, 19(2), 558-567

MacMillan, J.A. and Loyns, R.M.A. (1969), 'A Cross-Section Analysis of Farm Household Expenditures', Canadian Journal of Agricultural Economics, 17(2), 92-105

Malinvaud, E. (1977), The Theory of Unemployment Reconsidered, Basil Blackwell, Oxford.

McCallum, B.T. (1980), 'Rational Expectations and Macroeconomic Stabilisation Policy : An Overview', Journal of Money, Credit and Banking, 12(4), Pt 2, 716-746

Meade, J.E. (1981), 'Comment on the Papers by Professors Laidler and Tobin', Economic Journal, 91(361), 49-55

Minnis, P. (1982), Rural Income Fluctuations and Some Taxation Measures, Working Paper 82-25, Bureau of Agricultural Economics, Canberra, July

Muellbauer, J. and Portes, R. (1978), 'Macroeconomic Models with Quantity Rationing', Economic Journal, 88 (Dec.), 788-821

Mullen, J.D., Powell, R.A. and Reece, B.F. (1980), 'The Income and Consumption Experiences of a Sample of Farm Families', Australian Journal of Agricultural Economics, 24(3), 268-282

Neary, J.P. (1980), 'Nontraded Goods and the Balance of Trade in a Neo-Keynesian Temporary Equilibrium', Quarterly Journal of Economics, 95(3), 403-429

Nelson, C.R. (1981), 'Adjustment Lags Versus Information Lags : A Test of Alternative Explanations of the Phillips Curve Phenomenon', Journal of Money, Credit and Banking, 13(1), 1-11

Nevile, J.W. (1962), 'A Simple Econometric Model of the Australian Economy', Australian Economic Papers, 1(1), 79-94

———————————— (1975), Fiscal Policy in Australia : Theory and Practice, (2nd Edn.), Cheshire, Melbourne

Nguyen, D.T. (1982), 'Money Financing and the Dynamic Effects of Fiscal and Monetary Policies in a Theoretical Simulation Model', Paper Presented to the Economic Society of Australia and New Zealand, Eleventh Conference of Economists, Adelaide, 23-27 Aug.

———————————— and Turnovsky S.J. (1979), 'Monetary and Fiscal Policies in an Inflationary Economy : A Simulation Approach', Journal of Money, Credit and Banking, 11(3), 259-283

———————————— (1983), 'The Dynamic Effects of Fiscal and Monetary Policy Under Bond Financing : A Theoretical Simulation Approach to Crowding Out', Journal of Monetary Economics, 11(1), 45-71

Ockwell, A.P. and Batterham, R.L. (1982), 'The Influence of Credit on Farm Growth', Review of Marketing and Agricultural Economics, 50(3), 247-264

Officer, L.H. (1980), 'Effective Exchange Rates and Price Ratios Over the Long Run : A Test of the Purchasing Power Parity Theory', Canadian Journal of Economics, 13(2), 206-230

Okun, A.M. (1980), 'Rational - Expectations - with - Misperceptions as a Theory of the Business Cycle', Journal of Money, Credit and Banking, 12(4), Pt. 2, 817-825

O'Mara, L.P. (1979), 'Australian Wheat Marketing Arrangements Since 1948 - Costs and Benefits for Wheat Growers, Wheat Consumers and the Community', Unpublished Economics Honours Sub-Thesis, Australian National University, Canberra, Oct.

———————————— (1981), 'Some Economic Implications of Minimum Pricing : The Case of Wine Grapes in Australia', Review of Marketing and Agricultural Economics, 49(2), 107-123

———————————— , Carland, D. and Campbell, R. (1980), 'Exchange Rates and the Farm Sector', Quarterly Review of the Rural Economy, 2(4), 357-367

O'Mara, L.P., Nguyen, D.T. and Adams, P.D. (1983), 'A Macroeconomic Model Emphasising the Farm Sector : Philosophy, Structure and Development', Background Paper for the 27th Annual Conference of the Australian Agricultural Economics Society, Brisbane, 8-10 February

———————————— (1984), A Theoretical Simulation Model Emphasising Farm - Macro Linkages : Philosophy, Structure and Some Results, Working Papers in Economics and Econometrics, No. 098, Australian National University, Canberra, March

O'Mara, L.P. and Vanzetti, D. (1985), A Theoretical Simulation Model Emphasising Farm Macro Linkages: Some Results in the Presence of a Farm Export Constraint, Working Papers in Economics and Econometrics, No.114, Australian National University, Canberra, Feb.

Pagan, A.R. and Shannon, J.H. (1983), 'Sensitivity Analysis for Linearized Computable General Equilibrium Models', Mimeograph, Australian National University, Canberra, Oct.

Parish, R.M. (1962), 'The Costs of Protecting the Dairying Industry', Economic Record 38(82), 167-182

——————————— (1972), 'Reserve Price for Wool : A Critique' in Throsby, C.D. (Editor), Agricultural Policy, Pelican Readings in Australian Economic Policy, Penguin Books, Vi., 166-176

——————————— and Kerdpibule, U. (1968), Fresh Milk Marketing in N.S.W., Research Bulletin No. 6, Department of Agricultural Economics, University of Sydney.

Parton, K.A. (1978), 'An Appraisal of a Buffer Fund Scheme for Beef', Australian Journal of Agricultural Economics, 22(1), 54-64

Philpott, B.P. (1955), 'Fluctuations in Wool Prices, 1870-1953', Yorkshire Bulletin of Economic and Social Research, 7(1), 1-28

Pitchford, J.D. (1981), 'A Consistent Model of the Expectations - Augmented Phillips Curve and Inflation', Journal of Macroeconomics, 3(4), 489-500

——————————— (1983), 'Unemployment, Real Wages and the Money Supply in Australia', Economic Record, 59(165), 118-131

Pope, R. (1979), 'Capital Flows and Reactions of the Monetary Authorities : An Illustration of Misguided Zeal for Micro Indicators and Simultaneous Estimatation Techniques', Paper Presented to the Economic Society of Australia and New Zealand, Eighth Conference of Economists, La Trobe University, 27-31 Aug.

Porter, M. (1974), 'The Interdependence of Monetary Policy and Capital Flows in Australia', Economic Record, 50(129), 1-20

——————————— (1978), 'The Interdependence of Monetary Policy and Capital Flows in Australia : A Reply', Economic Record, 54(146), 286-287

Powell, R.A. and Mandeville, T.D. (1978), 'Analysis of Sector Interactions and Stability in a Rural Region of N.S.W.', Economic Record, 54(146), 239-255

Reeves, G.W. and Longmire, J.L. (1982), 'A Note on the Theory of Price Determination in the Australian Beef Market', Review of Marketing and Agricultural Economics, 50(1), 119-126

Reserve Bank of Australia (1976), Statistical Bulletin, Sydney, November

——————————— (1977), Conference in Applied Economic Research, Sydney, Dec.

Roberts, K. (1982), 'Desirable Fiscal Policies Under Keynesian Unemployment', Oxford Economic Papers, 32(1), 1-22

Roper, D.E. and Turnovsky, S.J. (1980), 'Optimal Exchange Market Intervention in a Stochastic Macro Model', Canadian Journal of Economics, 13(2), 296-309

Rutledge, D.J.S. and Madden, G.M. (1974), 'The Australian Short-Run Consumption Function : A Comment', Economic Record, 50(130), 287-295

Sargent, T.J. and Wallace, N. (1975), ' "Rational" Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule', Journal of Political Economy, 83(2), 241-254

Sieper, E. and Fane, G. (1981), Exchange Control and Exchange Rate Policy, Technical Paper No. 6, Australian Financial System Inquiry, Jan.

Smallhorn, P. (1973), 'Demand Elasticities for Raw Wool in Japan', Quarterly Review of Agricultural Economics, 26(4), 253-262

Smith, A.W. and Smith, R.L. (1976), 'A Model of the Australian Farm Sector : A Progress Report', Economic Record, 52(140), 462-482

Smyth, D.J. and McMahon, P.C. (1972), 'The Australian Short-Run Consumption Function', Economic Record, 48(122), 220-231

Snape, R.H. (1977), 'Effects of Mineral Development on the Economy', Australian Journal of Agricultural Economics, 21(3), 147-156

——————————— (1981), 'Australian Unemployment - Is it Created by Costs or by Demand?' in Committee for Economic Development of Australia (Editor), Growth 31 : Inflation and Unemployment, April, 20-35

Stoeckel, A. (1983), 'Outlook for the Rural Economy : 1983', Address Given to the 1983 National Agricultural Outlook Conference, Canberra, Jan. 1983 - Reproduced in Quarterly Review of the Rural Economy, 5(1), 86-89

Stone, J.O. (1981), 'The Outlook for the Australian Economy', Address Given to the 1981 National Agricultural Outlook Conference, Canberra, Jan. 1981 - Reproduced in Supplement to the Quarterly Review of the Rural Economy, 3(1), 27-34

Sutton, J. (1981), 'A Formal Model of the Long-Run Phillips Curve Trade-Off', Economica, 48(192), 329-343

Throsby, C.D. and Rutledge, D.J.S. (1977), 'A Quarterly Model of the Australian Agricultural Sector', Australian Journal of Agricultural Economics, 21(3), 157-168

——————————— (1979), 'The Elasticity of Demand for Exports : A Reply', Australian Journal of Agricultural Economics, 23(1), 67-68

Tisdell, C. (1972), 'Some Circumstances in Which Price Stabilisation by the Wool Commission Reduces Incomes', Australian Journal of Agricultural Economics, 16(2), 94-101

——————————— (1973), 'A Comment on Losses from Stabilisation', Australian Journal of Agricultural Economics, 17(2), 144-145

Tobin, J. (1980), 'Are New Classical Models Plausible Enough to Guide Policy?', Journal of Money, Credit and Banking, 12(4), Pt. 2, 788-799

——————————— (1981), 'The Monetarist Counter - Revolution Today - An Appraisal', Economic Journal, 91(361), 29-42

Treasury (1980), Submission to the Committee of Inquiry into the Australian Financial System : Treasury Paper No. 9, Forms of Direct Government Intervention in the Financial System, A.G.P.S., Canberra, Nov.

Turnovsky, S.J. (1981), 'Monetary Policy and Foreign Price Disturbances Under Flexible Exchange Rates : A Stochastic Approach', Journal of Money, Credit and Banking, 13(2), 156-176

——————————— (1983), 'Expanding Exports and the Structure of the Domestic Economy : A Monetary Analysis', Economic Record, 59(166), 245-259

——————————— and Ball, K.M. (1983), 'Covered Interest Parity and Speculative Efficiency : Some Empirical Evidence for Australia', Economic Record, 59(166), 271-280

Turnovsky, S.J. and Kingston, G.H. (1977), 'Monetary and Fiscal Policies Under Flexible Exchange Rates and Perfect Myopic Foresight in an Inflationary World', Scandinavian Journal of Economics, 79(4), 424-441

——————————— (1979), 'Government Policies and Secular Inflation Under Flexible Exchange Rates', Southern Economic Journal, 46(2), 389-412

Turnovsky, S.J. and Nguyen, D.T. (1980), 'Perfect Myopic Foresight and the Effects of Monetary and Fiscal Policy in a Simple Inflationary Model : Some Analytical and Numerical Results', European Economic Review, 14, 237-269

University of Melbourne (1983), The Agricultural Sector and Economy-Wide Modelling, Forum Papers No. 2, April

Vincent, D.P. (1983), Drought, World Recession and the Growth in Real Labour Costs : A Comparative Analysis of Their Effects on Domestic Activity, Research Memorandum, Orani Model, Industries Assistance Commission, Canberra, April

Waugh, D.J. (1977a), 'The Determinants of Investment in Australian Agriculture - A Survey of Issues : With Particular Reference to the Australian Sheep Industry', Quarterly Review of Agricultural Economics, 30(2), 133-149

——— (1977b), 'The Determinants and Time Pattern of Investment Expenditure in the Australian Sheep Industry', Quarterly Review of Agricultural Economics, 30(2), 150-163

Yapp, T. (1983), An Economic Analysis of Intervention in the Australian Egg Industry, Working Paper 83-25, Bureau of Agricultural Economics, Canberra, July

Young, R. (1973), 'Institutional Credit in the Rural Sector : An Exploratory Analysis of Demand and Supply', Quarterly Review of Agricultural Economics, 26(4), 228-238

Zerby, J.A. (1969), 'An Econometric Model of Monetary Interaction in Australia', Australian Economic Papers, 8(13), 154-177