USE OF THESES

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ISSUES IN TRADE LIBERALIZATION: TIMING, SEQUENCING, SPEED AND CREDIBILITY – THEORY AND PRACTICE IN KOREA

Cha Dong Kim

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

April 1992
Canberra, Australia
Declaration

Except where otherwise indicated, this thesis is my own original work.

[Signature]

Cha Dong Kim
Acknowledgements

Throughout the course of this dissertation, I have incurred a number of scholarly debts which I gladly acknowledge. First and foremost in my gratitude is my chair supervisor, Dr Rodney Falvey. His time-sharing for reading and commenting on all parts of the thesis, support, and interest have been beyond the call of duty. I am also grateful to my supervisory members, Professor Peter Drysdale and Dr George Fane, for their comments on many chapters, advice, and continued encouragement.

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The Australian National University has provided a Ph. D scholarship, for which I am very grateful. Finally, my wife, Eunhee, deserves special thanks since her constant assistance and patience have been absolutely fundamental. Also, thanks to my daughters, Dohyun and Younghyun, for their joy and enthusiasm.
Abstracts

The thesis discusses the dynamic effects of trade liberalization on welfare, current account and other macroeconomic variables. It highlights on the potential intertemporal costs of temporary reform during the transition, and hence focuses on the examination of the main issues raised by these costs: timing (duration), sequencing, speed and credibility of reform. We examine these dynamic issues using intertemporal optimizing frameworks.

We first show that both the long-run and the transitional effects of trade reform depend largely upon different assumptions on its timing and duration. We demonstrate that temporary reform can not only bring about a current account deficit but generate welfare costs, and is thus suboptimal to consumers. We also show that the resource re-allocation objective of trade reform is to be dampened if the reform ends prematurely. Second, we discuss how the effects of trade reform under capital controls differ from the effects under a free capital mobility regime, and show that if trade reform is temporary (or incredible) maintaining capital controls may alleviate the intertemporal costs arisen from the temporariness. This provides some arguments for the conventional view that trade account should be liberalized before the capital account.

Third, the credibility issue in trade reform is examined. We argue that if the reform is perceived to be incredible to the public, free trade would no longer be optimal since incredibility can act to create an intertemporal distortion. In line with this credibility issue, optimal speed of trade reform is also discussed. We demonstrate that gradualism may be preferred and be optimal when there is a credibility problem in the current reform.

Finally, a simulation model of Korea is established to reexamine the issues of timing, sequencing, speed and credibility in an integrated framework. By and large, the results obtained from the simulation analysis conform to our theoretical predictions. The simulation results also predict that Korea's pre-announced tariff reform program announced in 1988 for the period of 1989-1993 would generate a substantial welfare gain, if it is implemented as announced.
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CHAPTER 1

INTRODUCTION

1.1 Main Issues

This thesis deals with important issues in trade liberalization: timing, duration, sequencing, speed and credibility. To do this, the thesis examines the dynamics of trade liberalization under different assumptions on timing, duration, sequencing, and credibility: permanent versus temporary trade reform, trade reform with and without capital controls, gradual versus one-shot trade reform, and credible versus non-credible trade reform. Macroeconomic, welfare, and industry effects of trade liberalization are considered. A simulation analysis of the Korea’s trade reform is also conducted.

Throughout the thesis, the term *trade liberalization* refers mainly to a reduction of tariffs only. This is mainly because quantitative import restrictions virtually no longer exist in Korea except for some agricultural products, and accordingly, tariffs have now become an increasingly important trade policy instrument. Also, our analyses apply mostly for a small country.

The traditional theoretical background on tariff liberalization policy is firmly based on fundamental and well-known principles: gains from trade and comparative advantage. For a small country, world prices represent shadow prices and free trade is the optimal trade policy. That is, proportional tariff cuts lower the domestic price of importables and thus expands the feasible set of consumption possibilities, and thereby act to improve resident’s welfare. On the other hand, lower import prices (for both inputs and outputs) boost the export production while they discourage the importable industry. Hence, in the mid- to long-run, resources will be switched into the exportable sector. Trade
liberalization policy is thus in general compatible with the outward-oriented trade regime. Trade balance would not in general be a problem in the long-run.

Several issues should be confronted, however, before leaping to policy conclusions from this simple logic. An essential argument is that the standard principles are based on the static analyses of the relationship between tariffs, welfare, and the trade balance, ignoring issues involved in intertemporal resource allocation. First, the timing and the duration of reform must be considered. For example, a temporary tariff reduction tends to lower the price of current imports relative to future imports, which will, ceteris paribus, increase the consumption-based real interest rate, inducing a shift of import expenditure towards the current period. Consequently, a larger deficit in the present period's current account would be generated than in the absence of these intertemporal effects. The size of the deficits in the current period would in part depend on the duration of a temporary reform.

Second, there is sequencing issue between the trade and capital account. The effects of trade reform with capital (or foreign exchange) controls are different from the effects with no capital controls. Therefore, if there are restrictions on both current and capital account transactions, the relevant question is whether the two accounts should be liberalized simultaneously or whether there is any preferred order of liberalization. Two interrelated aspects can be discussed: the effects on allocative efficiency and on the macroeconomic variables. The current account, in particular, is affected sensitively by the ordering assumptions.

Third, there remains the question of the appropriate speed of liberalization. Once sequencing issues have been resolved, the government faces certain choices with respect to the speed of trade reform. Should the reform be implemented step by step or abruptly? The speed of reform is important for the economy's adjustment costs. The usual argument is that a full scale liberalization would speed up the beneficial effects of reform, but would entail economic costs such as unemployment.

Finally, and more importantly, the issues of timing, sequencing, and speed are all by and large related to the credibility of reform. It is argued that temporary trade reform is
functionally equivalent to incredible reform [Calvo, 1988]. Also, too gradual or reluctant a reform, i.e., trade reform which is not composed of major and intensive measures, would likely lack credibility. The upshot of credibility considerations in trade reform is that if the reform is not fully credible, and hence if the private agents anticipate future reversal of liberalization then reform will act to create an intertemporal distortion in the economy. If the degree of noncredibility is large, i.e., an intertemporal distortion is large, the beneficial effects of reform would be more than offset. As Rodrik [1989] argues, incredible reform in this case could be worse than no reform at all.

Despite the crucial importance of these issues, existing trade liberalization literature seemed to have neglected to incorporate these into theoretical as well as empirical applications. Some analytical studies focus on each issue separately. Very few studies, however, are based on solid micro foundations. Therefore, the objective of this study is to identify analytically various effects of alternative timing (and duration), sequencing, speed and credibility assumptions, using intertemporal optimization frameworks. Further, considering the limitations of theoretical studies, an intertemporal computable general equilibrium model for the Korean economy is developed as it enables us to reexamine these issues in a more consolidated way. It can also yield some definitive results from which some policy suggestions can be drawn out. The specific issues and questions we raise in this thesis are as follows.

(1) What are the effects of temporary and permanent trade reform, and how are they different in terms of their effects on welfare, saving and investment, and the current account?

(2) Are there any economic costs of temporary trade reform? If so, what are they, and through what channels do they occur? Are there any relations between these costs and the degree of temporariness of reform? Under what conditions, if any, are these costs greater as the duration of reform becomes shorter?

(3) What are the different effects of trade reform with and without capital controls? Should capital controls be maintained until trade has been liberalized? If so, what are the reasonings?
(4) What is the role of credibility in trade reform? And why is incredible trade reform suboptimal?

(5) What were the basic contents of Korea's trade liberalization programs in the 1980s? Were there any changing patterns in the Korean industry during the reform period? What were the characteristics of those reform programs in terms of timing, sequencing, speed and credibility?

(6) Are the theoretical results in general consistent with the results obtained from a consolidated large simulation model of the Korean economy? What are the short- and long-run predictions of Korea's pre-announced trade reform which was announced in 1988 for the period of 1989-1993? How would these effects be different if the announced plan is halted?

1.2 Structure of Thesis

We organize the thesis in the following way. Chapter 2 reviews the literature related to the issues of timing, sequencing, speed and credibility of trade liberalization. The review organizes the arguments between the proponents and opponents with regard to the question of sequencing. It also discusses theoretical results regarding the effects of different assumptions on the time horizon of trade reform (or exogenous external shocks). The focus is mainly on the effects on the current account and welfare. The importance of the credibility of trade reform is also highlighted.

Chapter 3 establishes an intertemporal optimizing model of the balance of payments where the economy's current and capital accounts transactions are in the government's control. Trade distortion in the form of tariffs and capital account distortion in the form of a dual exchange rate regime are specified in the model. The model essentially highlights the consumption-saving dynamics. We analyze the dynamic effects of a tariff reduction on individual's welfare and the current account both in the steady-state and during the transition. The relationships between trade policy temporariness and the critical variables are examined. It is argued that a high temporariness of trade reform can deteriorate
welfare. We show that trade reform with capital controls may generate a smaller deficit in the current account during the transitional adjustment, and this favours the conventional view of "current account first" order of liberalization.

In Chapter 4, we also set up an intertemporal optimizing framework, but now focus on the firm's investment dynamics. Adjustment costs are considered in modelling. We examine the effects of different timing of trade reform on sectoral investment, capital accumulation, and the current account. Timing and duration of trade reform are demonstrated to be a key in determining the economy's dynamic adjustment. It is shown that the dynamics in transition are qualitatively different between the exportable and the importable industry. We also show that as the temporariness of tariff reform is higher, the resource movement from the importable into the exportable industry is weakened, which is likely to lead the economy to a failure of reform.

Chapter 5 highlights the role of the lack of credibility of trade reform by making use of duality functions. Moving from a simple to a more general intertemporal framework, we show that noncredible trade reform is suboptimal as it creates an intertemporal distortion. Free trade policy is Pareto optimal if and only if it is credible to the public. In the case that reform lacks credibility, we show that there exists an optimal positive tariff in the current period, favouring gradualism. As long as the gradual implementation is innocuous to the government's credibility level, a slower speed of reform is optimal.

The welfare effects of the relaxation of capital controls are also examined in this chapter, and it is demonstrated that if the public questions the viability of the current trade reform, then a welfare-deteriorating effect of incredible trade reform may offset the beneficial effect of the capital account liberalization. Hence, if there is a credibility problem of trade reform, maintaining capital controls may have the effect of equalizing consumption across periods, which in turn supports the "trade account first" view of reform.

Korea's trade liberalization policy is illustrated in Chapter 6. We explain the recent trends of the Korean economy, the background of trade policy, the scope and depth of the recent trade reform, and the changing industrial (and macroeconomic) patterns during the
reform period. Our objective here is to provide the essential background of the structure and the size of the economy during the major reform period in the 1980s. However, this illustration is useful in interpreting and understanding the model and the results of the simulation of the Korean economy in the next chapter.

In Chapter 7, we try to integrate the theoretical analyses into a single consolidated model to reexamine our issues in the context of the Korean economy. The simulation model is essentially a multi-sector intertemporal computable general equilibrium model of the Korean economy, and is capable of examining not only macroeconomic effects of timing, sequencing, speed and credibility of trade reform, but its inter-sectoral effects as well. The simulation results are generally consistent with the results obtained separately from each theoretical framework. We also predict how the Korean economy will adjust in response to its trade reform which was announced in 1988 for the period of 1989-1993. Our observation is that the reform program would substantially enhance the nation's welfare if it is implemented according to the announcement. If, however, the plan is interrupted into, intertemporal welfare costs will be observed.

Finally, in Chapter 8, we restate the main issues of this thesis, summarize main findings, and draw conclusions. Also, limitations as well as possible future extensions of this thesis are discussed.
CHAPTER 2

TRADE AND CAPITAL ACCOUNT LIBERALIZATION: SEQUENCING, TIMING, AND SPEED AND CREDIBILITY—A SELECTIVE REVIEW OF LITERATURE

2.1 Introduction

There are some fundamental and well-known doctrines justifying the optimality of free trade and the benefits of policies that move the economy towards it. Very briefly, trade liberalization expands the feasible set of consumption possibilities; the increased exposure of domestic industries to international competition improves efficiency; and opportunities to exploit economies of scale are increased. In a similar vein, liberalizing international capital flows can provide residents with higher returns from their choice of portfolio diversification, and increase the availability of foreign funds. To the extent that these foreign funds are utilized to augment the domestic capital stock, the economy will grow over time. The freer movements of capital internationally can also stimulate competition and improve efficiency in the domestic financial system. Most economists agree that a fully liberalized economy is Pareto superior to a controlled economy. Also, the accumulated empirical evidence in fact indicate that more liberalized and outward-oriented economies have achieved a higher level of national income, efficiency and equity.¹

Despite the widespread acceptance of the long-run benefits of opening up, a number of liberalization programs in developing countries have been stopped at different stages before they have been completed. Also, a majority of developing countries begrudge embarking on external liberalization programs. Khan and Zahler [1983] and Edwards

1984] point out some effective barriers to the success of reform: sectoral conflicts, short-run adjustment costs, and mismanagement of the transition — all being related to dynamics. Hence, the explicit treatment of these problems requires dynamic analysis. Little is known, however, both theoretically and empirically about the principal attributes of successful transitional paths following reform. See also Krueger [1986]. The main problems which are involved in determining the transitional paths are: the order of liberalization of the current and capital account, the timing of trade liberalization, and the speed and credibility of the reform. If an instantaneous and simultaneous liberalization is not a feasible option, should trade reform precede the capital account liberalization, or vice versa? What are the different effects of different timing and durations of trade liberalization? And finally, what is the optimal speed of liberalization, and in what sense does the credibility of reform affect the outcome of reform?

In this chapter, we survey literature on these issues. First, regarding the order of liberalization, the central question is which account of the balance of payments should be opened first when distortions in both accounts are present. As Edwards [1984] notes, this sequencing question involves more than second-best problems. That is, in addition to the evaluation of the welfare effects of alternative strategies for external liberalization, the alternative orders of liberalization determine alternative paths of crucial variables such as the relative prices, aggregate output and the current account. We highlight the arguments for the 'current account first' order of liberalization and the critiques against this order. Second, in examining the effects of the timing and duration of trade liberalization, we mainly consider how these generate different effects on the current account. This is because the current account response during the transition can be one of the most crucial elements for determining the survival of trade liberalization, and thus understanding the nature of these time horizons of reform and their likely outcomes is of utmost importance. The effects of permanent vs temporary, and anticipated vs immediate trade reform are compared.

Third, in relation to the speed and credibility of reform, the question is: should the trade reform be conducted step by step or should it be carried on at one time. The problem
involved in this question is the adjustment costs incurred by the reform. The magnitude of costs during the adjustment could depend on how intensively or fast the reform proceeds. This question of the optimal speed of liberalization is as important as other issues since this may partly determine the credibility of the government's reform policy. One may argue that if the reform is implemented too slowly and hence does not bring about a required structural change in the economy, then the private agents would not believe that the true intention of the government is to liberalize, expecting the reform to be reversed. The expectation of the reversal itself creates an additional distortion in the economy, and therefore the reform becomes suboptimal due to the lack of credibility. Most economists generally agree on the costs of this imperfect credibility of liberalization. We can also relate this credibility issue to the time horizon of the policy temporariness.\(^2\)

Note that, in terms of the order of liberalization, our survey and discussion are confined only to the order of liberalization in the current and capital account of the balance of payments. Other sequencing questions, such as whether macro stabilization or liberalization should be conducted first, and whether there are any preferred order between quantitative restrictions, tariffs, and export subsidies, are not our main concern. See, however, Wolf [1986], Edwards [1989c], Falvey and Kim [1992], for these sequencing issues. We simply assume that the initial timing of trade reform is such that the quantitative restrictions have been dismantled before tariff reform has embarked, and also macro stabilization has been achieved before liberalization has begun.\(^3\)

The paper is organized in the following form. In Section 2 the arguments between the proponents and opponents regarding the sequencing question, 'which account should be liberalized first?' are provided. Section 3 surveys the timing and duration of trade reform to discuss different effects of a temporary vs permanent reform, and an anticipated vs immediate reform. Then, the credibility of reform in parallel with the speed of policy implementation is reviewed in Section 4. Finally, we summarize the survey in Section 5.


\(^3\)Unlike the case of the Southern Cone reform, these assumptions are especially relevant to Korea's history of trade liberalization until the late 1980s. See Chapter 6 for details.
2.2 Sequencing of Trade and Capital Account Liberalization

Static Optimizing Model

In an ideal, frictionless world without externalities, distortions, or other economic and political constraints, the sequencing issue is trivial and can simply be answered; all markets and sectors are best liberalized simultaneously. But in the less than perfect real world, simultaneous liberalization of all sectors is often infeasible, so that the question naturally arises as to which form of liberalization should first be pursued. This sequencing problem has been regarded as one of the most controversial issues in the theory of economic policy. It embraces both micro and macroeconomic implications. At a micro level, typical second-best problems are present; if there is more than one distortion in the economy, a removal of one distortion in the presence of other distortions does not necessarily bring about a welfare gain, whereas at a macro level different sequences of reform will generate different transitional adjustment paths for the critical macroeconomic variables such as the relative prices, output, and the current account. Moreover, in some circumstances, the micro and macro outcomes following sequential measures may turn out to be incompatible with each other. In this section we concentrate on the examination of the welfare implications of reducing one distortion while other distortions are kept in place. To do this, it may be useful to begin with a simple static real model.

Consider a small open economy with multiple goods and factors. The domestic price \( p \) of those goods which are subject to tariffs \( \tau \) is such that \( p = p^* + \tau \), where \( p^* \) is the world prices of imports (fixed). The economy is endowed with an internationally traded factor, referred to as capital, \( K \). The initial equilibrium may be given by

\[
E(p, u) = R(p, K) + \tau(E_p - R_p)
\]

which is the familiar income-expenditure identity. \( E \) is the expenditure function, \( R \) is the revenue function, the subscript denotes the partial derivative of the corresponding variable and thus \( E_p \) is the compensated demand function for importables, \( R_p \) is the supply function for importables, \( E_p - R_p \) is the volume of imports, and hence \( \tau(E_p - R_p) \) is
revenue from tariffs (redistributed). For the application of these expenditure and revenue functions in trade theory see Dixit and Norman [1980] and Woodland [1982]. Totally differentiate equation (1) to yield

\[ E_u(1 - \tau E_{pu}/E_u) \, du = \tau(E_{pp} - R_{pp}) \, d\tau + (R_K - \tau R_{pk}) \, dK \]

where \( E_{pu} = \partial E_p/\partial u \), \( E_{pu}/E_u \) is the pure income effect of a change in expenditure on importables and \( E_{pu}/E_u \in (0, 1) \) if all goods are normal in demand. \( E_{pp} = \partial E_p/\partial p \) and \( R_{pp} = \partial R_p/\partial p \) are the usual consumption and production changes associated with changes in tariffs, respectively. \( R_K \) is the value marginal product at domestic prices which is assumed to be equal to tariffs accruing to capital, and \( R_{pk} = \partial R_p/\partial K \) is the Rybczynski matrix whose sign determines capital intensity. \( R_{pk} \) will be positive if the importable goods are capital intensive on average.

The first term in the RHS of equation (2) states the well-known result that a tariff reduction must raise welfare. The second term in the RHS of equation (2) demonstrates that the capital account liberalization in the form of a capital-goods transfer in the presence of tariffs, has the possibility of immiserising if \( R_K < \tau R_{pk} \). That is, we have the possibility of the shadow price of capital, \( \lambda = R_K - \tau R_{pk} \), being negative. This immiserizing result occurs since when capital is accumulated, production of the capital intensive sector will increase by the Rybczynski effect, and the effect of pre-existing distortion will be reinforced. Hence, a capital transfer to domestic residents may reduce welfare by driving the economy further away from its free trade production equilibrium. Several authors have proposed that a capital account liberalization in the presence of trade distortions may lead to welfare losses, and hence suggested that the capital account should be opened only after trade has been liberalized [McKinnon (1973, 1982), Frenkel

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4If there are many goods which are subject to tariffs, then the interpretation is that a proportional tariff reduction unambiguously improves welfare, which also implies that non-uniform tariff reductions may bring about a deterioration of welfare. See Vousden [1990].

5Not, in this case, that the shadow price of capital, \( \lambda \), represents the value of marginal product of capital at world prices since \( R_K = p R_{pk} \), and so \( \lambda = p R_{pk} - \tau R_{pk} = p \lambda R_{pk} \).
The welfare-theoretic underpinning of this sequencing recommendations is the above result of an immiserising capital transfer.\(^6\)

Note, however, that in equation (2) we are not able to distinguish the welfare effect of trade liberalization in the presence of capital controls from the effect in the absence of capital control. To distinguish these, we introduce the concept of foreign ownership of capital in (1). Following Neary and Ruane [1986, pp. 572-575], equation (1) becomes

\[
E(p, u) = R(p, K) + \tau(E_p - R_p) - rK^* 
\]

where \(K^* = K - \bar{K}\). \(K\) is capital in use in the domestic economy, \(\bar{K}\) is capital owned by domestic residents, \(K^*\) is the foreign capital, and hence \(rK^*\) is the net outflow of factor income since we assume that capital in use exceeds capital owned by residents in the economy.\(^7\) Totally differentiate (3), we obtain

\[
E_u(1 - \tau E_p/E_u) du = [\tau(E_{pp} - R_{pp}) - K^*R_{Kp}] d\tau \\
- [\tau R_{pK} + K^*R_{Kp}] dK + r d\bar{K} 
\]

where \(d\tau = R_{Kp} d\tau + R_{Kp} dK\) and \(pR_{pK} = R_K = r\) are used.

Now we can compare expressions (2) and (4) for the effects of a removal of one distortion in the presence of the other distortion. Comparison between the coefficients of \(d\tau\) in (2) and (4) focuses attention on how foreign ownership alters the effects of the tariff reduction. In the presence of foreign ownership of capital, tariff reform generates an additional welfare gain in addition to the usual consumption cum production gain. This is so because tariff liberalization lowers the return to capital which is owned by foreigners. However, by assumption, foreign capital does not flow out of the country following the reduction in the domestic rental induced by the tariff reductions on the capital-intensive importable goods.

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\(^7\)Note that it is assumed that the foreign capital once located receives the domestic return, \(r\), not the foreign one, \(r^*\).
With foreign ownership of capital, we assume that \( r > r^* \), and hence a capital account liberalization will bring about an increase in foreign capital. Total capital in use will also be expanded. Then, the second and term in the RHS of (4) indicates that given \( K \), a transfer of capital in use (\( dK = dK^* > 0 \)) in the presence of tariffs is less likely to be immiserizing when some capital is foreign-owned, because there is an additional welfare gain generated by the reduction in rentals paid to the owners of existing foreign capital, \( K^* R_{KK} \). This result is in contrast with the one obtained by Edwards and van Wijnbergen [1986] since they consider only the payment of interest on foreign funds, but do not consider the ownership of foreign capital. Note that if rental is fixed at the world rate, capital flows adjust to equate the domestic and world rental rates. To see this, equation (4) can be modified as

\[
E_u(1 - \tau E_{pu}/E_u) \, du = \tau [(E_{pp} - R_{pp}) + R_{pp}R_{kp}/R_{KK}] \, dt
- [K^* + \tau R_{kp}/R_{KK}] \, dr^* + r^* \, d\bar{K}
\]

where we have used \( dK = 1/R_{KK}[dr^* - R_{kp}] \, dt \). In this case, tariff liberalization can bring about the endogenous flows of capital. Then, a tariff reduction unambiguously improves welfare (negative \( dt \) term in (5)), regardless of the capital intensity, since capital flows out if rentals fall following tariff liberalization. See also Falvey and Kim [1992], for the factor market implications of trade reform.

Therefore, although there exists a possibility of immiserizing capital transfer in the above simple model, the preceding results do not provide a clear-cut suggestion that the capital account should not be liberalized when there are trade restrictions. On the other hand, trade liberalization brings about a welfare gain, and the welfare gain will be reinforced if there is foreign ownership of capital. The degree of capital mobility does not qualitatively alter the effect of trade reform on welfare.\(^8\) If capital is fixed, a tariff reduction will reduce \( r \) to foreign capital, and hence foreign owners of capital will lose their income. If capital is mobile, then a fall in the rental to foreign capital will force \( K^* \) to flow out and hence, as reflected by the term \( R_{kp}R_{kp}/R_{KK} \), a larger supply response.

\(^8\)This is essentially because either \( r \) or \( K \) is endogenous in equations (4) and (5).
(production gain) will take place from liberalization. This is why trade liberalization in this case unambiguously improves welfare regardless of capital mobility.

**Sequencing and Welfare in an Intertemporal Optimizing Model**

One can notice that the above static framework is inadequate to fully examine the effects of trade liberalization with and without capital controls. Also, it is not clear what the restrictions on the capital account transactions are. For analyzing the effects of external liberalization on relative prices and welfare in a meaningful way, the explicit specification of the intertemporal budget constraint will be necessary. One may ideally want a fully specified intertemporal general equilibrium framework incorporating both the real and monetary sectors in the economy. Whether this kind of model is tractable or not deserves further research. For the moment, we will use a popular simple intertemporal model which focuses the real side of the economy.

Consider the extension of equation (1) to incorporate the agent's two-period intertemporal optimizing behaviour. The model becomes

\[
E(P_1(1, p_{m1}), \delta P^2(1, p_{m2}), u) = R^1(1, p_{m1}, v) + \delta R^2(1, p_{m2}, v) + \tau^1(E_{m1} - R^1) + \theta(R^2 - p_{m2}E^2)
\]

where we assume that the individual's utility function is weakly time separable, with preferences in each period being homothetic to allow the use of within-period price index, as in Svensson and Razin [1983]. The nominal exchange rate is fixed at unity and the prices of exportable goods are taken as the numeraire. \(R^t\) is the revenue function in period \(t\), \(v\) is the economy's fixed endowment of factors, \(P^t\) is the exact price index in period \(t\), \(\tau^t\) is the tariff rate in period 1, \(E_{mt} = \partial E/\partial p_{mt}\) is the compensated demand for the importable goods, \(R^t\) is the supply of importable goods, all in period \(t\). And finally, \(\delta (=1/(1+r))\) and \(\delta^* (=1/(1+r^*))\) are the consumer's domestic discount rate and the world discount rate, respectively. Consequently, \(\theta = \delta^* - \delta > 0\), denotes the present value of tax on foreign borrowing, and foreign borrowing is represented as the trade account surplus in period 2, \(R^2 - p^2E^2\). Notice that we assume that there is no trade
restrictions in period 2 so that $p_{m2} = p_{m2}^*$. In sum, equation (6) represents the economy’s intertemporal budget constraint with the revenues being redistributed to consumers in a lump-sum manner.

To see the effects of trade liberalization in the presence of capital controls, we differentiate (6) with respect to $\tau_1$ to obtain

$$\Omega \ du = [\tau_1 (E_{m1m1} - R_{\frac{1}{2} 2}) - \theta P^2 E_{2m1}] \ d\tau_1 \tag{7}$$

where $\Omega = E_u (1 - \tau_1 E_{m1u} / \theta + \theta P^2 E_2^2) > 0$ with $E_{m1u} = \partial E_{m1} / \partial u$ and $E_u^2 = \partial E_u / \partial u$, $E_{m1m1}$

$$= \partial E_{m1} / \partial p_{m1} = E_2^1 P_{12}^1 + E_{22}^1 P_{12}^2 < 0 \text{ with } P_{12}^1 = \partial P^1 / \partial p_{m1} > 0 \text{ and } P_{12}^2 = \partial P_{12}^1 / \partial p_{m1} < 0,$$

$R_{\frac{1}{2} 2} = \partial R_{\frac{1}{2}} / \partial p_{m1} > 0$, and $E_{2m1} = \partial E_{2} / \partial p_{m1} = E_{21}^1 P_{12}^1 > 0$ with $E_{21} = \partial E_{2} / \partial p^1 > 0$. In the absence of capital controls equation (7) reduces to $du/d\tau_1 = 1/\Omega [\tau_1 (E_{m1m1} - R_{\frac{1}{2} 2})]$, which is the usual result where a tariff reduction increases welfare in proportion to the net increase in imports at initial tariff level.

Equation (7) reveals that in the presence of capital controls, there is an additional channel through which the tariff reduction affects welfare, which is captured by the second term in the RHS of (7). This is an intertemporal substitution effect which acts to improve welfare. This so because a fall in the relative price of importables in period 1 lowers the cost of current consumption in terms of future consumption by raising the consumption-based discount rate, $\delta P^2 / P^1$. As a result, consumers will substitute consumption intertemporally, consuming more in the present period. However, consumption in period 1 is already below its optimal level (free trade level). Therefore, the tariff reduction alleviates the initial distortion, which results in an additional welfare gain through the interactions of the the tariff reform with the existing capital control. The effects of a capital account liberalization on welfare can similarly be obtained:

$$\Omega \ du = P^2 [\tau_1 E_{m12} - \theta P^2 E_{22}] \ d\delta \tag{8}$$

where $d\delta = -d\theta$, $E_{m12} = \partial E_{m1} / \partial P^2 = E_{12}^1 P_{12}^1 > 0$ with $E_{12} = \partial E_{1} / \partial P^2 > 0$. In equation (8), there are direct and indirect channels via which a relaxation of capital control affects
welfare. The second term in the RHS of (8) captures the usual income effect. A reduction of the tax in foreign borrowing, i.e., an increase in $\delta$ towards its world level, reduces the distortion in the capital account transactions, generating the improvement of welfare. This income effect basically depends on the initial level of distortion as well as on the propensity to consume, $E_{1u}$. In addition, the capital account liberalization has an intertemporal substitution effect which is revealed in the first term in the RHS of (8). The reduction of the tax on foreign borrowing makes future consumption relatively more expensive, induces consumers to substitute intertemporally, generating more consumption in period 1. However, tariffs in period 1 has already made the period-1 consumption to be sub-optimal, and therefore an intertemporal substitution acts to improve welfare. As a consequence, welfare unambiguously improves.

This intertemporal analysis reveals that the welfare gain from trade liberalization in the presence of capital control is reinforced to generate a greater gain in welfare than the case of trade liberalization after the capital account has been liberalized. In a similar way, the welfare improvement from the capital account liberalization in the presence of trade restrictions is greater than the gain in the absence of tariffs. Consequently, both sequencings of liberalization in this simple case bring about welfare gain, and hence no sequencing recommendation will be necessary. Note also that in this model, tax on foreign borrowing is an exogenous policy variable. The alternative approach is to take $\delta$ as an endogenous variable by imposing quantitative rationing in foreign borrowing. See Edwards and van Wijnbergen [1986] and Rodrik [1989a].

**Sequencing and Real Exchange Rates**

The undesirable effect of opening of the capital account, in that it will result in large destabilizing capital inflows and hence real appreciation in the short-run, has been indicated and analyzed by a number of authors, including McKinnon [1973, 1982], Frenkel [1982, 1983], Rodriguez [1981], Arriazu [1983], Obstfeld [1985], and Dornbusch [1982, 1983a], among others. They argue that if the fiscal deficit has been

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9 The immizerizing outcome of capital account liberalization does not occur in this intertemporal framework since the additional funds here is used for consumption only, not for capital accumulation.
controlled and the domestic financial market liberalized (and hence the domestic interest rate has been raised), the opening of the capital account may induce substantial net inflows of capital, triggered by the interest rate differentials. As long as the income elasticity of demand for nontradeable goods is positive, that is, if a fraction of these flows is spent on nontradeable goods, this generates excess demand for nontraded goods at given prices. Hence, the domestic absorption of these capital inflows will cause a rise in the relative price of these goods, and will result in a real appreciation of the exchange rates. Dornbusch [1983b], Edwards [1987b, 1989a, 1989b], Ostry [1988], Edwards and Ostry [1989], and van Wijnbergen [1989] examine issues involved in tariffs and the terms of trade disturbances, capital control, and the equilibrium real exchange behaviour.

To discuss the real exchange rate effects of liberalization, we add nontradeable goods to equation (5), and the two equations for their market clearing condition in each period. For simplicity, we assume that the importable goods are not produced (only consumed) and the exportable goods are not consumed (only produced) domestically:

\[(9) \quad E(P^1(p_{n1}, p_{m1}), \delta P^2(p_{n2}, p_{m2}), u) = R^1(1, p_{n1}, v) + \delta R^2(1, p_{n2}, v) + \tau_1 E_{m1} + \theta(R^2 - P^2 E_2)\]

\[(10) \quad E_{n1}(p_{n1}, p_{m1}, u) = R_{n1}^1(1, p_{n1}, v)\]

\[(11) \quad E_{n2}(p_{n2}, p_{m2}, u) = R_{n2}^2(1, p_{n2}, v)\]

where the exportable good is still taken as the numeraire so that \(p_{nt}\) is the relative price of nontradeable goods in terms of the exportable goods in period \(t\), \(E_{nt} = \partial E/\partial p_{nt}\) is the compensated demand function for nontradeable goods in period \(t\) while \(R_{nt}^1 = \partial R^1/\partial p_{nt}\) is the supply function of nontradeable goods in period \(t\). Equation (9) is the intertemporal income-expenditure identity and equations (10) and (11) are market clearing conditions for nontradeable goods in the respective periods. We define \(1/p_{nt}\) as the real exchange rate in period \(t\). The distortions in this model are the same as before; tariffs in period 1 and

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capital controls. Total differentiation of (9) provides the expression for the effect of a trade liberalization on welfare:

\[
\Omega \frac{du}{d\tau_1} = (\tau_1 E_{m1n1} - \theta P^2 E_{2m1}) + \\
(\tau_1 E_{m1n1} - \theta P^2 E_{2n1}) \frac{dp_{n1}}{d\tau_1} + (\tau_1 E_{m1n2} - \theta P^2 E_{2n2}) \frac{dp_{n2}}{d\tau_1}
\]

where \(E_{m1n1} = E_1 P_{12}^1 + P_{12}^1 E_{11} P_1^1 > 0\) if the importables and nontradables are gross substitutes \((P_{12}^1 > 0)\) and if this effect dominates over any intertemporal reallocation away from overall consumption in period 1. \(E_{2n1} = E_2 P_1^1 > 0, E_{2n2} = E_{22} P_1^2 < 0,\) and \(E_{m1n2} = \delta E_{12} P_1^1 P_{12}^1 > 0,\) i.e., intertemporal cross effects are assumed to be positive.

Equation (12) shows that in the presence of tariffs in period 1 and capital controls, there are two additional channels through which the tariff reductions affect welfare. The first bracket term in the RHS of (12) operates as in (7) to improve welfare. Consider the second term, \((\tau_1 E_{m1n1} - \theta P^2 E_{2n1}) \frac{dp_{n1}}{d\tau_1}\). It will be either positive or negative, depending first on the relative strength between intratemporal substitution effect and intertemporal substitution effect, and second on the real exchange rate behaviour. If there is a real depreciation, namely, \(dp_{n1}/d\tau_1 > 0\) and if \(\tau_1 E_{m1n1} < \theta P^2 E_{2n1}\) is satisfied, then the tariff reduction in period 1 in the presence of capital controls acts to improve welfare additionally through the real depreciation effect. This occurs because a decrease in the price of nontraded good in period 1 reduces the consumption rate of real interest which induces substitution of overall spending from the future towards today. Since the present consumption is too low due to the tariffs and capital controls, the movement of the real exchange rate in period 1 further reduces the distortions, acting as a further improvement of welfare.

The third bracket term in (12), \((\tau_1 E_{m1n2} - \theta P^2 E_{2n2}) \frac{dp_{n2}}{d\tau_1}\), reveals the channel through which future expected changes in the real exchange rate caused by the current tariff reform affect welfare. Since we assume that all cross intertemporal effects are

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11 Note that if there are tariffs in period 2, equation (12) becomes more ambiguous to sign. That is, with period-2 tariffs, \(\delta \tau_2 E_{m2n1}, \delta \tau_2 E_{m2n1}\) and \(\delta \tau_2 E_{m2n2}\) enter the first, second and third brackets respectively, which results in additional ambiguity in signing (12).
positive, \( \tau_1E_{m1n2} - \theta P^2E_{2n2} > 0 \). Thus, if there is an anticipation of a real appreciation in the future, \( \frac{dP_{n2}}{dt_1} < 0 \), it favors the improvement of welfare whereas a real depreciation in period 2 will act to reduce welfare. Similar explanations can also be provided: a real appreciation in the future raises the consumption-based discount factor, inducing consumers to substitute their consumption towards period 1, and thereby further alleviating the distortions created by the capital controls and tariffs. Edwards [1987a], using a similar model, derives a formula for the real exchange rates response following changes in tariffs, and concludes that tariff reform can bring about either a real depreciation or a real appreciation. He also indicates the possibility of 'overshooting' of the real exchange rate, i.e., the real exchange rate in period 1 could rise more than the future real exchange rate under certain circumstances.\(^{12}\)

Note that equation (9) can also be used to examine the effect of a relaxation of capital controls on welfare when there are real exchange rate effects. The obtained expression is similar to that of (12). That is,

\[
\Omega^2 \frac{du}{d\delta} = P^2(\tau_1E_{m12} - \theta P^2E_{22}) - (\tau_1E_{m1n1} - \theta P^2E_{2n1}) \frac{dP_{n1}}{d\delta} \\
- (\tau_1E_{m1n2} - \theta P^2E_{2n2}) \frac{dP_{n2}}{d\delta}
\]

Similarly, the effect of the capital account liberalization on welfare in the presence of tariffs depends largely on the movements of the real exchange rates.\(^{13}\) Note that this kind of framework can be used for examining the effect of a variety of disturbances. For example, by adding tariffs in period 2, we may consider the effect of an anticipation of a future tariff liberalization on welfare in the presence and absence of capital controls. The effects of an anticipation of a future policy change will be discussed later.

We have seen that in the Svensson and Razin-type intertemporal framework without nontraded goods, any sequential liberalization program will result in a gain in welfare. However, once a nontraded good is introduced in the model, it is not possible to

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\(^{12}\)Equations (9)-(11) contain three endogenous variables, the prices of a nontraded good in each period and welfare, so that we can solve for those variables.

\(^{13}\)Note that the term, \( \Omega \), now contains \( P^2\theta E_y \).
determine whether or not a removal of one distortion in the presence of the other will improve welfare. This is because the responses of the real exchange rates are ambiguous. If a real appreciation takes place following the capital account liberalization before tariffs have been liberalized, it can be shown that welfare will be further improved. This implies that as far as the individual's welfare is concerned, the real appreciation on its own does not constitute a problem [see Lal, 1987], and hence the argument for the conventional sequencing recommendation of 'current account first' may be weakened in terms of the welfare effects of sequential reform.

However, the fundamental argument against the opening of the capital account before (or simultaneously with) trade reform is not in the real appreciation itself, but rather in the real appreciation when the economy requires a real depreciation through the trade reform. Initial real appreciation will lead to resource movements opposite to those required during the process of trade liberalization.\(^\text{14}\) Hence, it is argued that the opening of the capital account before the trade liberalization is completed will lead to unnecessary shifts in national resources, in effect away from traded to nontraded goods industries. In addition, if the opening of the capital account inhibits the real exchange rate from depreciating sufficiently, it would become more difficult to manage the transition in the tradable sector from an illiberal to a new freer structure. As a result, a real appreciation can cause aggregate imports to increase above aggregate exports, leading to a squeeze on profitability in the tradable goods sector [Corden, 1982 and 1985]. The experience of Argentina in the late 1980s was an example that trade reform may be collapsed by this real appreciation effects of the capital account liberalization. See Michaely, Papageorgiou, and Choksi [1991].

McKinnon [1973, p. 161] further emphasizes that securing the full liberalization of foreign trade is inherently contrary to the use of foreign capital since capital inflows themselves may inhibit the complete removal of import restrictions during the liberalization and its aftermath. The so-called McKinnon Paradox of capital inflow is

\(^{14}\)For example, resources are likely to shift to the exportable sector if a real depreciation occurs following trade reform, while a real appreciation following capital account reform can stimulate resources to flow into the import-competing sector.
noted in Harberger [1982, p. 125], "if output stability is a desideratum, it is worth paying some price to avoid drastic changes in the rate of capital inflow." In a similar line, Dornbusch [1983, p. 176] argues that allowing the public to get into dollars by liberalizing the capital account before the required real depreciation has been achieved is the worst thing to do. This overvaluation problem during the liberalization process, what Bruno [1988] calls the 'Southern Cone Syndrome', has been proved to be unsustainable in the long-term as private agents commence to speculate through the process of acquiring foreign exchange and remitting it abroad, i.e., massive capital flight. The recent empirical study by Cuddington, among others, illustrates a significant positive relationship between overvaluation and capital flight [see Table 3 in Cuddington, 1986, pp. 22-23]. There is no doubt that all these arguments are in favour of the order of liberalization which opens the current account first.

The 'current account first' view has provoked a number of intuitive critiques. First, Stockman [1982] argues that McKinnon's descriptions of capital inflows after the opening-up of the capital account such as "extraordinary injection of foreign capital," and capital inflows to finance domestic investment "throw out incorrect market signals," are implicitly defined relative to an unspecified ideal. In general, it is hard to recognize what level of short-run capital inflows is McKinnon's unusual level and what degree of capital account liberalization will generate an extraordinary injection of capital [Edwards, 1984]. One may argue that excessive capital inflows associated with capital account liberalization are unsustainable in the long-run. But the reason that such capital inflows are not sustained in many cases is that the liberalization of trade is itself not sustained.

Second, let us follow Lal's [1987] arguments. Suppose that capital controls are maintained during the trade liberalization process, then the government will have to judge the precise extent of the nominal exchange rate change to yield the appropriate required real exchange rate at each point during the transition. If it misjudges, and hence the appropriate real depreciation is not generated, then it is always possible to have an incipient deficit in the balance of payments which the government may be tempted to reduce by import controls—thus aborting the trade liberalization. On the other hand, if the
misjudgement is such that the initial real depreciation is greater than that required in the final equilibrium, the real exchange rate would first appreciate and then depreciate, with unnecessary resource movements similar to those caused by the opening of the capital account. Lal's main point is that it is not apparent how one could determine the extent of real depreciation, and choose between these two alternative sets of unnecessary resource movements, in advocating one sequencing pattern over another.

Third, the proponents of the order of 'current account first' seem to emphasize too much the undesirable effect of capital inflows associated with the capital account liberalization, and neglects the obvious advantage of foreign capital. Mathieson [1979] shows that if capital inflows are properly anticipated they can be made a beneficial part of stabilization and reforms, creating a more rapid reduction of the inflation rate and a higher rate of growth. Similar arguments are provided in Lal's [1985] empirical analysis on Sri Lanka. Lal [1986, p. 218] also argues that capital inflows are obviously helpful as there i. a tremendous shortage of capital in developing countries, but economists exaggerate the harmful effects and forgetting the obvious advantage of capital inflows. Ahmed [1986b, pp. 179-181], in his comment on Harberger [1986], notes that "the instability of short-run capital is prone to being somewhat overrated--certain forms of short-run capital-for example, trade credit- are probably more stable than medium-term credit." Stockman [1982] states that "the real issue is whether capital inflows facilitate mutually beneficial exchange and help promote economic growth." Harberger [1982, p. 169] also agrees to the beneficial aspects of long-term sustainable capital inflows.

In fact, Lal [1987, p. 288] proposed the order of "capital account first," suggesting that: (i) remove the domestic capital market distortions; (ii) eliminate exchange controls with the announcement of a phased program for removing commodity market distortions; (iii) remove trade barriers. The essential message of Lal's sequencing suggestion is that it is in practice extremely difficult to judge the precise extent of the required nominal exchange rate change during the liberalization process. His contention to float is simply that it is better not to manipulate the nominal exchange rate during the transition because it is very difficult, and very easy to mismanipulate. The difficulty in obtaining the real
exchange rate at a right level is pointed out by several authors. Khan [1986] argues that since the real exchange rate is endogenous and responds to several factors, it may be very hard to obtain a correct level. Hansen and de Melo [1983, 1985] indicate that from Uruguay's experience it is exceedingly difficult to keep the real exchange rate stable. See also Fisher [1986], Stockman [1982], Lal [1987], Edwards [1989b], Ahamed [1986a], Mussa [1986], Khan and Lizondo [1987], and Helmers [1988]. The important point to make here is that it is important to obtain the equilibrium real exchange rate when a developing country embarks on the external reform. In this sense, Lal's sequencing proposal is that a country should open the capital account first by floating to generate the required nominal exchange rate automatically.

Historical cases of liberalization experiences have not provided a definitive answer on these sequencing debates. For example, a number of research suggest that Korea followed the conventional sequencing. See Kim [1991], Edwards [1988], and Sachs [1987]. Uruguay opened the capital account and deregulated the domestic financial market before liberalizing trade. Hansen and de Melo [1985, p. 935] note, "no major imbalances occurred before 1979, when the financial liberalization was completed and the real exchange rate did not appear to be in disequilibrium from the viewpoint of the allocation of resources in the long-run," and hence "its experience does not seem to support the common view that the current account should be liberalized before the capital account." Also, Corbo and de Melo [1987, p. 129] evaluate Uruguay's reform, "...none of the perverse side-effects, such as a real exchange rate appreciation, occurred so long as the exchange rate was not used to bring down inflation." They concluded that the debacle that ultimately resulted was mainly due to the adoption of the Tablita (the schedule of devaluation) in 1978. Fernandez [1985] and Calvo [1986a, 1986b] also indicate that the failure of reform in Chile and Argentina is largely due to the adoption of Tablita which is inconsistent with the capital account liberalization. See De La Cuadra and Hachette [1991] for the Chilean reform. In fact, a substantial appreciation did take place in Uruguay in the early 1980s, but trade reform was not reversed [Favaro and Spiller, 1991]. Israel's capital account reform brought about an appreciation, but at the end stage of gradual trade
reform, so that trade reform survived [Michaely, et. al., 1991]. However, as Edwards [1984] argues, Lal’s sequencing proposal may not be practical since he fails to take account of any necessary institutional arrangements before floating.

Khan and Zahler [1983] developed a stylized Latin American general equilibrium model and examined macroeconomic effects of the sequential liberalization of the balance of payments accounts; tariff cuts in the presence of capital controls, relaxation of capital controls in the presence of tariff, and simultaneous removal of restrictions in both accounts. Their experiments of sequential liberalization produce interesting results with regard to the theoretical arguments on the order of liberalization. They found little noticeable difference when the different sequences of liberalization policies were adopted, which is mainly due to the negligible effect of the capital account liberalization on prices and the real sector. These simulation results do not seem to vindicate the ‘current account first’ view. Khan and Zahler [1983, p. 264] themselves state that, “...these results do not indicate a clear-cut support for the proposition made by McKinnon [1982] and Frenkel [1982] that tariff reforms should necessarily take place prior to policy changes that affect capital movements.”

As we have seen, most sequencing discussions have neglected the structural distortions which are built in the economy, and have assumed implicitly the existence of an additional structural distortion standing in the way of a simultaneous and complete liberalization. Then, they proceed to analyze the second-best interactions of the liberalization of one of the two accounts with the existing restrictions on the other. The problem with this approach is that it ignores a second set of second-best interactions with the third implicit distortion which could be more significant. Hence, these models are not only unsuited for analyzing the optimal sequencing of liberalization when the current and capital account can both be tackled, but they also lead to possibly misleading sequencing recommendations when the restrictions can be removed only one at a time. Rodrik [1987]

15In addition to those historical evidence, whether capital controls are practically effective or not is questionable. Capital controls may work in the short-run, but in the medium- or long-run such restrictions are not sustainable because economic agents will find ways to evade them by incurring costs at the time when capital is transferred. See Gros [1987] and Arriazu [1985].
establishes a Keynesian-type model where an additional distortion is in the form of a wage-price distortion. The upshot of his analysis is to demonstrate that a policy which deals with restrictions on the current account and capital accounts simultaneously—without necessarily removing them both—will be generally superior to one which is concerned with one account at a time.

Kahkonen’s [1987] intertemporal model incorporates a structural distortion in the form of domestic financial repression in addition to the current and capital account distortions. Having abstracted from capital flight in his model, Kahkonen shows that the capital account liberalization yields a welfare gain even when the domestic financial market is distorted, and domestic financial liberalization in the presence of tariff reduces welfare. The paper also shows that trade liberalization and the capital account liberalization are to a large extent independent of each other, so that support for ‘trade account first’ view is similarly scant. Instead, the trade liberalization and domestic financial liberalization are interrelated; tariff reductions increase welfare unambiguously only if the domestic financial market has been liberalized, and the domestic financial liberalization will unambiguously generate welfare gains only under free trade. It appears that a simultaneous liberalization of trade and domestic financial liberalization would be beneficial in a financially repressed economy. In his comment on Kahkonen’s paper, Haaparanta [1988] shows that Kahkonen’s result that domestic financial liberalization in the presence of tariffs reduces welfare is weakened if capital flight is included. The intuition is that in a financially repressed economy an increase in capital flight tends to reduce total savings, which are below the social optimum due to financial repression.

In sum, the question of the order of liberalization was essentially generated by the liberalization experience of the Cone of South American countries, and no clear-cut analytical answer has been provided to this question. Also, empirically, the evidence is rather ambiguous. More robust empirical inferences would require a much wider range of liberalization experiences. At a theoretical level, it is inherently a tricky subject which involves welfare evaluation as well as macroeconomic issues. The important point to
make is that the effects of a particular order of liberalization themselves depend on the timing and the speed of that order, a subject which our discussion now turns to.

2.3 Timing of Trade Liberalization

Another important element which determines the transitional process of trade liberalization is policy timing and duration. The responses of the rational private agents would be different, depending on whether tariff reform is expected to be permanently maintained or it is anticipated to be short-lived, and whether or not tariff reductions are announced before implementation. In particular, the current account response upon which the success of reform is largely dependent, varies according to the timing and duration of reform, and thus we focus our review on the current account effects.

Traditional comparative static analysis of a tariff reduction demonstrates that tariff reform lowers the domestic price of importable goods and hence switches expenditure towards these goods, generating a current account deficit. If the growth of imports is matched by the growth of exports, the current account will be unchanged in a new equilibrium at a higher level of total trade. From the viewpoint of dynamics, however, the current account may deteriorate in the short-run since imports are instantly available as trade is liberalized, while exports may take time to grow through investment and market development. If a short-run deterioration of the current account is too large, the government may be induced to restrict imports again to improve the current account. Also, rational private agents, as the current account worsens, begin to anticipate either future devaluation or import controls, reinforcing current consumption. The recent country studies conducted by the World Bank provide a number of evidences which confirm that the survival of a liberalization policy is determined, first and foremost, by developments in the balance of payments position, particularly by the current account position [Michaely, Papageorgiou, and Choksi, 1991].

*Timing and the Current Account*
The effects of the timing of tariff reductions on the current account are analogous to the effects of terms of trade changes (improvements) on it. For this reason, it is natural to begin with the classic Harberger-Laursen-Metzler (H-L-M) proposition [Harberger (1950), Laursen and Metzler (1950)]. Their basic argument is that a deterioration in the terms of trade would lower real income and hence reduce saving out of any given level of nominal income, both measured in units of exportable goods. Consequently, the terms of trade deterioration will cause a current account deficit. This proposition is based on non-optimizing and static analysis, with no concept of the timing of the terms of trade change. As recently indicated by many authors, the current account—being the difference between saving and investment—is inherently a forward-looking variable. Thus, the question of how the timing of the terms of trade change affects the current account requires an explicit intertemporal analysis. Different effects of the different timing of shocks can be distinctive only in such a framework.

We again employ a Svensson and Razin-type two-period intertemporal optimizing model to discuss the timing issue. Similar frameworks can be found in Sachs [1981, 1982], Obstfeld [1982], Svensson and Razin [1983], Greenwood [1984], Edwards [1987b], Frenkel and Razin [1987], and Ostry [1988], among others. Slightly modifying equation (6) to yield:

\[ E(P_1(1, P_{m1}), \delta*P_2(1, P_{m2}), \nu) = R_1(1, P_{m1}, \nu) + \delta*R_2(1, P_{m2}, \nu) \]
\[ + \tau_1(E_{m1} - R_1) + \delta*\tau_2(E_{m2} - R_2) \]

which is exactly the same as (6), except that here we have trade distortions in both periods while there is no control on capital movements. Hence, the relevant discount factor is the world discount rate, \( \delta^* \). Other notations are as before. The current account for the present period can be written as

\[ CA^1 = R_1(1, P_{m1}, \nu) + \tau_1(E_{m1} - R_1) - P_1E_1 \]
where \( E_1 = \partial E / \partial P^1 \) is the overall consumption demand (compensated) in period 1. Totally differentiate (15) to examine the effects of the different timing of tariff reductions on the current account:

\[
\begin{align*}
(16) \quad dCA^1 &= [\tau_1(E_{m1m1} - R_{22}) - P^1E_{11}P^1_2]d\tau_1 \\
&+ [\tau_1E_{m1m2} - P^1E_{12}P^2_2]d\tau_2 + E_{1u}[\tau_1P^1_2 - P^1]du
\end{align*}
\]

which enables us to consider three cases: temporary tariff reduction \((d\tau_1 < 0, d\tau_2 = 0)\), permanent tariff reduction \((d\tau_1 = d\tau_2 = d\tau < 0)\), and anticipated future tariff reduction \((d\tau_2 < 0, d\tau_1 = 0)\).

**Temporary Tariff Reduction**

\[
dCA^1/d\tau_1 = \tau_1(E_{m1m1} - R_{22}) - P^1E_{11}P^1_2 + E_{1u}[\tau_1P^1_2 - P^1]du/d\tau_1
\]

where \(du/d\tau_1 = 1/\Omega[\tau_1(E_{m1m1} - R_{22}) + \delta^*\tau_2E_{m2m1}] \geq 0\). The first term, \(\tau_1(E_{m1m1} - R_{22}) < 0\), is the income effect associated with the net change in the consumption of importables evaluated at the initial level of tariff. The second term, \(-P^1E_{11}P^1_2 > 0\), is the direct effect of a period-1 tariff reduction. That is, a temporary fall in the relative price of importables only causes the consumption-based real rate of interest to fall. This is so because a fall in \(p_{m1}\) lowers the consumption-based price index in period 1, \(P^1\), with \(P^2\) and \(\delta^*\) being constant. As a result, the cost of current consumption relative to future consumption has reduced, which induces substitution of aggregate spending towards the present period. This causes the current account to worsen. The final term represents the wealth-equivalent of the change in the welfare level, and it is ambiguous since the negative period-1 welfare effect coexists with the positive period-2 welfare effect. That is, a lower tariff in period 1 acts to increase intertemporal welfare by increasing consumption of imports in that period, whereas it acts to reduce welfare by reducing imports consumption in period 2. Therefore, in general a temporary tariff reduction has ambiguous effects on the current account. If, however, the direct substitution (intertemporal) is sufficiently large, i.e.,
\( \tau_1 (c_{m1} - R_{22}) < P^1 E_{11} P^1_2 \) in absolute terms, and also if \( du/d\tau_1 < 0 \), the current account in the present period will deteriorate in response to a temporary tariff cut.

**Anticipation of Future Tariff Reduction**

\[
dCA_1/d\tau_2 = E_{12} P^2_2 (\tau_1 P^1_2 - P^1) + E_{1u} [\tau_1 P^1_2 - P^1] du/d\tau_2
\]

where \( du/d\tau_2 = 1/\Omega [\delta^* \tau_2 (E_{m2m2} - R_{22}^2) + \tau_1 E_{m1m2}] \geq 0 \). A fall in \( p_{m2} \) affects the real interest rate for consumption, causing expenditure switching towards period 2. There is also welfare effect, and it is again ambiguous. The future lower price of importables increases welfare if the negative income effect in period 2 outweighs the positive income effect in period 1, and conversely. If \( du/d\tau_2 < 0 \), both the direct substitution effect and welfare effect act to improve the current account in period 1, whereas if \( du/d\tau_2 > 0 \) the effect on the current account depends on which effect dominates (substitution or wealth).

**Permanent Tariff Reduction**

\[
dCA_1/d\tau = [\tau_1 (E_{m1m1} - R_{22}^1) - P^1 E_{11} P^1_2 + E_{12} P^2_2 (\tau_1 P^1_2 - P^1)] + E_{1u} (\tau_1 P^1_2 - P^1) du/d\tau
\]

where \( du/d\tau = 1/\Omega [\tau_1 (E_{m1m1} - R_{22}^1) + \delta^* \tau_2 (E_{m2m2} - R_{22}^2) + \delta^* \tau_2 E_{m2m1} + \tau_1 E_{m1m2}] \geq 0 \). As revealed, a permanent tariff reduction has also an ambiguous effect on the current account. Both welfare effect and direct substitution effect are ambiguous. If we impose some restrictions such that the unitary demands for the importables (i.e., its expenditure share) in both periods are identical, namely \( P^1_2 = P^2_2 \), and the present value of the initial tariff levels in both periods are the same, i.e., \( \tau_1 = \delta^* \tau_2 \), then the effect of a permanent tariff reduction on the current account is similar to the effect derived in the context of a static framework. Put differently, equiproporionate reductions in \( \tau_1 \) and \( \delta^* \tau_2 \) will necessarily improve welfare, which in turn acts to improve the current account. Also, equiproporionate tariff reductions would not generate any changes in the consumption rate of real interest, and therefore, there will be no intertemporal effect [Ostry, 1988].
Therefore, two main channels through which non-permanent reforms alter the current account have been demonstrated. First, the intertemporal substitution effect; a temporary tariff reduction lowers the cost of current consumption in terms of future consumption. This reduces the consumption-based real interest rate, which discourages saving and hence acts to deteriorate the current account today if the temporary cut occurs today, and to improve the current account if it is expected to occur tomorrow. Second, a fall in $p_{m1}$ increases welfare, and its magnitude depends on the changes in the net imports at the initial level of tariffs in both periods, which in turn will depend on the strength of a direct welfare effect in one period relative to an indirect welfare effect in the other period. As Svensson and Razin [1983] have demonstrated, a permanent reform will not have a large impact on the current account if both real income and spending rises by similar amounts (given homothetic preferences). The net effect of temporary reform depends on both the wealth equivalent of the change in the welfare level and the intertemporal substitution effect.

These analyses, however, abstract from the effect of the timing of the trade reform on the real exchange rates. Historic evidence reveals that trade reform in general alters both the level and composition of aggregate real spending, part of which falls on the nontradable goods. As a result, nontradable markets would be in disequilibrium during the transition if relative prices did not adjust. In order to establish market clearing, new real exchange rates will be required. The changes in real exchange rates will in turn feed back to influence the current account balance. Therefore, if we consider a nontraded good in the model as we have done in equations (9)-(11), both temporary and permanent tariff reductions will have an additional effect on the current account via changes in the real exchange rates. Although we omit the algebraic derivation for this, the intuition is straightforward. If a temporary tariff reform results in an equilibrium real depreciation in period 1, there will be an additional force which causes the current account to deteriorate since a real depreciation means a lower relative price of nontradables, and thus there will be substitution towards period-1 aggregate spending. Also, if a real appreciation occurs in period 2 following period-1 tariff reduction, there will be tendency to substitute
expenditure away from period 1, so that it acts to improve the current account in period 1. Edwards [1987b] and Ostry [1988] separately showed that whether tariff reform brings about real depreciation or real appreciation is ambiguous, depending on the intratemporal substitution effect between the importables and nontradables in addition to the intertemporal substitution effect and wealth effect. Thus, the effect on the current account will become more ambiguous.

Moreover, the effects of the timing of the terms of trade change on labour supply and production have been neglected in the above discussions. Bean [1986] produces the results that a temporary tariff reduction will improve the current account if a direct income effect is only partially offset by a wealth-induced rise in spending in the current period. This result is in line with the one obtained by Svensson and Razin [1983]. However, when production is variable, there will also be a wealth-induced fall in labour supply in both periods as well as a direct rise in labour demand in all sectors in the current period as the product wage falls. Consequently, the consumption wage rises in both periods inducing substitution away from leisure towards consumption, which in turn leads the current account balance to fall. Thus, the overall effect on the current account is ambiguous again.

On the other hand, Bruno [1984], Svensson [1984], Marion [1984], Marion and Svensson [1984], Obstfeld [1980], Matsuyama [1987], Lopez and Rodrik [1990], and Ostry [1991] examine the effects of the timing of productivity shocks, such as imported oil price changes, on the current account. Under certain conditions, a temporary fall in oil price causes the final goods production to rise, leading saving to rise, and hence the current account improves. A permanent productivity shock is ambiguous in general since in these models both saving and investment are commonly affected by the shocks. 16

As known, two-period models do not provide much room for dynamics for the current account mainly because a deficit in period 1 must correspond to a surplus in period 2, and vice versa. On the other hand, an infinite horizon analysis, as in Obstfeld [1980, 1982],

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16 Note that all these results contrast sharply with the traditional static view where whether or not tariff cuts worsen the current account depends largely on the import and export demand elasticities within each period.
is more suitable for the dynamic paths of the current account, but it requires an arbitrary restriction that the rate of time preference increases in wealth for the stability of the steady-state equilibrium. Obstfeld's [1982] prime objective is to show how the Laursen-Metzler effects may be reversed in his intertemporal model, although his conclusion that a permanent terms of trade improvement leads to a decrease in saving and hence a current account deficit, may be counterintuitive and unlikely. See Matuyama [1987, p. 300]. Persson and Svensson [1985] and Engel and Kletzor [1986, 1988] employ overlapping generation models to reexamine the Harberger-Laursen-Metzler proposition. They demonstrate that the response of the current account to tariff reform is sensitive to the modelling of saving behaviour. In a model in which the consumer's discount rate varies endogenously such as the Uzawa [1968]-Obstfeld [1982] form, saving falls with lower tariffs. This result may be reversed in the Blanchard [1985]-Yarri [1965] type model in which consumers have uncertain lifetime. In both models the response of the current account depends both on a production distortion effect which alters steady-state income and an effect on steady-state expenditure. Through the production effect, saving always falls when tariffs fall. However, in terms of spending effects, in the Uzawa-Obstfeld type model tariff reductions will reduce saving, in contrast to the uncertain lifetime model where the expenditure effect may lead to raise saving as tariffs fall.

Another additional important source which makes the current account effect of tariffs ambiguous comes through forward-looking investment behaviour – see Razin [1984], Marion and Svensson [1984], Sachs [1981], Bruno [1982], Svensson [1984], Helpman and Razin [1984], and Murphy [1988], who all deal with two-period models, however. It is clear that changes in tariffs will also have an impact on investment, and through it they can affect the current account. In the first place, if capital goods are imported (as is usual in developing countries), a reduction in tariffs will increase investment, leading the current account to deteriorate, and this effect may be substantial if a large portion of the country's investment goods are imported. If the increased investment raises the present value of lifetime income, saving is also likely to rise, producing an additional source of ambiguity in determining the current account.
Recently, Turnovsky [1990], Sen and Turnovsky [1988, 1989], Gavin [1990], and Roldos [1991] have emphasized the relationship between the timing of tariffs (or terms of trade change) and the current account, using the investment dynamics. An important feature of these models is that they incorporate adjustment costs in specifying the investment function. Sen and Turnovsky's [1988] one-sector model demonstrates that a fall in the long-run desired capital stock by the imposition of a permanent tariff causes an immediate reduction in the rate of investment, which in turn leads to a current account surplus. The declining capital stock is, however, accompanied by an accumulation of foreign bonds in his model. If the investment effect dominates, a current account surplus will be generated. Note that the surplus in this case stems from the fall in investment, not from the increase in saving as in H-L-M [1950] and Eichengreen [1981].

Turnovsky's [1990] other paper examines the effects of tariffs on the current account in the Hecksher-Ohlin framework, and finds that the dynamics depend on the relative capital intensities of the import-competing consumption good sector and the nontraded investment good sector. Gavin [1990] establishes a key link between the price of the nontraded good, the real interest rate, savings and investment, and the current account. He illustrates that if the substitutability in consumption between traded and nontraded goods is low, then an improvement in the terms of trade leads to a transitory current account surplus, and conversely.

Roldos [1991] incorporates the stylized production structure of developing economies into the model. He demonstrates that a permanent reduction in tariffs generates a current account surplus, as the import-competing sector spreads the decline of the desired capital stock over time. A temporary reduction in tariffs has ambiguous effects, depending on the duration of temporary reform. If the size and duration of the tariff reduction are large enough, a strong response in investment could outweigh the reduced saving, and the current account will improve. For small and short-lived tariff reform, too much

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17The model is based on a dynamic sector-specific framework where the importables are a capital as well as a consumption good. However, a shortcoming of this model is that the dynamics of the exportable sector is ignored and hence investment takes place only in the importable sector. The effects of the timing of tariffs also depend largely on this formulation.
investment in the present period reinforces the current account deficit caused by the consumption distortion.

Sen and Turnovsky [1989] show that regardless of the timing of the terms of trade change, the short-run dynamics of the economy depend on the long-run response of the capital stock, which in turn consists of a negative substitution effect, together with a positive income effect. If the substitution effect (between consumption and leisure) dominates, the current account goes into deficit since the terms of trade improvement generates an investment boom. By contrast, if the income effect dominates, the shock reduces investment, resulting in a current account surplus. In the latter case, the H-L-M proposition is vindicated, not through savings but through the investment side.

Note that there are intertemporal monetary optimizing models of tariffs, developed by Kimbrough [1982, 1985], Michener [1984], Vegh [1988], and Fender and Yip [1988], and non-optimizing models by Eichengreen [1981], and Edwards [1989a]. The essential message of these models is that changes in tariffs distort the choice between consumption goods and asset holdings, and as a consequence substitution between financial assets and consumption goods occurs. In these frameworks, the capital account could be endogenously determined. Thus, these models can also be utilized to examine the sequencing issue by assuming some distortions in transactions in both accounts. For this approach, see Aizenman [1985] and Edwards [1989a], among others.

2.4 Speed and Credibility of Trade Reform

The issue of policy credibility has increasingly become an important topic in macroeconomics. It has been developed within the anti-inflationary stabilization and monetary literature, and it has had a major influence on the evolution of ideas concerning macroeconomic policies. The point is that if the government does not establish credibility of its policy announcements, then any new attempt will be met with skepticism, and this exacerbates the undesirable effects on the critical macro variables. In the trade liberalization literature, the credibility issue has been discussed in an insightful fashion.
The core argument is as follows: trade reforms that are not believed to be long-lived will not only fail in terms of welfare-improvement, but will also be detrimental to the macroeconomic performance. This is mainly because the lack of credibility creates a distortion in the intertemporal structure of relative prices. Excessive spending will occur in the presence of intertemporal substitution and resources will not shift as they will under perfect credibility. Both micro and macro costs will be incurred. Thus, Rodrik (1989b, p. 3) argues that a reform lacking credibility can therefore prove as bad as no reform at all.

In a series of papers, Calvo [1986a, 1987a, 1988] provides the formal analysis of the costs of the lack of credibility of reform in terms of the current account and welfare. His papers also establish the functional equivalence between the lack of credibility and the policy temporariness. The intuition is as follows. The gains from trade literature argues that free trade is optimal in the sense that it maximizes output at world prices if free trade is going to be the policy followed in the entire future of the economy. However, if we were to anticipate that sometime in the future a liberal policy will be reversed, the question is: is the liberalization policy still optimal today?

The answer is no, and he shows in his simple model that a temporary liberalization always ends up with a lower welfare. He further argues that the detrimental effects of a temporary trade liberalization policy may become more pronounced as the liberalization period is shortened. The current account deficit becomes bigger, the shorter is the period of liberalization. Calvo's results may be weakened (as Calvo himself recognizes) if his one-good model is extended to a two-good model or to include a larger menu of assets. However, the important lesson from these examinations is that expectations alone may render a reform policy that would be optimal if credible into a suboptimal one. His simulation results indicate that the costs of the imperfect credibility of trade reform may not be negligible, particularly when they are compared with the usual estimates for the costs of protection. Calvo's analyses have been extended by Aizenman [1991] and Reinikka [1992], who examine the costs of incredible trade reform on both consumption and production.
Rodrik [1989a], uses a two-period and one-good model, to make a similar point that the welfare costs of the imperfect credibility arise from the intertemporal distortion introduced by the private sector's anticipation of future reversal. Rodrik's point can be illustrated by the following simple analysis. In order to highlight intertemporal distortion caused by the lack of credibility, we assume that only one imported good is consumed (and not domestically produced) and output of exportable goods is given. The intertemporal equilibrium condition is given by

\[(17) \quad E((1+\tau_1, \delta(1+\tau_2), u) = \bar{Y}_1 + \delta \bar{Y}_2 + \tau_1(E_1 - \bar{Y}_1) + \delta \tau_2(E_2 - \bar{Y}_2)\]

where \(\bar{Y}_1\) is the fixed output of exportable goods in period \(t\). For simplicity, we treat \(\tau_2\) as the certainty-equivalent level of the second-period tariff. Total differentiation yields

\[(18) \quad \left(E_u - \tau_1 E_{1u} - \delta \tau_2 E_{2u}\right) du = (\tau_1 E_{11} + \delta \tau_2 E_{21}) d\tau_1 + ...\]

It is clear from equation (18) that the future tariff anticipation (with certainty in this case) acts as an intertemporal distortion.\(^\dagger\) This is represented by the term \(\delta \tau_2 E_{21}\), and this acts to reduce welfare. The intertemporal distortion is caused by the artificial reduction in the consumption rate of real interest, resulting in sub-optimal levels of saving in the economy. Rodrik [1989a, p. 762] argues, "the economy suffers from an anticipated but unrealized reversal in the trade reform in exactly the same way that it would from an actual reversal." He concludes that a lack of credibility is functionally equivalent to unsuccessful reform.

In Rodrik [1989a, 1989c] and Engel and Kletzler [1987], the credibility level is endogenized. In the model of Engel and Kletzler [1987], the government's lack of credibility is represented by a set of beliefs the private sector holds about the type of government it faces. Next they endogenize beliefs by allowing the private sector to update them using Bayes' rule. They argue that the welfare-maximizing government must

\(^\dagger\)The result will also hold in the case of uncertainty. That is, if there is a probability of future tariff imposition, then welfare deterioration is proportional with that probability. See Froot [1988].
postpone liberalization as long as incredibility persists. However, with learning process, the government eventually adopts free trade policy. The endogeneity of the level of credibility of reform is also emphasized in the model developed by Froot [1988]. Using Svensson and Razin-type two-period model, he derives the optimal speed of liberalization as well as optimal level of credibility. Like the results obtained by Calvo and Rodrik, Froot also stresses that the lack of credibility of trade reform acts as a distortion which becomes intensified under the typical first-best policy of immediate liberalization. On the investment side, Rodrik [1989c] and Aizenman [1991] examine the relationship between the return differential between sectors in the private investment and incredibility. Rodrik [1989d] also examines a positive relationship between incredibility and fiscal imbalance. In all these models, endogenous incredibility stems from policy uncertainty.

One of the reasons why credibility problems arise is the dynamic inconsistency of trade reform. The government may find it desirable ex ante to follow an open trade system, but once firms reallocate their capital and consumer's saving decisions are made, it may be tempted to reverse policies to compensate the losers (import-competing sectors) or for balance of payments reasons. In other words, before some choices have been made by the private sector, an optimal reform policy expects some responses of private behaviour to occur. But ex post, after the choices have been made, the response to reform may be different from the ex ante expected response, which makes the government's ex post constraints different from the ex ante constraints. Then, there is an ex post incentive to deviate from the ex ante optimal policy, creating a credibility problem. This means that free trade is optimal, but is time-inconsistent. Lapan [1988] points this out; if the government can change tariffs ex post, then the announcement is essentially irrelevant, and the standard optimal tariff will not be time-consistent.

Staiger and Tabellini [1987, 1988] also indicate the time-inconsistency of free trade policy. Their results crucially depend on the decision order between the three economic agents; government, consumer, and producer, which produce a one-shot game between

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19Rodrik's [1989c and 1989d] model is an application of hysteresis model initiated by Dixit [1989]. Krueger's [1989] asymmetric information model is also along a similar line.
them. In a dynamic optimization model, however, if the same static one-shot game were repeated an infinite number of times, or if an element of symmetric information were incorporated into the finitely repeated game, then the policy-maker would face incentives to maintain or to establish a reputation, which may eventually blur the distinction between the optimal and time-consistent liberalization policy [Barro and Gordon, 1983].

One important but yet unresolved question which is closely related to the credibility of reform is the speed at which it should be implemented. Should a liberalization program be implemented gradually or in a drastic way? The case for gradualism is well known. It relies on prudence and on the smooth tuning during the implementation. Little, Scitovsky, and Scott [1970] favour gradualism on the ground that radical reform is likely to produce huge adjustment costs. Michaely [1986] argues that gradualism is favoured in terms of minimizing the political opposition to trade reform. Rodrik [1989b] seems to be against gradualism, arguing that the adjustment costs on their own do not constitute a reason for gradualism. This is also the point made by Mussa [1986].

The most popular analytical approach to the question of the speed of trade reform is to consider a two-period intertemporal model with tariff distortions (or other distortions such as capital controls) in both periods. An abrupt reform implies zero tariffs in both periods, while a gradual reform implies a positive tariff in period 1 and a zero tariff in period 2. Given this framework, we then ask what is the optimal tariff in period 1, and find that indeed positive tariffs (small) in period 1 and zero tariffs in period 2 are optimal in the second-best sense. It suggests that with intertemporal distortion of the type considered in two-period models, it is optimal to carry out the reform gradually. For this approach, see Leamer [1980], Edwards and van Wijnbergen [1986], Rodrik [1987, 1989a], Edwards and Ostry [1989], Kahkonen [1987], and Froot [1988].

Some arguments against gradualism have also been raised. Fisher [1986] argues that the problem with gradualism is that the shock measures can be postponed until later, and then the painful measures will not in fact be implemented when the time comes, and hence the required restructuring does not occur. Frenkel's [1983] contention that "gradualism merely postpones the application of drastic treatment" uses the same logic. Rodrik
[1989b] says that it is true that a series of small adjustment hurts less than a one-time big adjustment and it is privately and socially beneficial to absorb shocks over a number of years. He continues, "...but this confuses the speed at which the policy is introduced with the speed at which the adjustment in the private sector takes place...," and argues that there is no case to slow down the adjustment further by phasing in the reform gradually on economic efficiency grounds. He then asserts that credibility will generally be enhanced by a reform which is larger in magnitude, but narrow in scope, and says "as long as the scope of reform is kept appropriately narrow at each successive stage, gradualism has little to recommend to itself; the cold-turkey strategy is preferable on efficiency as well as credibility grounds." See also Wolf [1986] and Whalley [1989].

Corden's [1987, p. 20] argument seems to support these points; "...the longer between the formal commitment and its actual implementation, the greater the opportunity for interest groups to slow up or even halt liberalization and the more likely it is that expectations about credibility of the government intentions will be undermined." Mussa [1987] also argues that if the credibility is in jeopardy it will discourage movements of resources out of the import-competing sector and into the expansion of exports. A too slow reform will create doubt about its seriousness and encourage the political forces opposing liberalization. He continues, "excessive timidity can be as damaging as excessive aggressiveness." Stockman [1982] suggests, "if the main issue is to establish credibility, this can be best be understood not by relaxing constraints gradually in some particular order but by simultaneously making major reductions in controls on all parts of the economy."

There are, however, few empirical findings concerning the speed of trade liberalization. Even the existing empirical findings do not provide a definitive answer, repeating the theoretical indeterminacy of the speed of the trade reform. For example, Whalley [1989] is in favour of gradualism; "initial rapid liberalization experiments in the 60s and 70s in Brazil, Argentina, and Chile, proved to be unsustainable in the longer-run..., in contrast, in Asian NICs and near NICs, trade liberalization has been much more incremental. Initial steps were small and less dramatic than in Latin America...which has
been sustained in the longer-run." He also takes Korea as an example of gradualism in its trade reform. See also Kim [1991].

In contrast, Michaely, Papageorgiou, and Choksi [1981], in the World Bank study of trade liberalization episodes in 19 developing countries, conclude that the likelihood of survival of a liberalization attempt is substantially higher when the initial policy measures undertaken are intensive and significant; reluctant policy actions which lead to gradual action, are much more likely to cause a failure. A minor initial policy movement is likely to be regarded as temporary and loses credibility. They continue, "...in no country has a first major attempt at liberalization collapsed, and a subsequent minor attempt succeeded." They also claim that "in the majority of the country studies, authors have concluded that implementation of the liberalization policy should have been faster than it has actually been." The reason may be that, surprisingly, in their 19-country study a serious adjustment cost (particularly in the form of unemployment) following trade reform is not found. As Corbo and de Melo [1987] mention, "indeed trade liberalization in Argentina and Uruguay was too little, too late, and too slow." Bruno [1988] also states that the problem of credibility did not arise initially in Chile because the drastic liberalization program was carried out very rapidly. In general there is little doubt that credibility of reform and its speed is crucial to determine the long-term survival of liberalization policy. An initial intensive program of reform may help to enhance the government's credibility.

Theoretical analysis of this issue is currently incomplete and unresolved, and also empirical investigations have been limited in the sense that they are not based on a controlled analysis. Further, static simulation studies have not been capable of analyzing the issues here. In this sense, intertemporal multi-sectoral simulation analyses could be useful to examine the main issues.20

2.5 Summary and Conclusion

20See de Melo [1988], Robinson [1989], Shoven and Whalley [1984], and Dervis, de Melo, and Robinson (1982), for the introduction (and survey) and application of a computable general equilibrium model to trade policy issues in developing countries.
Three broad issues related to external liberalization have been reviewed in this chapter: the order of liberalization of the current and capital account, the timing and duration of trade liberalization, and the speed and credibility of trade reform. These topics have received increasing attention from academics as well as policy-makers in developing countries. The convenient tool of intertemporal analyses has facilitated a detailed examination of these issues. Based on our selective survey, the following summaries emerge.

When a simultaneous and instantaneous liberalization of the current and capital account is not feasible, whether or not trade reform must precede a relaxation of capital controls becomes important. Despite many efforts, the existing literature does not provide a definite answer to this question. We have concentrated our discussion on the welfare consequences of alternative orderings using prototype intertemporal frameworks, and concluded that from the second-best perspective almost anything can happen in terms of aggregate welfare following a partial reform. The real exchange rate adjustment can also go either way. It seems that the proponents of the order of 'current account first' concentrate on the unnecessary resource switching following the capital account liberalization when the economy requires a real depreciation in response to trade reform. The real appreciation could prevent productive resources from shifting out of the importable sector into the exportable sector. The opponents against this sequencing argue that floating is the best way to avoid the volatility of the real exchange rates during the transition. The emerging consensus is that whichever sequencing a country adopts, maintaining the real exchange rates at the right level to support export promotion is crucial to successful reform. The misalignment of the real exchange rate during the liberalization process can generate some macroeconomic costs such as current account deficits or large debts, which have been the prime cause of liberalization failure in many developing countries.

The timing of trade reform is another important area that has attracted increasing concern. Whether trade reform is expected to be maintained long, or it is perceived to be terminated soon, whether the government announces the reform program before
implementation or conducts it immediately without announcement, the relative price signals perceived by the private agents are in general different. Different policy timing can generate different time paths for crucial variables such as the individual's welfare and the current account as a result of the individual's optimizing behaviour. We have discussed some channels through which trade reform affects these variables: intratemporal substitution effects, intertemporal substitution effects, and wealth effects. Also, the real exchange rates and the real wages can be additional channels via which the current account and welfare are influenced. Although the effects of different policy timing are generally ambiguous, potential costs for temporary reform were unanimously indicated.

A number of analyses have demonstrated the functional equivalence of the lack of credibility and the temporariness of trade liberalization. If the reform is perceived to be temporary by the private agents, even though the government proclaims that it will be permanent, then the anticipation of the future reversal of liberalization creates another intertemporal distortion in the economy. The consumer would consume more imports before they become expensive. Temporary trade reform also tends to increase future production opportunities in the importable industry relative to the exportable industry. Hence, the imperfect credibility undermines an important motivation for lowering tariffs to begin with: resource realignment. If intertemporal substitution is large, a larger current account deficit in the present period will be generated. The private sector envisions this and expects the reform to be reversed, and again consumes more in the current period. Eventually tariffs will go up.

Hence, it is not free trade that is optimal, but a credible free trade policy that is optimal. Some argue that to enhance credibility the reform must be intensive in its magnitude. However, one can argue that if the reform is abrupt, the costs during the adjustment periods may be substantial. The debate over gradualism continues both theoretically and empirically. To investigate interactions between our issues in a consistent way, a numerical simulation study which can integrate consumption-investment dynamics into a multi-sectoral intertemporal general equilibrium setting would be useful, since in that we can distinctively investigate the effects of the effects of various
durations of timing horizon, gradualism versus cold-turkey strategies, and welfare and macroeconomic effects of trade reform with and without capital controls.
CHAPTER 3

TRADE LIBERALIZATION, CAPITAL CONTROL, AND THE CURRENT ACCOUNT: TIMING AND SEQUENCING

3.1 Introduction

The purpose of this chapter is to examine the dynamic effects of trade liberalization, in the form of a reduction of tariffs, on welfare and the current account. The role of capital controls during trade reform is also discussed, and some arguments for a conventional sequencing of external liberalization, current account first, are made. We also discuss the effects of different time horizons of trade policy. This is done by investigating the costs of temporary trade reform in terms of both the current account deficit and the welfare index, and comparing them with its permanent counterpart.

The analysis relies much on the intertemporal optimization framework. It incorporates optimizing agents with perfect foresight. The model attempts to capture in a simple way some of the most salient macroeconomic feature of developing economies, including the existence of exchange controls reflected by the spread between the official and the parallel exchange rate, and trade distortions in the form of import tariffs on consumption goods. Broadly speaking, two main theoretical strands are involved in our model; the currency or asset substitution and the dual exchange rates literatures. The former strand is inspired by Calvo and Rodriguez [1977], and later developed and applied in a number of open economy analyses, along with portfolio balance models. The latter has also been used extensively in analyzing the effects of capital controls in developing countries. These types of models have been shown to be useful in the examination of a country's balance of payments in relation to individual's asset choice problem. The model is thus able to

1See, Calvo [1985], Vegh [1988], and Engel [1989], among others.
analyze the effects of changes in the economy's relative price structure on both goods and asset markets, and as a result on the current and capital accounts.

Our dual exchange rate system can be interpreted as equivalent to *capital controls* because the outcome concerning the behaviour of the economy under dual rates can be shown to apply also to an economy operating with a single exchange rate and quantity controls on international capital flows. See Gardner (1985), Dornbusch (1986), and Phylaktis (1988), among others. The use of a dual exchange rate system, whether it is an institutional arrangement or it is a consequence of a growing-up of a parallel foreign exchange market due to exchange controls, generates a flexible wedge between the official exchange rate and a freely determined financial rate. This wedge discourages the individual's portfolio diversification since it acts as an effective tax on holdings of foreign assets by residents [Adams and Greenwood, 1985]. In this dual rates regime, individuals neither buy nor sell foreign bonds abroad, and any foreign exchange earnings must be converted immediately into domestic money at the central bank. Put differently, the private sector as a whole cannot change its net foreign claims. The only way to alter the economy's net foreign asset position over time is through changes in the balance of payments accounts, which is the current account when there is quantitative restrictions on international capital transactions [Obstfeld 1986]. In this process, the central bank acquires foreign bonds while the private sector accumulates real balances, and conversely.

Using this framework, three issues in trade liberalization are examined. First, we examine the dynamic paths of the economy in response to trade reform when both goods and assets are considered in the individual's choice problem. Second, we analyze the dynamic effects of trade reform when capital controls of a dual exchange rate type are

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2Both cases are common in developing countries, see Edwards (1989a).
3We assume that there are no domestic bonds, or that domestic bond market operates but they are perfect substitutes for foreign bonds.
4One implication of this type of capital restriction is that the relative price change in the real sector is accompanied by wealth effects which can spill over into asset markets. However, a dual rate type of capital controls seems to have largely been neglected in the trade policy literature. Recent exceptions are Aizenman [1985], Bhandari [1989], and Bhandari and Vegh [1990], but Aizenman's model is a non-optimizing one and Bhandari's is a simulation model. On the other hand, a number of real models which assume quantity controls have been developed, see Edwards and van Wijnbergen [1986] and van Wijnbergen [1989], among others.
effective, and distinguish them from the case of free capital mobility. Finally, the effects of permanent versus temporary trade reform on the current account and welfare are compared. Also, the importance of the duration of temporary of reform is also examined, and some potential costs of temporary reform are investigated.

The results suggest that a permanent unanticipated trade liberalization causes the current account balance to fall in the short-run as it induces the consumption of both imports to rise. Individual's real money balances will drop during the transition through the current account deficit. In the long-run, the effects on individual's real balances are ambiguous since the net output gains brought about by a depreciation of the real commercial rate in response to reform act to increase real balances. When capital controls are in effect through the dual exchange rate regime, individuals anticipate the real financial rate to fall as their real wealth rises and the marginal utility of consumption correspondingly falls. Consequently the appreciation of the real financial rate takes place.

When trade reform is done under a single fixed rate, the current account effect of trade liberalization would be bigger since a higher real wealth generated by trade reform can induce individuals to demand more foreign bonds (at a given exchange rate). Hence, the current account deficit caused by the trade reform will be magnified if accompanied by an outflow of capital. This may suggest that the existence of quantitative capital control in the form of the dual rates may have the effect to alleviating the current account deficit brought about by trade reform, through the price adjustment in the parallel exchange market. If one of the government's objectives is a smaller current account deficit during trade reform, it will be required to maintain capital controls in our model. In this sense, the analysis favours the McKinnon-Frenkel [1982] order of liberalization of the balance of payments accounts: opening of the current account before the capital account.

Temporary trade liberalization is shown to worsen the current account. In addition, it is demonstrated that under certain circumstances the current account deficit today (when reform is in effect) worsens as the duration of temporary reform becomes shorter. The reasoning is that the opportunity cost of consuming during the periods when temporary reform is in effect in terms of consuming after reform has ended diminishes as the
duration of temporary policy gets shortened, leading to a higher consumption (and a higher current account deficit) in the initial periods. In other words, the consumption rate of real interest when the reform is in effect is relatively lower, inducing a large substitution in consumption towards the periods of temporary reform.

We also show that temporary reform is sub-optimal in the sense that welfare gains are smaller than permanent reform. The shadow price of wealth falls relatively less following reform in the temporary case, accompanying smaller wealth effects, which in turn yields smaller consumption and welfare gains. As the time horizon of temporary reform becomes shorter, the marginal value for wealth drops far less, resulting in almost no welfare-improving effects of trade reform. Welfare is maximized in permanent reform and is minimized in the extreme temporary policy, and also in some cases of a strong intertemporal substitution the trade balance initially deteriorates most in temporary reform.

The remainder of this chapter proceeds as follows. Section 2 establishes an analytical framework and spells out the consumer's intertemporal optimization problem. A perfect foresight equilibrium is then defined and the model is solved in Section 3. In Section 4 the effects of trade liberalization and its dynamics are examined, and some implications of the sequencing of external reform are drawn. The effects of a supplementary fiscal policy is also discussed. Section 5 then analyzes the effects of temporary trade reform, and the issues of timing and duration are highlighted. Section 6 concludes. Finally, the Appendix provides technical details.

3.2 Analytical Framework

Consider a small open developing economy which is characterized by both commercial and financial restrictions in its international transactions. The commercial restriction is assumed to be in the form of nominal tariffs whereas external financial repression is modelled by recognizing the existence of parallel market for foreign assets mainly because the government effectively controls the convertibility of domestic and foreign assets. The authority's restrictions on private capital flows generate a parallel
financial rate which is freely determined to clear the market for capital transactions, and it diverges from (and is normally higher than) the officially fixed commercial exchange rate.\textsuperscript{5}

The model consists of three sectors: producers, consumers, and the government. All consumers and firms are assumed to be identical, enabling us to focus on a representative of each type. There are three goods in the model, but it is assumed that firms produce only two types of goods, exportable goods and nontradeable goods, using only one variable factor of production, referred to as labour. It is assumed that there is no growth in resources in this economy. The representative consumer and the government consume two goods, nontradeables and import goods. The latter goods are not produced domestically and are subject to an ad valorem tariff. The consumer allocates wealth between the two assets, domestic money and foreign bonds.

The production structure is modelled in a simple way. The firm produces either exportable or nontradeable good by hiring labour input to maximize profit. Labour is supplied inelastically and assumed to be perfectly mobile across sectors. Under the assumption of perfect competition and factor market clearing, we can derive the following supply functions:

\begin{equation}
\begin{align*}
(1) & \quad y_x = y_x(p_n), \quad \frac{\partial y_x}{\partial p_n} < 0 \\
(2) & \quad y_n = y_n(p_n), \quad \frac{\partial y_n}{\partial p_n} > 0
\end{align*}
\end{equation}

where \( y_x \) is output supply of the exportable good, \( y_n \) is output supply of the nontradeable good, and \( p_n \) is the relative price of the nontradeable in terms of the exportable good. The exportable good is taken as the numeraire. We assume that the world price of export good is given at unity \( (p_x^* = 1) \), and hence the domestic price of export good is just \( E_c \) where \( E_c \) is the exchange rate (pegged) for commercial transactions. Denoting the absolute price of the nontraded good as \( p_n \), then the relative price of the nontraded good in terms of the

\textsuperscript{5}In the present framework, financial liberalization policies can be interpreted as either a policy that increases foreign assets in the hands of private sector, or as a policy which can eliminate the wedge between the two rates such as the exchange rates unification.
export good is \( p_n/E_c \) which we denoted as \( p_n \) in equations (1) and (2). Thus, \( 1/p_n \) is defined as the real exchange rate. Consequently, an increase in \( p_n \) represents a real appreciation, and vice versa. The signs of the partial derivatives imply that an appreciation of the real exchange rate will raise nontradeable output but lower output in the exportable sector as resources shift between sectors.

The representative consumer is assumed to maximize discounted flow of utility over an infinite horizon, subject to the wealth accumulation constraints. The consumer's problem at time zero (the 'present' time) is to maximize

\[
\int_{0}^{\infty} \left( U(c_m, c_n) + V(h) \right) e^{-\delta t} \, dt
\]

where \( c_m \) and \( c_n \) are consumption of the imports and the nontradeables, respectively, \( h \) is the stock of real money balances (units are explained below), and \( \delta \) is the positive rate of time preference (fixed). The utility functions, \( U:R^2 \to R \) and \( V:R^1 \), are increasing \( (U_m > 0, U_n > 0, V' > 0) \), twice differentiable and strictly quasi-concave \( (U_{nm} < 0, U_{mm} < 0, U_{nn} < 0, V'' < 0) \). The two consumption goods are assumed to satisfy the Inada conditions - for instance, \( \lim_{c_m \to 0} U_m(c) \to +\infty \), and \( \lim_{c_m \to +\infty} U_m(c) \to 0 \), implying that the agent will not wish to specialize in either consumption of imports or nontradeables as long as both have positive prices. In addition, for expositional simplicity, the subutilities of \( U(\cdot) \) and \( V(\cdot) \) are assumed to be additively separable, postulating that the marginal rate of substitution between consumption goods, \( U_m(\cdot)/U_n(\cdot) \), is independent of the individual's demand for money.\(^6\)

The consumer's total stock of nominal wealth (\( A \)) consists of nominal stocks of domestic money (\( H \)) and foreign bond (\( B \)): \( A = H + EB \), where \( E \) is the exchange rate (freely determined) for financial transactions. The foreign bond bears interest at a fixed world interest rate, \( r^* \). The quantity of foreign assets is assumed to have been inherited with the fixed amount \( (B = \bar{B}) \) initially, and from the present time the effective capital

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\(^6\)The economic consequences of the assumption of the strong separability in terms of the uniqueness of the state state equilibrium are discussed in Anderson and Takayama [1977, p. 347], Brock [1975, pp. 147-148], Obstfeld [1986], and Michener [1984].
control is prevailing throughout the economy. The stock constraint in real terms can then be written as

\[ a = h + b \]  

where \( a = \frac{A}{E_c} \), \( h = \frac{H}{E_c} \), \( b = \left( \frac{E}{E_c} \right) \bar{B} \), and we let \( \frac{E}{E_c} = \gamma \) (i.e., \( b = \gamma \bar{B} \)) where \( \gamma \) is the spread between the financial and the commercial nominal exchange rates and may be interpreted as the real rate for financial transactions. The individual's total income consists of current income from the production of the two types of goods, exportable and nontradable goods, plus interest income from foreign bond holdings, plus net capital gains given by the expected rate of depreciation of the real financial rate. Hence, the rate of change in the individual's real wealth is given by the following equation:

\[ \dot{a} = p_n y_n + y_x + r^* \bar{B} + \dot{\gamma} - \pi h - p_m c_m - p_n c_n \]  

where in the RHS of (5) \( p_n y_n + y_x \) is income from current production, \( r^* \bar{B} \) represents real interest income from holdings of foreign bonds, repatriated at the commercial rate \( (r^* \bar{B} = \bar{E_c} r^* \bar{B} / E_c) \), \( \dot{\gamma} (= \dot{\gamma} / \dot{\gamma}) \) is the expected rate of depreciation of the real financial rate, \( \pi \) is the rate of inflation which is equal to the rate of devaluation of the commercial rate, i.e., \( \pi = \bar{E_c} E_c \), and the final two terms represent expenditure on imports and nontradables. \( p_m \) is the domestic relative price of the imported good with \( p_m = E_c (1 + \tau) p_m^* / E_c = (1 + \tau) p_m^* \) where \( \tau \) is an ad valorem tariff and \( p_m^* \) is the fixed world price of imports. The initial condition is

\[ a(0) = a_0 \]

where \( a_0 = h_0 + b_0 \). We rule out the possibility that the economy can run up an indefinite credit or debt with the rest of the world: the transversality (or boundary) condition is

\[ \lim_{t \to \infty} a(t) e^{-\tau t} = 0 \]  

\[ ^7 \text{Note that } \pi \text{ is assumed to be constant after } t = 0. \]
Then, the accumulation condition (5), using (4) and (6), can be integrated to yield the following lifetime budget constraint at time 0:

\[ a_0 + \int_0^\infty [p_n y_n + y_x - p_m c_m - p_n c_n - ((r^* + \gamma)/\gamma + \pi)h] e^{-rt} dt = 0 \]

where \((r^* + \gamma)/\gamma\) can be interpreted as the domestic real interest rate, \(r\), and \(r + \pi\) can then be regarded as the nominal interest rate. Thus, the expenditure concept embodied in equation (7) consists of spending on consumption and spending on liquidity services, the real price of the latter good being the nominal interest rate, \((r^* + \gamma)/\gamma + \pi\). In other words, the real rate of return on holding foreign assets includes the rate of depreciation of the real financial rate in addition to the world interest rate. The rate of depreciation of the real financial rate equals the nominal financial rate (capital gain) minus the nominal commercial rate (inflation rate: capital loss). The opportunity cost of holding domestic money is the rate of domestic inflation which in this case is the rate of devaluation of the nominal commercial rate plus the real interest rate, which is the nominal interest rate. Therefore, the lifetime budget constraint (7) states that the present value of future expenditure (i.e., consumption plus the opportunity cost of holding domestic money) should be equal to the all-inclusive measure of wealth (the initial wealth plus the present value of future income receipts).

To set up the microfoundations of the individual's money demand, we follow the useful analytical device of the *money-in-the-utility function* approach in which the domestic money appears as an argument in the utility function. This *money-in-the-utility function* approach was inspired by Sidrauski [1967], and has been used in examining various issues on inflation and international monetary economics. Possible justifications are that money directly gives utility, or money provides a *real convenience*.
yield which can induce agents to hold it [Samuelson, 1968, p. 8], or the utility function can include money by means of a transactions costs argument [Brock, 1974]; money provides the non-pecuniary services by reducing the costs of exchange of goods. The use of real balances promotes more efficient exchange and hence saves costly resources such as time and capital. Some other approaches, such as the Clower constraint and the overlapping generations models, have been adopted, but no single approach has been fully satisfactory as a true monetary theory of why money is held. Concrete discussions on this subject appear in Barro and Fisher [1976], Kareken and Wallace [1980], McCallum [1983], and Feenstra [1986].

The representative consumer's intertemporal optimization problem is to maximize lifetime utility, as given by (3), by choice of the time paths of $c_m, c_n, h$, and $b$ subject to the lifetime budget constraints (4) and (5), with the nonnegativity conditions $c_m, c_n, h$, and $b \geq 0$ for all time ($t > 0$); taking (6) and the time paths of $E_c, \tau, p_m^*, \pi$, and $r^*$ as given. The Lagrangean form for the maximization problem of the household is given by

$$H(c_m, c_n, h, b, \lambda, \lambda^1) = [U(c_m, c_n) + V(h)] e^{-\delta t}$$

$$+ \lambda [p_n y_n + y_x + r^* B + \hat{y} b - \pi h - p_m c_m - p_n c_n] + \lambda^1 (a - m - b)$$

where $\lambda$ is the Lagrangean multiplier associated with the flow budget constraint equation, (4), and can be interpreted as a shadow price in terms of foregone utility of accumulating a unit of wealth. $\lambda^1$ is the Lagrangean multiplier associated with the stock constraint (5). As shown in Appendix 3.1, the first order conditions for this problem can be summarized by the following relations:

$$\frac{U_n(c_m, c_n)}{U_m(c_m, c_n)} = \frac{p_n}{p_m}$$

$$\frac{V'(h)}{U_m(c_m, c_n)} = \frac{r^*/\gamma + \pi + \hat{\gamma}}{p_m}$$

$$\frac{p_m V'(h)}{U_m(c_m, c_n)} = (\pi + \delta) - \frac{\dot{U}_m}{U_m}$$
where $U_m(\cdot)$ and $U_n(\cdot)$ are the marginal utilities of consumption of imports and nontradeable goods, respectively, and $\dot{U}_m = dU_m(\cdot)/dt$. Equation (8) shows that the marginal rate of substitution (MRS) between the two consumption goods must equal their relative price, and equation (9) is just the MRS condition between consumption of importables and real balances. Equation (10) illustrates that at an optimum the MRS between real balances and the consumption of importables must equal the subjective cost of postponing present consumption, $\delta$, plus the opportunity cost of money holdings, less the rate of increase in the marginal utility of consumption of that good. By our assumptions of the quasi-concavity of the utility functions, the Inada conditions, and the transversality condition, the Sufficiency Theorem for optimal controls states that any solution which satisfies the necessary conditions, (8)-(10), is optimal [Arrow and Kurz, 1970, p. 49].

The condensed efficiency conditions, (8), (9), and (10), can now be used to derive the dynamics of the system. From equation (8) we may write consumption of the nontradeable good as a function of the consumption of the imported good and the two relative prices:

\[(11) \quad c_n = c_n(c_m, p_n, p_m)\]

As will be explained later, the government is assumed to consume the nontraded goods. Then, the market clearing condition for the nontradeable good is

\[(12) \quad y_n(p_n) = c_n(c_m, p_n, p_m) + g_n\]

where $g_n$ is the government's consumption of the nontradeable goods. Equation (12) generates the equilibrium price of the nontradeable goods as a function of the prices and quantity of imports, and the level of government consumption of the nontradeable good:

\[(13) \quad P_n = P_n(c_m, p_m, g_n)\]

Substituting (13) into (11) yields
(14) \[ c_n = c_n(c_m, p_m, g_n) \]

where the signs of the partial derivatives of \( c_n \) can readily be derived (see Appendix 7.2): \( \partial c_n/\partial c_m > 0, \partial c_n/\partial p_m < 0, \) and \( \partial c_n/\partial g_n < 0. \) Equation (9) produces the evolution of the real financial rate over time, and then equation (10) can be used to derive the dynamic equation governing the time path of the consumption of imports. Both dynamic equations are also derived in Appendix 7.1. The rate of change of the consumption of import is given by

(15) \[ \dot{c}_m = \Gamma [(\pi + \delta) (U_m(c_n(c_m, p_m, g_n), c_m) - p_m V(h))] \]

where \( \Gamma = 1/[U_{mm} + U_{mn}(\partial c_n/\partial c_m)] < 0. \) The rate of change of the real financial rate is given by

(16) \[ \dot{\gamma} = \left[ \frac{p_m V(h)}{U_m(c_n(c_m, p_m, g_n), c_m) - (\pi + \tau^* \gamma)} \right] \]

To characterize the equilibrium of this economy, it remains to specify the government budget constraint. The fiscal authority finances an exogenous consumption of both the imported and nontradeable goods through the tariff revenue and the expansion of central bank credit. We assume that the fiscal authority does not issue interest-bearing bonds. Then, the government budget constraint is

(17) \[ p_n g_n + p_m g_m = \tau p_m c_m + \dot{D}/E_c \]

where \( g_n \) and \( g_m \) are the government's real consumption of the nontraded and import goods, respectively, in units of export goods. \( c_m \) represents the tariff revenue collected, which implies that the government's imports are not subject to tariffs, and \( \dot{D}/E_c \) is the change in domestic credit. The money supply rule in real terms can be written as

(18) \[ \dot{h} + \pi h = \mu h + \dot{R} \]

---

12 This is obtained by substituting (A10) of Appendix 3.2 into \( \Gamma. \) Kimbrongh [1985, p. 261] derives a similar equation, but he neither considers nontradeable goods nor capital controls.
where \( \mu \Delta h = \dot{D}/\dot{E}_c \) and \( h + \pi h = \dot{H}/\dot{E}_c \) are used, with \( \mu \) denoting a constant ratio of real money stock.\(^{13}\) Equations (17) and (18) yield the rate of accumulation of foreign reserves, \( \dot{R} \),

\[
\dot{R} = \nu_p \nu c_m - \nu h s_n - \nu m s_m^* + \dot{h} + \pi h
\]

From (4), we obtain

\[
\dot{a} = \dot{h} + \dot{\bar{B}}
\]

which explicitly illustrates that domestic residents are prohibited from transacting with foreigners in world capital markets.\(^{14}\)

Equating equation (20) with (5) generates the evolution of real money balances:

\[
\dot{h} = \nu h y_n + y_x + r^* \bar{B} - \pi h - \nu m c_m - \nu h c_n
\]

From equations (19) and (21), and using (17), we obtain

\[
\dot{R} = \nu h y_n + y_x + r^* \bar{B} - \nu m c_m - \nu h c_n - \nu h s_n - \nu m s_m^*
\]

The interpretation of (22) is that the net accumulation of foreign assets by the economy as a whole is equal to the current account balance, i.e., income minus absorption, as should be the case in any well-defined open economy analysis. Imposing an equilibrium condition in the nontradeable goods market into (22) yields an alternative expression for the current account surplus:

\[
\dot{R} = y_x + r^* \bar{B} - \nu m c_m - \nu m s_m^*
\]

---

\(^{13}\)The monetary authority's money supply rule is such that at any time \( H = D + \dot{E}_c R \) where \( H \) is the base money supply (nominal), \( D \) is domestic credit, and \( R \) is the foreign exchange reserve in foreign currency. Thus, \( \dot{H}/\dot{E}_c = \Delta D/\dot{E}_c + \dot{R} \), which is equivalent to (18) of the text.

\(^{14}\)Since the central bank is assumed not to intervene in the financial markets, the stock of foreign bond holdings is the constant stock of net foreign assets at the time when the dual rate system was adopted. At any point of time free financial rate would adjust to clear market and prevent any net flow of capital. An individual cannot adjust his portfolios through the banking system. This feature is one of the key characteristics of the presence of dual exchange rates system where nominal money supply is now given at any moment in time and can only change over time through the current account.
Then, the following expression for the evolution of the real balances can be derived from equations (18) and (23), using (17):

$$
\dot{h} = y_x + r^*B - p_m^*c_m - p_m^*g_m + (\mu - \pi)h
$$

which can equivalently be represented as $\dot{h} = y_x + r^*B - \pi h - p_m c_m + p_n \varepsilon_n$. Throughout the paper, we assume that $\mu - \pi < 0$, otherwise the economy would be unsustainable in the long run. Equations (23) and (24) indicate that if the government finances its deficit by printing money at the rate $\mu$ which is also the rate of inflation, then the only source of change in the real money stock is the current account, that is, $\dot{R} = 0$ schedule coincides with $\dot{h} = 0$ schedule.

3.3 Perfect Foresight Equilibrium

We combine the optimality conditions (8)-(10), together with the dynamic equations (15) and (16), the accumulation equation for real money balances (24), (11) and (13), and summarize the economy’s perfect foresight equilibrium with the following set of equations:

$$
\begin{align*}
\frac{U_m(c_m, c_n(c_m, p_m, \varepsilon_n))}{U_n(c_m, c_n(c_m, p_m, \varepsilon_n))} &= \frac{p_m(c_m, p_m, \varepsilon_n)}{p_n} \\
\frac{p_m V'(h)}{U_m(c_m, c_n(c_m, p_m, \varepsilon_n))} &= (\pi + \delta) + \frac{\dot{U}_m}{U_m} = 0 \\
\delta - r^*/\gamma - \gamma - \frac{\dot{U}_n}{U_n} &= 0 \\
\dot{c}_m &= \Gamma[(\pi + \delta)(U_m(c_n(c_m, p_m, \varepsilon_n), c_m) - p_m V'(h)] \\
\dot{h} &= y_x(c_m, p_m, \varepsilon_n) + r^*B - p_m^*c_m - p_m^*g_m + (\mu - \pi)h
\end{align*}
$$

15See Brock [1974, 1975] again. For dynamic optimization and optimal control, see Long [1988], and for differential equations see Ross [1984].
where equation (13) has been substituted into these equations.

A perfect foresight equilibrium is characterized by the conditions in which (1) the non-tradeable goods market clears (2) the government's budget balances (3) money supply equals its demand, and (4) expectations are instantaneously and simultaneously fulfilled in parallel with the relevant optimality conditions. Hence, equations (12) and (25)-(30) provide the basis for the short-run and long-run analysis of the model and its response to policy shocks. Next, we shall determine both the steady state equilibrium and the evolution of the dynamic system.

**Steady State Equilibrium**

The economy's steady state equilibrium is attained when the following conditions are simultaneously satisfied: (i) the current account is balanced ($\dot{\tilde{h}} = 0$), (ii) the rate of change of the two (commercial and financial) nominal exchange rates are the same ($\dot{\gamma} = 0$), (iii) the rate of change of the consumption of imports is zero ($\dot{\tilde{c}} = 0$), (iv) the nontradeable goods market clears, and (v) fiscal policy is sustainable ($\mu = \pi$). These conditions imply that

\[
\text{(31)} \quad y_x(\tilde{p}_n(\tilde{c}_m, \tilde{p}_m, \tilde{e}_n)) + \gamma B - p_m^* \tilde{c}_m - p_m^* e_m = 0
\]

\[
\text{(32)} \quad (\gamma + \delta)(U_n(\tilde{c}_m, \tilde{p}_m, \tilde{p}_n(\tilde{e}_m, \tilde{p}_m, \tilde{e}_n)), \tilde{c}_m) = p_m V(\tilde{h})
\]

\[
\text{(33)} \quad \frac{p_m V(\tilde{h})}{U_n(\tilde{c}_m, \tilde{p}_m, \tilde{p}_n(\tilde{e}_m, \tilde{p}_m, \tilde{e}_n)), \tilde{c}_m} = \left[ \pi + \frac{r^*}{\gamma} \right]
\]

\[
\text{(34)} \quad y_n(\tilde{p}_n) = c_x(\tilde{e}_m, \tilde{p}_m, \tilde{e}_n) + \tilde{e}_n
\]

where a tilde denotes the steady-state value for the corresponding variables. It can be readily calculated that (32) and (33) yield $\tilde{\gamma} = r^*/\delta$. The steady state equilibrium is obtained in the following recursive way. Given the exogenous parameter values in the steady state, equations (31) and (32) simultaneously determine the steady-state values for
c_m and h. Then, c_m determines the steady-state level of the real commercial exchange rate $1/p_n$ in (34), which in turn determines output of both goods. The equilibrium values for c_m and h also independently determine the equilibrium value for $\gamma$ in (33), by which the steady state level of real bond holding (and hence real wealth) is determined. This steady-state equilibrium will not be altered unless other exogenous shocks occur. Note that in determining the steady-state real commercial rate, monetary variables do not play any role. The real commercial exchange rate in the long-run is determined solely by the real fundamental variables, as has been stressed in Edwards [1989a, pp 6-9] and Williamson [1983, p. 14].

**Solution of Dynamic System**

To analyze the dynamics of consumption of imports, real balances, and the real financial rate, the system of three differential equations (28)-(30) is linearized around the steady-state equilibrium:

\[
\begin{bmatrix}
\dot{c_m} \\
\dot{h} \\
\dot{\gamma}
\end{bmatrix} =
\begin{bmatrix}
Z_{11} & Z_{12} & Z_{13} \\
Z_{21} & Z_{22} & Z_{23} \\
Z_{31} & Z_{32} & Z_{33}
\end{bmatrix}
\begin{bmatrix}
c_m - \bar{c}_m \\
h - \bar{h} \\
\gamma - \bar{\gamma}
\end{bmatrix}
\]

(35)

where $[Z]_{3 \times 3} \equiv Z_{ij}$ $(i, j = 1, 2, 3)$ are the elements of the coefficient matrix of the system:

- $Z_{11} = (\pi + \delta) > 0$, $Z_{12} = -p_m V'' \Gamma < 0$, $Z_{13} = 0$,
- $Z_{21} = (\partial y_x / \partial c_m) - p_m^* < 0$, $Z_{22} = (\mu - \pi) < 0$, $Z_{23} = 0$,
- $Z_{31} = -\gamma p_m V/U_m^2 > 0$, $Z_{32} = \gamma p_m V''/U_m < 0$, $Z_{33} = (p_m V'/U_m - \pi) > 0$.

It can be derived that

- $\text{Trace } [Z] = \delta + \mu + [(p_m V'/U_m) - \pi] > 0$
- $\text{Det } [Z] = [(p_m V'/U_m) - \pi] \left( \pi + \delta(\mu - \pi) + p_m V'' \Gamma[(\partial y_x / \partial c_m) - p_m^*] \right) < 0$.
where a positive trace of $[Z]$ implies that there is at least one positive root in the characteristic equation. The determinant of $[Z]$ is negative, implying that there is either one negative root (strictly, negative real parts) or three negative roots. Both stability conditions indicate that there is one negative eigenvalue in the solution, and this yields a saddle point equilibrium. The slope of the saddle paths in $(c_m, h)$ space and $(h, \gamma)$ space, respectively, can be shown to be positive. This means that in $(c_m, h)$ space the consumption of imports moves in the same direction with the individual’s holding of real money balances along the stable adjustment trajectory. Also, along the stable path in $(h, \gamma)$ space a real depreciation of the financial exchange rate accompanies the accumulation of real balances. The solution and the slope of the saddle path are shown in Appendix 3.3.16

The recursivity of the system allows us to examine the dynamic movement of the consumption of imports and real money balances independently of the evolution of the real financial rate, enabling us to utilize a phase diagram in $(c_m, h)$ space without reference to movements in $\gamma$. Since the dynamics of $c_m$ and $h$ do affect the dynamics of $\gamma$, the dynamic analysis in $h$ and $\gamma$ space will subsequently be followed, from which we can investigate the interaction between the real and financial variables.

It can be shown that the slope of $\dot{c}_m = 0$ in $(c_m, h)$ space is positive $(dc_m/dh|_{c_m=0} = -Z_{12}/Z_{11} > 0)$ and that of $\dot{h} = 0$ is negative $(dc_m/dh|_{h=0} = -Z_{22}/Z_{21} < 0)$. These loci are drawn in Figure 3.1. The upward-sloping $\dot{c}_m = 0$ schedule implies that at a higher level of consumption of imports, real money balances must also be higher (given $\gamma$ and other parameters) in order to keep the rate of change in the consumption of imports at zero. The $\dot{h} = 0$ locus slopes downward since an increase in the consumption of imports can only be achieved by a decumulation in real money balances to balance the current account. The positively-sloped saddle path, $SS$, in $(c_m, h)$ space was explained above. It is obvious that the crossing point of these two differential equations in Figure 3.1, e, determines $\bar{c}_m$ and $\bar{h}$, and that these equilibrium values will only be influenced by changes in $P_m$ and other policy parameters.

16For examining the stability of the dynamic system, see Gandolfo [1980], among others.
17Notice that $\gamma$ does not enter either equation (28) or (29).
Having determined $\bar{c}_m$ and $\bar{h}$, the corresponding equilibrium value for the real financial rate, $\bar{\gamma}$, can be determined at $e$ in Figure 3.2. Also, the corresponding equilibrium real commercial rate can be determined in $(c_m, p_n)$ space, as drawn in the left quadrant of Figure 3.1.
Suppose that the economy’s initial consumption of imports and the real money balances are respectively denoted by $c_m_0$ and $h_0$ in Figure 3.1. There exists a corresponding value of $\gamma_0$ (which clears the asset market) on the unique stable path in Figure 3.2, and hence a specific domestic value of foreign assets, $\gamma_0B$ at that time. In addition, the corresponding unique real exchange rate $1/p_n_0$ on the saddle path in Figure 3.3 exists. This shows that the initial consumption level and real balances are below their long-run equilibrium levels. Since they are on a unique stable trajectory, SS, the economy evolves towards the steady-state equilibrium, $e$, over time. If consumption of imports and real balances are initially low as at $c_m_0$ and $h_0$ in Figure 3.1, the adjustment path is characterized by rising import consumption and rising real money balances. Also, along the stable path in Figure 3.2, rising real balances is associated with a rising real value of foreign assets by a depreciation of the real financial rate. This is so because given the fixed amount of foreign bonds in the private sector, increasing holdings of the real balances can only be achieved by the current account surplus, and therefore to regain asset compositional equilibrium the real financial rate must depreciate.

The left quadrant of Figure 3.1 depicts the real exchange rate movement during the transition. As the consumption of the imports increases along the saddle path, the consumption of the non-traded good will fall due to substitution. To restore equilibrium in the nontraded good market, the price of the nontraded good must fall, resulting in a real depreciation in the commercial rate until the system approaches to the steady-state. Overall, the transition from the initial position to the steady-state, $e$, is explained by the rising consumption of both goods, the rising real balances, a gradual fall in saving, reducing the current account surplus, the rising real value of foreign assets due to capital gains associated with the financial depreciation.

Note that on the supply side, however, the real depreciation of the commercial rate increases the production of the exportable goods and reduces the production of the nontradeable goods, labour moves away from the nontraded good sector into the export sector.\(^{18}\) This export boom induces the current account balance to improve during the

\(^{18}\)Note that imports are not produced domestically.
transition. The net effect of the real depreciation on the current account is thus ambiguous. In the steady state, the current account is balanced and the real money stock is constant. The premium of the capital account rate is constant as the nominal financial rate changes at the same pace as the nominal commercial rate. There is no excess demand or supply in the nontraded goods market.

3.4. Trade Reform under Capital Controls

Steady-State Effects

We start by examining the steady-state effects of an unanticipated permanent reduction of a tariff. The initial equilibrium given by point e in Figure 3.1 will obviously be disturbed by this tariff liberalization policy since a lower tariff implies a lower relative price of imports. The lower price of imports causes \( c_m = 0 \) locus to shift to the left and \( h = 0 \) schedule to shift upward. The shift in the \( c_m = 0 \) locus is given by \( \frac{dc_m}{dp_m} |_{c_m=0} = \frac{V' - (\pi + \delta)U_{mn}(\partial c_n/\partial p_m)\Gamma}{Z_{11}} < 0 \), and the shift in the \( h = 0 \) schedule being given by \( \frac{dh}{dp_m} |_{h=0} = \frac{-(\partial y_x/\partial p_m)}{Z_{22}} < 0 \). This is drawn in Figure 3.3 where a new long-run equilibrium at \( e' \) is characterized by a higher level of consumption of imports and a lower level of real money balances than the initial tariff equilibrium. Note, however, a lower real balances in the new steady-state is not necessarily be always the case (refer to explanation below). The algebraic expressions of these effects are shown in Appendix 3.4.

The steady-state effects of a lower tariff can be explained as follows. First, a lower relative price of imports alters the consumer's choice between consumption goods, as well as between consumption and real balances. As long as the two consumption goods are not perfectly substitutable, i.e., as long as both goods are consumed, there will be a substitution towards consumption goods away from real balances. That is, both loci of \( c_m = 0 \) and \( h = 0 \) are affected. However, whether the new steady-state real balances are lower or higher than their original level is ambiguous, depending mainly on the relative
strength of substitution between consumption goods and consumption and real balances, and income effects.

That is, since the production is variable in this model, a lower price of imports induces consumers to reduce their consumption of nontradeables, which brings down the price of nontradeables. That is, a real depreciation of the commercial exchange rate takes place. This increases (reduces) output in the exportable (nontradeable) sector.\footnote{See equation (A24) in that if the term $K_2$ is zero, then there will be no output effects, and hence $d\hat{h}/dp_m$ will unambiguously be positive, i.e., the current account is in deficits in the new steady-state.} If the net output increases, then it acts to increase individual's real balances. If this positive effect on real balances is exactly offset by the negative effect on real balances (i.e., substitution away from real balances), then the $c_m = 0$ and the $h = 0$ loci will shift by the same amount, leaving the steady-state real balances unchanged, namely, the current account in the long-run balances. If, however, as shown in Figure 3.3, gains in real balances (by output gains) falls short of losses, real balances in the new steady-state are lower than the original steady-state level. The crucial factor is the magnitude of changes in the real exchange rate (for commercial transactions). According to Figure 3.3, we have a higher consumption of imports, but a lower level of real balances, than the initial stationary equilibrium.

Now what happens in the steady-state real financial rate in response to trade reform? To examine this, it is useful to write down an algebraic expression for this:

$$\frac{dy}{dp_m} = \left[ -Z_{31} \frac{d\hat{c}_m}{dp_m} - Z_{32} \frac{dh}{dp_m} + K_3 \right] \frac{1}{Z_{33}}$$

where $Z_{31} > 0$, $Z_{32} < 0$, $Z_{33} > 0$, and $K_3 > 0$. This equation suggests that the response of the steady-state real financial rate to trade reform depends largely on the responses of the steady-state consumption of imports and real balances.\footnote{Recall the recursivity of the system.} Suppose, as represented in Figure 3.3, that trade reform reduces the steady-state real balances, i.e., $d\hat{h}/dp_m > 0$ (with $d\hat{c}_m/dp_m < 0$), then $dy/dp_m > 0$. That is, the real financial rate in response to a permanent trade reform appreciates in the long-run. This can be explained as follows. A lower price
level caused by a tariff cut increases individual's real wealth. This induces a current account deficit in the new steady-state at a given level of the financial rate. To preserve a current account balance, i.e., to keep a change in real balances at zero, a real appreciation must occur in the new steady-state. Note, however, there is a possibility that the net gains in output are large by a sufficient depreciation in the real commercial exchange rate, and in this case trade reform can increase the steady-state level of real balances and therefore the effects on the real financial rate are ambiguous.

**Impact and Transitional Effects**

Then, what do the transitional dynamic paths look like? When the shock of the tariff reduction occurs, the price of imports becomes cheaper, and therefore the individuals instantaneously increase their consumption of imports and the economy jumps up to point q on the new saddle path in Figure 3.3.

\[ (c_m(0) - \bar{c}_m) = \frac{Z_{12}}{(Z_{11} - \nu_1)}(h_0 - \bar{h}) \]

The initial increase in the consumption of the imported goods can be derived from the relationship \((c_m(0) - \bar{c}_m) = \frac{Z_{12}}{(Z_{11} - \nu_1)}(h_0 - \bar{h})\), which indicates that the transitional...
response partly depends on the steady-state effects. The initial response in consumption of imports is given by

\[
\frac{\text{dc}_m(0)}{\text{dp}_m} = \frac{\text{dc}_c}{\text{dp}_m} + \frac{Z_{12}}{(Z_{11} - \nu_1)} \frac{\text{d} \bar{r}}{\text{dp}_m} < 0
\]

which indicates that the initial response (at time 0) of the consumption of the imported goods depends upon the changes in the steady-state values of \(c_m\) and \(h\) as well as in the slope of the stable trajectory itself. As revealed in equation (36), and drawn in Figure 3.3, an initial increase in the consumption of the imported good lies above its new steady-state level. This reflects that in the short-run individuals increase consumption by substituting away from real balances. During the transitional adjustment, the consumption of imports (and the nontraded goods) falls. The real money holding also falls along with the current account deficit, although the rate of decrease diminishes over time as the economy approaches towards the new steady-state equilibrium point, e'.

Implications of Capital Controls

What are the implications of this adjustment in response to trade reform when the capital account transactions are controlled by the authority? When the capital account transactions are controlled through dual exchange rates, the trade liberalization policy was shown to entail wealth effects via changes in the financial exchange rate. When trade reform goes into effect, the current account (and hence the balance of payments) moves into deficit, overall consumption is high relative to its ultimate level, and the marginal utility of consumption is low. Thus, the real financial rate exceeds its steady-state level, and falls toward it as the economy converges to external equilibrium. As a result, a deficit associated with a lower tariff is accompanied by a falling (appreciation) financial exchange rate during the transition of liberalization. The initial movement of the real financial rate is given by:

\[
\frac{\text{dy}_0(0)}{\text{dp}_m} = \frac{\text{dy}_0}{\text{dp}_m} - \frac{\psi_{31}}{\psi_{21}} \frac{\text{d} \bar{r}}{\text{dp}_m}
\]
where $\psi_1/\psi_2$ is the slope of the saddle path in $(\gamma, h)$ space (see (A22) in Appendix). Equation (37) indicates that the initial movement of $\gamma$ is ambiguous even $d\gamma/dp_m > 0$ and $dh/dp_m > 0$ are assumed. Figure 3.4 shows this. If the steady-state effect of a tariff cut on the current account is too large, then the real financial rate immediately rises, as drawn by $S'S'$ in Figure 3.4 and in upper part of Figure 3.5, whereas if the steady-state effect on the real financial rate is relatively greater, then the saddle path in $(\gamma, h)$ will shift down and hence $\gamma$ initially falls ($S''S''$ in Figure 3.4 and lower part of Figure 3.5). The former case produces overshooting of $\gamma$ and the latter undershooting result.\footnote{See, for example, Aizenman's nonoptimizing model where the zero derivative locus for the real financial rate does not shift by tariff, generating undershooting result [1985].}

The case of an initial fall in the financial rate can be explained as follows. When tariffs fall, the new steady-state real financial rate, $\bar{\gamma}'$, is anticipated to fall. This expectation discourages the demand for foreign bonds, which induces the real financial rate to fall immediately after tariff reform. Also, the real balances drop via the current account deficit caused by a reduction of tariffs. To restore the current account equilibrium, the real financial rate (at a given quantity of foreign bond) will fall (at a lower rate, however)

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{3.4.png}
\caption{Trade Reform and Real Financial Rate}
\end{figure}
continuously until the economy will reach a new equilibrium where the current account is balanced fully.

On the other hand, the possibility of an initial rise in the real financial rate can be explained as follows. Lower prices of both types of goods are associated with a higher real wealth in terms of those goods. The higher real wealth induces the consumers to demand more foreign bonds, and again with the fixed quantity of bonds, equilibrium in the asset market requires an immediate rise in the price of foreign bonds. This creates the expectation of a future drop in the real financial rate, which causes the demand for foreign assets to fall, resulting in the actual fall in the real financial rate over time when the expectations are fulfilled.

In sum, the current account is in deficit during the transition of tariff reform, and the real money balances will drop to preserve the rate of change of real balances at zero (the current account balance). When capital control is in effect through the dual exchange rates, a reduction in real balances is not sufficient to eliminate the current account
pressure, and consequently the appreciation of the real financial rate up to a new steady-state equilibrium is required.

Note, however, that if there were no restrictions in capital transactions via having achieved a single unified exchange rate, then \( \gamma \) would be fixed and \( B \) would be variable. Individuals can always swap domestic money for foreign bonds and therefore there is no disequilibrium in asset markets. Therefore, the increased wealth caused by lower prices associated with trade reform can bring about an increased demand for foreign bonds, which implies an outflow of capital, i.e., a capital account deficit at a fixed unified rate. Real balances will drop correspondingly. Hence, in this case the foreign reserve losses caused by trade reform will be magnified by capital transactions. The existence of capital control (quantity control) in the form of the dual rates may alleviate the current account burden brought about by trade reform through changes in the freely determined financial exchange rate. We thus have the following proposition.

*Proposition 3.1* When the net output gains are negligible, trade reform under dual rates causes the steady-state real financial rate to appreciate, whereas under a single fixed rate capital outflows can occur. Thus, the current account deficit under capital controls is smaller than in a regime with liberalized capital transactions [Aizenman, 1985].

This may support the order of opening the current account before the capital account. Figure 3.7 draws the time paths of the current account in response to tariff reform when there are and are not capital controls.

*Notes on Supplementary Fiscal Policies*

The model predicts that trade liberalization is likely to generate deficits in the current account during the transition. Capital control in the form of the dual exchange rates may work in reducing these current account deficits, as examined. However, capital controls

\[ \text{[Aizenman, 1985]} \]

The proposition is under the assumption that the purchase of foreign bonds increases in the free capital regime. However, if a more complicated model where income can fall in response to trade reform, then the demand for foreign bond may decrease.
of the dual rates system are not sustainable in the long-run, as indicated by many authors. Macroeconomic policy mix may be required to minimize undesirable effects of trade reform. An active role of the government to tackle a transitional problem may be called for. Here we discuss a fiscal policy of an unanticipated and permanent reduction in domestic government spending.

The effects of a reduction in government consumption can be divided into two sub-cases where the effects can be different; a reduction in government consumption of import goods or nontradeable goods. The examination for the former can be relatively simple since it would not (ceteris paribus) change the level of private consumption, but mainly has current account implications (by the ß equation). The cut in government consumption would contribute to improving the current account balance, depending on the share of the government’s imports in total imports.\(^\text{23}\) However, changes in government consumption on imports essentially do not alter the total resources available in the private sector since it would not change the relative price structure in the economy. On the other hand, changes in government consumption of the nontraded goods affect the price of nontradeable goods, and thus the current account through changes in the real commercial rate. The changes in the real commercial rate have also output effects.

Suppose that the government reduces its spending on the nontraded goods. Unlike the changes in government’s consumption of imports, the cut in government’s consumption

\(^{23}\)In general, the government consumption of imports takes a small proportion in total import consumption, and hence there may be limits in reducing the government consumption of imports. In the case of Korea, in 1987 the government consumption of imports is almost none.
of the nontraded goods would increase the available resources in the private sector. If the reduction in \( g_n \) is not fully offset by a reduction in the production of the nontraded goods, the private sector must increase \( c_n \) to clear the market. If the two consumption goods are assumed to be complementary, then \( c_m \) will rise, which would act to deteriorate the current account as individuals will substitute away from real balances into consumption goods. However, the cut in \( g_n \) reduces the relative price of nontradeable goods, which causes a real depreciation in the commercial rate. This increases output in the exportable, and this acts to improve the current account during the transition. Therefore, the effects are in general analytically ambiguous. The comparative static results for this discussion are contained in Appendix 3.4.

### 3.5 Costs of Temporary Trade Reform

We now turn to the examination of the dynamics related to the timing of trade reform. Especially, we concentrate on the economic consequences of temporary trade reform and its potential costs, and compare those with the ones in the case of permanent reform. In order to highlight our issues, we start from a simple setting.

**Intertemporal Consumption Substitution**

The simplest description of temporary trade reform in an infinite horizon framework is that \( p_m = p_m^0 \) for \( 0 \leq t \leq T \) and \( p_n = p_n^0 \) for \( T < t \). That is, a free trade policy is maintained from time 0 to time \( T \), and an ad-valorem rate \( \tau \) afterwards, so that \( p_m^0 = p_m^* \) and \( p_m^+ = p_m^*(1 + \tau) \). Using (13), (14) and (A1), we obtain

\[
\theta(c_m, p_m) = \lambda p_n.
\]

where \( \theta(c_m, p_m) = U_m(c_n(c_m, p_m, p_n(c_m, p_m)), c_m) \). The signs of the partial derivatives of \( \theta \) function are: \( \theta_1 = U_{mn}(\partial c_n/\partial c_m + (\partial c_n/\partial p_n)(\partial p_n/\partial c_m)) + U_{mm} < 0 \) and \( \theta_2 = U_{mn}(\partial c_n/\partial p_m + (\partial c_n/\partial p_n)(\partial p_n/\partial p_m)) > 0 \). Let us assume that there exists import consumption level of \( c_m^0 \) which corresponds to free trade price \( p_m^0 \) and that of \( c_m^* \)

\[24\] Note that \( g_n \) is omitted for simplicity.
corresponding to a distorted price, \( p_+ \). Equation (39) can be divided into two equations:

\[ \vartheta(c_m^0, p_m^0) = \lambda p_m^0 \quad \text{and} \quad \vartheta(c_m^+, p_m^+) = \lambda p_m^+ \]

This implies the following relationship between the marginal utilities of the consumption of imports at different points in time:

\[ \frac{\vartheta(c_m^0, p_m^0)}{\vartheta(c_m^+, p_m^+)} = \frac{p_m^0}{p_m^+} < 1 \]

which implies that, with \( \vartheta_1 < 0, c_m^0 > c_m^+ \), the present consumption of imports (from time 0 to T) is greater than the future consumption (time T afterwards) when the liberalization is expected to be temporary.

Then, what will happen to consumption as the trade liberalization policy is expected to be more temporary? Intuitively, the shorter is T, the smaller is the effect on \( c_m^+ \) at any given level of \( c_m^0 \). Therefore, the opportunity cost of \( c_m^0 \) in terms of future utility diminishes as T gets smaller, leading to a higher consumption of \( c_m^0 \). Remembering that consumption and money are separable in the utility function, equation (26) and (27) can be written as

\[ p_n(c_m, p_m)V'(h) = U_n(c_n(c_m, p_m, p_n(c_m, p_m)), c_m)(\pi + r^* + \gamma), \]

which can be written as

\[ h = h(c_m, p_m, \pi + r^* + \gamma) \]

with \( h_1 < 0, h_2 > 0, \) and \( h_3 < 0 \). Therefore, there exists numbers \( h^0 \) corresponding to \( c_m^0 \) and \( h^+ \) corresponding to \( c_m^+ \), with \( h^0 < h^+ \). A smaller \( h^0 \) corresponding to a higher \( c_m^0 \) implies that real money balances are smaller in free trade situation, and that takes place through the current account deficit. As a result, temporary policy causes the current account to worsen, and worsens more as the time horizon of the temporary policy is shortened. This point was first made by Calvo [1986a and 1987a], and we summarize as follows.\(^{25}\)

**Proposition 3.2 [Calvo, 1987].** As the duration of temporary trade reform is shortened, the resultant current account deficit becomes larger.

Note, however, that the intertemporal consumption substitution is emphasized in the above analysis, and hence no wealth effects are considered in this proposition. Two

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\(^{25}\)Calvo's result from a one-good model holds here as long as both goods are complementary, \( U_{nm} > 0 \).
offseting forces against this current account deficit result can be considered: output gain from the exportable sector (when the production is variable) and the financial appreciation induced by a lower tariff. First, if a lower tariff generates an increase in income, then this induces consumers to save more, which has the effect to reduce current consumption. This makes the effects of temporary reform on the initial current account deficit ambiguous. Second, the financial appreciation effect is apparent in our case since the term \((\pi + \tau^*/\gamma + \dot{\gamma})\) can be endogenous and \(h_3\) is negative, so that the number \(h^0\) which corresponds to \(c_m^0\) will in fact become larger as \(\pi + \tau^*/\gamma + \dot{\gamma}\) is reduced by a tariff reduction. One can thus assert that if the government anticipates that private agents will expect the trade liberalization to be temporary, it should maintain capital controls.

**Wealth Effects**

In contrast to the intertemporal substitution effects of temporary tariff reform, we will show that wealth effects are small in the case of temporary reform but large in permanent reform. To see this, we adopt an explicit form of the utility function and the equilibrium price structure of the nontradeable goods. Then, we conduct the optimization procedure to obtain the shadow price of wealth, and therefore we can examine explicitly how a jump of the shadow price of wealth is different in magnitude in response to temporary and permanent reform. For the exposition as clear as possible, we assume that (1) there is no capital control, and (2) output is fixed. Now we impose that \(u(c_m, c_n) = c_m^2c_n^{1-\gamma} \) where \(\gamma \in (0, 1)\) with \(\gamma\) being the importable expenditure share. The instantaneous utility function is taken to be of the constant relative risk aversion form, \(U[u(c_m, c_n), h] = (c_m^{\alpha}c_n^{\gamma})^{1-\sigma}/(1-\sigma)\), where \(\sigma > 0, 1/\sigma\) is the intertemporal elasticity of substitution, and \(\beta \in (0, 1)\). The lifetime budget constraint is identical to (7), except that \(\tau^* + \dot{\gamma}/\gamma\) is replaced by the fixed domestic real interest rate, \(\rho\). Hence, the individual’s problem is to maximize

\[
\int_0^\infty \frac{1}{1-\sigma} \left[ (c_m^{2\alpha}c_n^{\gamma})^{1-\beta} \right]^{1-\sigma} e^{-\delta t} dt
\]

\[72\]

\[26\text{If } \sigma = 1, V(u, h) = \beta \log u + (1 - \beta) \log h, \text{ with } \log u = \alpha \log c_m + (1 - \beta) \log c_m.\]
subject to

\[(41-2) \int_0^\infty [y - p_m c_m - p_n c_n - (\pi + \rho) h] e^{-\rho t} dt + b_0 + h_0 = 0\]

where \( y = p_n y_n + y_x \) which denotes fixed output (endowment). The optimal shadow price of wealth is obtained as

\[
\lambda^* = \frac{\left\{ \int_0^\infty \left[ \left( 1 - \beta \right) p_m \right] \left( \beta (1 - \alpha) \right) \left( \frac{(1 - \beta) p_m}{\beta (1 - \alpha)} \right) e^{-\rho t} dt \right\}^\sigma}{a_0 + \int_0^\infty e^{-\rho t} dt}^{\sigma}
\]

where a star denotes the optimal value and the denominator comes from the economy-wide budget constraint. The explicit solution for \( c_m, c_n, h, \) and \( \lambda \), is contained in Appendix 3.5. Equation (42) says that the shadow price of wealth, \( \lambda^* \), is a function of fixed output and the price variables. Any unanticipated shock in these variables will cause \( \lambda^* \) to jump to a new optimal level. Likewise, a jump in \( \lambda^* \) will alter individual's lifetime consumption path, so that individuals will revise their consumption schedule between current and future periods. Next, the equilibrium condition for the nontraded good market is given (as before) by \( y_n = c_n(\lambda, p_n, p_m) + g_n \), which generates \( p_n = p_n(\lambda, p_m) \). To obtain a clear-cut result, we also impose a particular functional form for \( p_n \):

\[(43) \quad p_n = q\lambda^{-\sigma(1 - \alpha) / \beta(1 - \alpha)} p_m^{1/\beta(1 - \alpha)} \]

where \( q \) is a constant, and \( \partial p_n / \partial p_m > 0 \) and \( \partial p_n / \partial \lambda < 0 \), with \( \sigma > 1 \). Substituting (43) into (42), with some manipulations, yields the following equation for the marginal value of wealth:
where \( q \) is set to unity, and 
\[
\Sigma = \left\{ \left[ \frac{1-\beta}{\beta} \right]^{(1-\beta)/(1-\sigma)} \left[ \frac{1-\beta}{\beta} \right]^{(1-\beta)/(1-\sigma)} (\beta)^{(1-\sigma)/(\sigma-1)} \right\}.
\]
Let the integrand of the numerator of (44) be \( \Phi \), i.e., 
\[
\Phi = \Sigma^{1/(1-\beta)} p_m^{-(\beta+1)(1-\sigma)/(\sigma(1-\beta)}
\]
then 
\[
\frac{d\lambda^*}{dp_m} = \frac{-(\beta+1)(1-\sigma)\Sigma^{1/(1-\beta)} p_m^{-(\beta+1)(1-\sigma)/(\sigma(1-\beta))}}{\sigma(1-\beta)} > 0
\]
under the assumption that the intertemporal elasticity of substitution is less than unity, i.e., \( \sigma > 1 \). This means that at a given output level an unanticipated fall in the price of imports causes a permanent fall (jump-down) in \( \Phi \), and hence in \( \lambda^* \).

We are now ready to examine wealth effects of temporary trade reform via the response of this \( \lambda \). Let \( \lambda^p \) be the initial jump (down) of the shadow price of wealth when a tariff cut is expected to be permanent, and \( \lambda^s \) be the one when a tariff cut is perceived to be temporary. Recall the nature of temporary trade reform is such that \( p_m = p_m^t \) for \( 0 \leq t \leq T \) and \( p_m = p_m^* \) for \( T < t \). Then, by performing integration of the numerator of (44), we can obtain:

\[
\lambda^p = \frac{\left\{ \frac{1}{\rho} \Sigma^{1/(1-\beta)} p_m^{-(\beta+1)(1-\sigma)/(\sigma(1-\beta))} \right\}^{\sigma}}{\left\{ a_0 + \int_0^\infty e^{-\rho t} \, dt \right\}^{\sigma}}
\]

\[\text{To focus on a strong wealth effect, we assume that the intertemporal elasticity of consumption substitution is less than zero, } 1/\sigma < 1. \text{ However, the analysis with the case of } 1/\sigma > 1 \text{ is straightforward.}\]
where $\Phi^p = \frac{1}{\rho} \sum_{i=1}^{r} \left[ (p^* - p^0)^{i(\beta+1)}(1-\sigma)/\sigma \right] e^{-\rho t}$.

It follows from (46) and (47) that $\lambda^p < \lambda^S$, implying that the shadow price of wealth initially jumps down less when a tariff reduction is temporary. Differentiate $\lambda^S$ with respect to $T$ to generate

$$\frac{d\lambda^S}{dT} = \frac{-\sum_{i=1}^{r} \left[ (p^* - p^0)^{i(\beta+1)}(1-\sigma)/\sigma \right] e^{-\rho t}}{(\rho a_0 + y)^{r-1}} < 0$$

or $d(\lambda^S - \lambda^P)/dT < 0$. This shows that as the time horizon ($T$) of temporary tariff cuts is shortened, the value of $\lambda^S$ becomes bigger, that is, the marginal value for wealth falls less as the duration of the temporary tariff reduction is shortened.

We can substitute the optimal $c^*, c_n$, and $h$ functions, (A32)-(A34), into the lifetime utility index, (41-1), to investigate a welfare change associated with the timing of the trade reform. The intertemporal utility index $W$, with some manipulations, is given by

$$W = \int_0^\infty \left[ \frac{\Theta}{1-\sigma} \lambda^{(\alpha\beta+\sigma-1)/\rho} p^0 (\beta+1)(\sigma-1)/\sigma \right] e^{-\delta t} dt$$

where $\Theta = \left\{ \left[ \frac{3}{1-\alpha} \right]^{(1-\sigma)/\alpha} \right\}^{1-\sigma}$. Equation (49) can be written, by integration, as

$$W^p = \left( \Theta/\delta(1-\sigma) \right) \lambda^{(\alpha\beta+\sigma-1)/\rho} p^0 (\beta+1)(\sigma-1)/\sigma$$

where $W^p$ is the utility index of a permanent reform. The level of utility when the temporary shock is first revealed at time 0 is calculated as
\begin{align*}
W^S &= \left[\Theta/\delta(1-\sigma)\right] \lambda^{-(\alpha+\sigma-1)/\sigma} p_m^{\delta(\beta+1)(1-\sigma)/\sigma} \\
&\quad \left[\Theta/\delta(1-\sigma)\right] \lambda^{-(\alpha+\sigma-1)/\sigma} \left[p_m^{\delta(\beta+1)(1-\sigma)/\sigma} - p_m^{\delta(\beta+1)(1-\sigma)/\sigma} e^{-\delta T}\right]
\end{align*}

It follows from (50) and (51) that \( W^S < W^P \), which says that the utility gain is higher in permanent reform, and conversely. This is because in a temporary tariff reduction the marginal value for wealth falls less, and hence the corresponding consumption increase is ceteris paribus smaller, leading to a smaller welfare gain. Alternatively, from (51) we can readily obtain that \( \partial W^S/\partial \lambda < 0 \) and \( \partial W^S/\partial p_m < 0 \).\(^{28}\) Then, we evaluate the initial jump in \( W^S \) at \( p_m^* = p_m^0 \), as

\begin{align*}
(52) \quad dW^S &= \left(\partial W^S/\partial \lambda\right) d\lambda + \left(\partial W^S/\partial p_m\right) dp_m
\end{align*}

We know that as the duration of temporary reform is shortened, \( d\lambda \) (jump in \( \lambda \)) becomes smaller. If \( T \) is sufficiently short, \( \lim_{T \to 0} d\lambda \to 0 \), then the welfare gain is also at a minimum. This is the case where there is virtually no wealth effect, and the welfare index depends only on the price change, \( dp_m \).

**Current Account**

Using Bellman's principle [Bellman, 1953], the optimal shadow value before the shock, \( \lambda^* \), (at time 0 when \( p_m = p_m^* \)) given by (44) must equal the optimal \( \lambda \) at any time \( t = T \) with \( T > 0 \). This implies that (47) can also be written as

\begin{align*}
(53) \quad \lambda^S &= \frac{\left\{\frac{1}{\rho} \left[p_m^{-(\beta+1)(1-\sigma)/\sigma} - p_m^{-(\beta+1)(1-\sigma)/\sigma} e^{-\rho(1-T)}\right]\right\}^{\sigma}}{\frac{a_T + \int_T^0 e^{-\rho(1-T)} dt}{T}^{\sigma}}
\end{align*}

It follows from (44) and \( \lambda^S > \lambda^P \) that \( a_T < a_0 \), indicating that temporary trade liberalization generates more losses in net foreign claims than a permanent one between time 0 and time \( T \) when the liberalization is in effect: i.e., the current account deficit between time 0 and

\[^{28}\] \( \partial W/\partial p_m = -\Theta/(\delta \sigma) \lambda^{-(\alpha+\sigma-1)/\sigma} p_m^{\delta(\beta+1)(1-\sigma)/\sigma} < 0 \).
time \( T \) is bigger in the case of temporary liberalization. Moreover, \( d((\lambda^s - \lambda^F)/dT) < 0 \) implies \( d(a_0 - a_T)/dT < 0 \), generating Calvo's result that as the duration of reform is shortened the current account deficit in the liberalization period is bigger since as \( T \) gets smaller, \( a_0 - a_T \) gets bigger and hence \( a_T \) becomes smaller for a given \( a_0 \).  

3.6 Conclusion

Using an intertemporal optimizing model with perfect foresight, we have analyzed the dynamics of trade liberalization on consumption and the current account when capital controls are in effect. We have also discussed the role of capital mobility in the transitional adjustment. A permanent vs temporary trade reform is compared, and the potential costs of temporary trade reform were focused on. While the results obtained are model-specific and should be interpreted with a caution, the main findings seem to be robust and plausible, and can be summarized as follows.

(1) A permanent unanticipated trade liberalization causes the current account balance to fall as the consumption of both the imports and nontradeable goods rises. The current account deficit is initially accompanied by a decumulation of individual's real balances. The long-run effects on the real balances are shown to be ambiguous, however. When capital control is in effect through the dual exchange rates, individuals anticipate the real financial rate to fall as their real wealth rises and the marginal utility of consumption falls. Consequently an appreciation of the real financial rate up to a new equilibrium is observed.

(2) When trade reforms are implemented under a single fixed rate, the current account burden of trade liberalization would be larger since the higher real wealth generated by the trade reform induces increased purchases of foreign bonds. Hence, the current account deficit caused by the trade reform would have been magnified by the outflow of capital.

\(^{29}\) If we evaluate (46) at \( p_m^* = p_m^0 \).

\(^{30}\) We can also show that the current account deficit will be larger as \( 1/\theta \) becomes larger. This is because a large value of the intertemporal elasticity of consumption substitution \( ceteris paribus \) implies a larger change in the consumption rate of real interest, which in turn generates a larger expenditure switching towards the present period following temporary reform.
This means that the existence of capital control (quantity control) in the form of the dual rates can alleviate the current account burden caused by trade reform through changes in the freely determined financial exchange rate. This may support the McKinnon-Frenkel [1982] order of liberalization of the balance of payments: opening of the current account before the capital account. Maintaining capital control may work to prevent an excessive losses through the current account.

(3) Temporary trade liberalization is more likely to worsen the current account, and the deficit may be bigger than the one in permanent liberalization especially if strong intertemporal expenditure switching occurs. Under strong intertemporal substitution, the current account deficit today (when the reform is in effect) worsens as the expected duration of temporary reform becomes shorter. As T (time indicator for a temporariness) becomes shorter, the opportunity cost (marginal utility) of consuming from time 0 to T in terms of consuming afterwards diminishes, leading to a higher intertemporal switching in consumption toward the present period.

(4) However, temporary reform generates smaller wealth effects, which are manifested by a smaller drop in the marginal value for wealth following temporary reform. The welfare gain is almost nil if the duration of reform is sufficiently short. This is partly because consumers should spread any temporary income gain over several periods, and in order to do that, they must save more rather than consume more in the current period, and this can act to offset the intertemporal substitution effects.

It should be noted that this chapter has concentrated on the consumption-saving dynamics through which trade reform influences individual's choice between assets and consumption goods. The important drawback of this is that the firm's investment dynamics are completely ignored. In a resource-poor economy such as Korea, large portions of both investment goods and intermediate goods are imported. Thus, trade liberalization would obviously affect firms' intertemporal profit maximization and hence resource allocation between sectors. The current account is also influenced through these channels. These will be examined in the next chapter.
APPENDIX TO CHAPTER 3

3.1 FOCs for the Consumer's Problem and Deriving Dynamic Equations

(A1) \[ U_m e^{-\delta t} - \lambda p_m = 0 \]

(A2) \[ U_n e^{-\delta t} - \lambda p_n = 0 \]

(A3) \[ V'(h) e^{-\delta t} - \lambda \pi - \lambda^1 = 0 \]

(A4) \[ \lambda \tau - \lambda^1 = 0 \]

(A5) \[ \frac{\partial H}{\partial \lambda} = \dot{\lambda} \]

(A6) \[ \frac{\partial H}{\partial \lambda^1} = \ddot{\lambda} = -\lambda^1 \]

where \( r = (r^* + \dot{\gamma})/\gamma \). From (A1) and (A2), we can obtain equation (8) in the text. Eliminating \( \lambda^1 \) from (A4) and (A5) yields \( V'(h) e^{-\delta t} = \lambda(\pi + r) \), and this with (A1), and with (A3) provides:

(A7) \[ \frac{V'}{U_m} = \frac{\pi + \tau}{p_m} \]

which is equation (9) of the text. Using that \( p_m \dot{\lambda} = (U_m - \delta U_m) e^{-\delta t} \) in (A3) and (A4) respectively, we obtain equations (10) and (27) in the text:

(A8) \[ \frac{p_m V'}{U_m} = (\pi + \delta) - \frac{U_m}{U_m} \]

(A9) \[ \delta - r = \frac{U_m}{U_m} \]

Note that (A8) and (A9) imply (A7) so that \( \tau \) is redundant. Remembering that \( r = (r^* + \dot{\gamma})/\gamma \), (A7) generates equation (16) in the text. Next, using \( \dot{U}_m = U_{mm} \dot{c}_m + U_{mn} \dot{c}_n \), with
\( c_n = c_n(c_m, p_m) \) and hence \( \dot{c}_n = (\partial c_n/\partial c_m) \dot{c}_m \). (A8) then generates equation (15) of the text.

3.2 Short-Run Effects

Equation (25) of the text can be written as

\[
p_n(c_m, p_m, g_n) U_m(c_n(c_m, p_m, g_n), c_m) = p_m U_n(c_n(c_m, p_m, g_n), c_m)
\]

Partially differentiate with respect to \( c_m, p_m \), and \( g_n \) respectively to yield

\[
\frac{\partial c_n}{\partial c_m} = \frac{p_m U_{nm} - p_n U_{mm} - U_m \frac{\partial p_n}{\partial c_m}}{p_n U_{mn} - p_m U_{nn}} > 0
\]

(A10)

\[
\frac{\partial c_n}{\partial p_m} = \frac{U_n - U_m \frac{\partial p_n}{\partial p_m}}{p_n U_{mn} - p_m U_{nn}} < 0
\]

(A11)

\[
\frac{\partial c_n}{\partial g_n} = \frac{-U_m \frac{\partial p_n}{\partial g_n}}{p_n U_{mn} - p_m U_{nn}} < 0
\]

(A12)

where in signing (A11) it is assumed that \( U_n < U_m \frac{\partial p_n}{\partial p_m} \) with \( \frac{\partial p_n}{\partial p_m} > 0 \).

3.3 Solution to Dynamic System

Reproducing the linearized system:

\[
\begin{bmatrix}
\dot{h} \\
\dot{\gamma}
\end{bmatrix} =
\begin{bmatrix}
Z_{11} & Z_{12} & Z_{13} \\
Z_{21} & Z_{22} & Z_{23} \\
Z_{31} & Z_{32} & Z_{33}
\end{bmatrix}
\begin{bmatrix}
c_m - \bar{c}_m \\
h - \bar{h} \\
\gamma - \bar{\gamma}
\end{bmatrix}
\]

(A13)

where

\[
Z_{11} = (\pi + \delta) > 0, \quad Z_{12} = -p_m V' \Gamma < 0, \quad Z_{13} = 0,
\]

\[
Z_{21} = [(\partial y_x/\partial c_m) - p_m'] < 0, \quad Z_{22} = (\mu - \pi) < 0, \quad Z_{23} = 0,
\]

\[
Z_{31} = -p_m V'/U_m^2 > 0, \quad Z_{32} = \gamma p_m V'/U_m < 0, \quad Z_{33} = [(p_m V'/U_m) - \pi] > 0
\]
where \( \frac{\partial y_x}{\partial c_m} < p_m \) is assumed to sign \( Z_{21} \). It can be derived that

\[
\text{Trace } [Z] = \delta + \mu + [(p_m V/U_m) - \pi] > 0
\]

\[
\text{Det } [Z] = [(p_m V/U_m) - \pi] \left[ (\pi + \delta)(\mu - \pi) + p_m V' \Gamma [V (\partial y_x/\partial c_m) - p_m] \right] < 0
\]

This implies that there is one negative root (more precisely, negative real part of complex conjugate) and two positive roots. This ensures that given the initial values of \( m_0 \) and \( b_0 \), there exists a unique convergent path satisfying the dynamic system. The general solution to (A13) is given by:

\[
\begin{bmatrix}
  c_m(t) \\
  h(t) \\
  \gamma(t)
\end{bmatrix} =
\begin{bmatrix}
  \psi_{11} & \psi_{12} & \psi_{13} \\
  \psi_{21} & \psi_{22} & \psi_{23} \\
  \psi_{31} & \psi_{32} & \psi_{33}
\end{bmatrix}
\begin{bmatrix}
  A_1 e^{\nu_1 t} \\
  A_2 e^{\nu_2 t} \\
  A_3 e^{\nu_3 t}
\end{bmatrix} +
\begin{bmatrix}
  \bar{c}_m \\
  \bar{h} \\
  \bar{\gamma}
\end{bmatrix}
\]

where \( A_j (j = 1, 2, 3) \) are arbitrary scarlars associated with corresponding initial values, and \( \psi_j = [\psi_{1j}, \psi_{2j}, \psi_{3j}] \) is the eigen vector (non-zero) associated with the corresponding eigen value, \( \nu_j \). Let us define \( \nu_1 \) as negative part of the eigen value. Letting \( A_2 = A_3 = 0 \) then ensures the saddle path. Then, (A14) can be written as

\[
\begin{align*}
  c_m(t) &= A_1 \psi_{11} e^{\nu_1 t} + \bar{c}_m \\
  h(t) &= A_1 \psi_{21} e^{\nu_1 t} + \bar{h} \\
  \gamma(t) &= A_1 \psi_{31} e^{\nu_1 t} + \bar{\gamma}
\end{align*}
\]

From which we can obtain

\[
\begin{align*}
  \frac{c_m(t) - \bar{c}_m}{h(t) - \bar{h}} &= \frac{A_1 \psi_{11} e^{\nu_1 t}}{A_1 \psi_{21} e^{\nu_1 t}} = \frac{\psi_{11}}{\psi_{21}} \\
  \frac{\gamma(t) - \bar{\gamma}}{h(t) - \bar{h}} &= \frac{A_1 \psi_{31} e^{\nu_1 t}}{A_1 \psi_{21} e^{\nu_1 t}} = \frac{\psi_{31}}{\psi_{21}}
\end{align*}
\]
which indicates that the saddle path in \((c_m, h)\) space enters \((c_m, \tilde{h})\) with slope \(\psi_{11}/\psi_{21}\), and it in \((h, \gamma)\) space enters \((\tilde{h}, \tilde{h})\) with slope \(\psi_{31}/\psi_{21}\). It then remains to obtain \(\psi_{11}/\psi_{21}\) and \(\psi_{31}/\psi_{21}\). Since \([Z - V_j]V_j = 0\) where \(I\) is the identity matrix, it follows that

\[
\begin{align}
(A18) & \quad (\pi + \delta - \nu_1)\psi_{11} - (p_m V^\prime/\Gamma)\psi_{21} = 0 \\
(A19) & \quad [(\partial y_s/\partial c_m) - p_s^*]\psi_{11} + (\mu - \pi - \nu_1)\psi_{21} = 0 \\
(A20) & \quad (-\gamma p_m V'/\Gamma U_m^2)\psi_{11} + (\gamma p_m V'/U_m)\psi_{21} + [(p_m V'/U_m) - \pi - \nu_1]\psi_{31} = 0
\end{align}
\]

Therefore, we obtain

\[
\begin{align}
(A21) & \quad \psi_{11} = \left[\frac{p_m V'/\Gamma}{\pi + \delta - \nu_1}\right] > 0 \\
(A22) & \quad \psi_{31} = \left[\frac{1}{(p_m V'/U_m) - \pi - \nu_1}\right] \left[\frac{\gamma p_m V'}{\Gamma U_m^2} \psi_{11} - \frac{\gamma p_m V''}{U_m}\right] > 0
\end{align}
\]

The sign of \(\psi_{31}/\psi_{21}\) is not obvious since the first term is positive, but the second term is ambiguous. The sign of the second term of (A22), however, can be traced as follows. Substituting \(\psi_{11}/\psi_{21}\) into (A22), with some manipulations, we have

\[
\left[\frac{\gamma p_m V'}{\Gamma U_m^2} \psi_{11} - \frac{\gamma p_m V''}{U_m}\right] = \frac{\gamma p_m V''(p_m V' - U_m(\pi + \delta - \nu_1))}{U_m^2(\pi + \delta - \nu_1)}
\]

This will be positive if \(p_m V' - U_m(\pi + \delta - \nu_1) < 0\). But from (A7), \(p_m V' = U_m(\pi + r)\). Hence, showing \(p_m V' - U_m(\pi + \delta - \nu_1) < 0\) is equivalent to showing \(\delta < r > \nu_1\). This is obvious as long as \(\delta = r\) and \(\delta > r\), which we assume here. Note that if \(\delta < r\) the sign of (22) is ambiguous.

### 3.4 Steady-State Effects

Totally differentiate the steady-state equations to yield
where a tilde notation is omitted, and

\[
\begin{align*}
K_1 &= \left[ V' - (\partial c_n / \partial p_m)(\pi + \delta)U_{mn} \Gamma \right] < 0, \\
K_2 &= -\partial y_x / \partial p_m > 0, \\
K_3 &= -\gamma V'[U_m - p_m U_{mn}(\partial c_n / \partial p_m)]/U_m^2 > 0, \\
N_1 &= -(\partial c_n / \partial g_n)(\pi + \delta)U_{mn} \Gamma < 0, \\
N_2 &= -\partial y_x / \partial g_n < 0, \\
N_3 &= -\gamma V'p_m U_{mn}(\partial c_n / \partial g_n)/U_m^2 < 0
\end{align*}
\]

Let the determinant of \([Z]\) be \(\Delta\), and we obtain

\[
\begin{align*}
\frac{dc_m}{dp_m} &= (1/\Delta)[K_1(Z_{22}Z_{33}) - Z_{12}(K_2Z_{33})] < 0 \\
\frac{dh}{dp_m} &= (1/\Delta)[Z_{11}(K_2Z_{33}) - K_1(Z_{21}Z_{33})] \\
\frac{dy}{dp_m} &= (1/\Delta)[Z_{11}(Z_{22}K_3 - K_2Z_{32}) - Z_{12}(Z_{21}K_3 - K_2Z_{31}) + K_1(Z_{21}Z_{32} - Z_{22}Z_{31})] \\
\frac{dc_m}{dg_n} &= (1/\Delta)[N_1(Z_{22}Z_{33}) - Z_{12}(N_2Z_{33})] > 0 \\
\frac{dh}{dg_n} &= (1/\Delta)[Z_{11}(N_2Z_{33}) - N_1(Z_{21}Z_{33})] \\
\frac{dy}{dg_n} &= (1/\Delta)[Z_{11}(Z_{22}N_3 - N_2Z_{32}) - Z_{12}(Z_{21}N_3 - N_2Z_{31}) + N_1(Z_{21}Z_{32} - Z_{22}Z_{31})]
\end{align*}
\]

3.5 Derivation of \(\lambda^*\)

To prove the proposition in Section 6 of the text, it is necessary to conduct the optimization procedure. The Lagrangean function for maximizing (41-1) subject to (41-2) is
\[
L = \int_0^\infty \left\{ \left[ c_m c_n \right]^{1-\beta} h^{1-\beta} \right\}^{1-\sigma} e^{-\delta t} dt + \lambda \left\{ a_0 + \int_0^\infty \left[ p_n y_n + y_1 - p_m c_m - p_n c_n - (\pi + \rho) h \right] e^{-\eta t} dt \right\}
\]

The first order conditions are

(A29-1) \[ \int_0^\infty \left\{ \left[ c_m c_n \right]^{1-\beta} h^{1-\beta} \right\}^{1-\sigma} h^{1-\beta} e^{\beta \left[ c_m c_n \right]^{1-\beta} c_n c_m} e^{-\delta t} dt = \lambda \int_0^\infty p_m e^{-\eta t} dt \]

(A29-2) \[ \int_0^\infty \left\{ \left[ c_m c_n \right]^{1-\beta} h^{1-\beta} \right\}^{1-\sigma} h^{1-\beta} (1-\beta) e^{\beta \left[ c_m c_n \right]^{1-\beta} c_n c_m} e^{-\delta t} dt = \lambda \int_0^\infty p_n e^{-\eta t} dt \]

(A29-3) \[ \int_0^\infty \left\{ \left[ c_m c_n \right]^{1-\beta} h^{1-\beta} \right\}^{1-\sigma} h^{1-\beta} (1-\beta) e^{\beta \left[ c_m c_n \right]^{1-\beta} c_n c_m} e^{-\delta t} dt = \lambda \int_0^\infty (\pi + \rho) e^{-\eta t} dt \]

and the lifetime budget constraint, (41-2) of the text. From (A29-1)-(A29-2), and (A29-1)-(A29-3), we respectively obtain

(A30) \[ c_n = \frac{p_m}{p_n} \frac{1-\beta}{\pi + \rho} c_m \]

(A31) \[ h = \frac{1-\beta}{\pi + \rho} \frac{p_m}{\beta} c_m \]

Substituting (A30) and (A31) into (A29-1), with some manipulation, to obtain \( c_m \) as a function of \( \lambda \) and other parameters. Using (A30) and (A31) to obtain the optimal value for \( c_n \) and \( h \):

(A32) \[ c_m = \left[ \frac{(\lambda p_m)^{1-\sigma}}{p_m (\beta(1-\gamma)(1-\sigma)/(\gamma)) (1-\beta)/(1-\sigma)} \left\{ \left[ \frac{1-\beta}{\beta(\pi+\rho)} \right]^{1-\sigma} \right\} \right]^{1/\sigma} \]
Next, substituting (A32)-(A34) into (41-2) of the text yields

\[
\begin{align*}
\lambda^* &= \frac{\left\{ \int_0^\infty \left[ \frac{(1-\delta)\beta(1-\gamma)(1-\sigma)/\sigma}{\beta(\tau+\sigma)} \right] \cdot \left[ \frac{(1-\beta)\rho_m}{\gamma \beta(\tau+\rho)} \right] \cdot e^{-\delta t} \, dt \right\}^{\sigma}}{\int_0^\infty e^{-\delta t} \, dt} \\
&= \left\{ a_0 + \int_0^\infty e^{-\delta t} \, dt \right\}^{\sigma}
\end{align*}
\]

which is equation (42) in the text.
CHAPTER 4

TIMING AND DURATION OF TRADE REFORM, CAPITAL ACCUMULATION AND THE CURRENT ACCOUNT

4.1 Introduction

The analysis of trade reform in the previous chapter was based on the consumption-saving dynamics in which trade reform alters the intertemporal relative price index (and other variables), and hence distorts the choice between consumption and savings (intertemporal consumption substitution) during the transition. Consideration of firm's investment was completely excluded. It is intuitively obvious that trade reform can affect firm's production and profitability, and hence its investment decision in the current period. The rate of capital accumulation in the economy would thus be influenced by a trade liberalization policy. If, in particular, the economy's resource endowment is poor and hence if production (and investment) relies heavily on imports, trade reform will have further implications for the current account. Recently, the investment dynamics associated with a change in tariffs (or terms of trade) have been a subject of increased examination.

Turnovsky [1990], for example, investigates the sectoral effects of tariffs on capital accumulation in the usual Heckscher-Ohlin framework. Both permanent and temporary tariffs are discussed in his paper, and whether tariffs are contractionary during the transition depends upon mainly the pre-existing sectoral capital intensities. Other studies by Murphy [1989], Sen and Turnovsky [1989], and Roldos [1991] examine the effects of tariffs or other disturbances (e.g. terms of trade change) on capital accumulation and

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1The draft version of this chapter was presented to a Ph.d. Conference in Economics and Business at the University of Western Australia in Perth during 6-8 November 1991 [Kim, 1991b]. I am indebted to the participants of that workshop for many helpful comments. Especially, I would like to thank Professor Richard Snape for his valuable comments. I would also like to thank Dr Sisira Jayasuriya for his useful suggestions.

2See references in Chapter 3 of this thesis.
the current account. A notable point is that the results in these analyses are sensitive to the modelling of the investment function.

A common trend in modelling investment seems to be to introduce costs of adjustment to the investment process, by assuming that capital is immobile between industries at least in the short-run. For example, heavy machinery goods are typically industry-specific, and thus investment is irreversible once installed. If this is the case, then investment expenditure will be the sum of direct costs of new capital plus adjustment costs associated with its installation. This specification of the investment expenditure function has been shown to generate particular results in response to shocks. In Murphy's [1989] model, it is assumed that only traded goods are purchased for replacement of capital, but only nontraded goods are used for installation, which enables him to discuss the real exchange rate and investment. Mussa [1978] and Wilcoxen [1987] assume that only labour is used for installation. Fernandez and Rodrik [1990] specify the adjustment costs of human capital in their uncertainty model.

Perhaps the most popular specification, following Hayashi [1982] and Abel and Blanchard [1983], has been to postulate a linearly homogeneous adjustment costs function which depends on the level of investment as well as the capital stock. This assumption may be useful to estimate the marginal value of an additional unit of installed capital (Tobin's q), since the marginal value for capital in this case is equal to the observable average value of installed capital. Similar specifications of the investment technology can be found in Goulder and Summers [1989], Goulder and Eichengreen [1989], Mercenier and Sampaio De Souza [1990], Turnovsky [1990], Ahn [1991], among many others.

In examining the dynamic relationships between tariffs and investment, Turnovsky [1990] assumes that the economy produces two traded consumption goods, one of which is exported and a nontraded investment good, and analyzes the impact of permanent and temporary tariffs on sectoral adjustments. The importance of sectoral capital intensities is emphasized. Murphy [1989] explicitly includes the capital supply industry in his two-sector (traded-nontraded) model. He assumes that traded goods are used for investment
and nontraded goods for installation in the capital supply industry, and analyzes the real exchange rate effects of various shocks. His model, however, excludes the possibility of direct investment in the importable, exportable or domestic industry. Roldos [1991], on the other hand, employs a sector-specific capital model to examine tariffs and capital accumulation. In his importable-exportable sector model, only the importable sector invests while the exportable sector does not. He argues that permanent tariff increases are likely to generate current account deficits via increased investment in the importable industry, which may not be the case if investment in the exportable sector was included. Sen and Turnovsky [1989] establish a two-good model where the domestic industry invests, and discuss mainly the effects of a deterioration of the terms of trade on the current account. In their examination, the substitution and income effects play a crucial role in determining both the transitional dynamics and the steady-state.

The present study examines the effects of a tariff reduction on investment in both the importable and exportable industries within an intertemporal optimizing framework. The effects on the current account are also discussed. Two key features of the model should be stressed. First, we assume that importable goods are used for capital creation in both industries. Furthermore, the importable goods are also used as intermediates for a current production in the exportable industry. As Roldos [1991] points out, this type of production structure characterizes resource-poor but export-oriented economies (e.g. Korea) more appropriately. Second, dynamic analyses in both industries are simultaneously dealt with to compare the different adjustment patterns in each industry following tariff reform.

Both a permanent and a temporary tariff cut (both unanticipated and immediate) are examined. Pre-announcement effects of a permanent tariff reform are also examined. Two main results emerge. First, a tariff reduction, regardless of timing, unambiguously increases investment in the exportable industry and hence its capital stock will rise. Further, tariff cuts will increase the profitability and hence the real rate of return to capital in the exportable industry. The increase in the capital stock, given savings, partially acts to worsen the current account balance. On the other hand, tariff reform lowers the real
return to capital in the importable industry, which in turn will lead its marginal value for capital to fall. Consequently, investment in the importable industry may fall, although the lower price of imported capital goods can act to increase its investment. Obviously, the overall effects of tariff reform on both the economy's total capital stock and the current account very much depend upon the relative intensity of responses in these industries.

Second, we conclude that the dynamics in the transition are qualitatively different in the two sectors, depending on whether tariff reductions are permanent or temporary. Moreover, the time horizon of the temporariness of reform is a key element in determining both the steady-state and the transitional dynamics. In general, as the duration of temporary reform is shortened, the initial investment will be smaller in the exportable industry due to a smaller jump in its marginal value of capital, which in turn can act to improve the current account balance. Notice that opposite responses apply in the importable industry. Calvo's [1988] general conclusion that a higher degree of policy temporariness brings about an initial larger current account deficit may only be valid when the effects on the import-competing industry dominate during the transition.

The remainder of this paper proceeds as follows. Section 2 establishes an analytical framework, spelling out the agents' optimization problems and deriving a perfect foresight equilibrium. In Section 3, the model's steady-state properties and its dynamics are described. Section 4 then discusses the long-run effects of trade liberalization on investment and hence capital accumulation, and the current account. Transitional dynamics are examined in Section 5. The final Section concludes and technical details are contained in the Appendix.

4.2 The Model

Consider a small open economy which produces two goods: importable and exportable goods. In order to focus on the dynamics of investment, we simplify the consumption sector by assuming that only the exportable good is consumed. It is also assumed that the importable good serves both as an intermediate input for the production
of exportable good and as an investment good in both industries. The world relative price of the importable good in terms of the exportable good is given by $p_m^*$, and the corresponding domestic relative price by $p_m$, where $p_m = E(1 + \tau)p_m^*$ with $\tau$ being the ad valorem tariff rate. The nominal exchange rate, $E$, is assumed to be fixed and unity. Finally, residents of the country can lend and borrow unlimitedly in the international financial market, so that the relevant real interest rate is the fixed world interest rate, $r$, in units of the exportable good.

**Firms**

Each of the two production sectors is assumed to be perfectly competitive, and is characterized by a representative firm whose objective is to maximize the present value of future cash flows. Each industry produces according to a standard neoclassical production function, using labour and capital. In addition, the exportable industry uses the importable good as an intermediate input. Hence, in the exportable industry, the optimal short-run intensities for labour and long-run intensities of capital and labour are determined by the value-added function, and we assume that input substitution between the intermediate and value added functions is not allowed.

The production function of the exportable industry can then be specified as $Y_x = \min G[V(K_x, L_x), pz]$, where $Y_x$ is the quantity of gross output, $V$ is the value-added function, $K_x$ and $L_x$ stand for employment of capital and labour, $p$ is the constant input-output ratio between intermediate input and gross output, and $z$ is the quantity of intermediate good. We impose $p = 1$ by suitable choice of units. The production function of the importable industry is $y_m = F(K_m, L_m)$, where $y_m$, $K_m$, and $L_m$ denote importable sector's output, capital, and labour, respectively. Note that the value-added function of the exportable firm and the production function of the importable firm are assumed to possess the usual neoclassical properties: constant returns to scale increasing, twice differentiable, and strictly quasi-concave in their arguments, i.e.,

$$V_{K_x} > 0, V_{L_x} > 0, V_{K_x}K_x < 0, V_{L_x}L_x < 0, \text{ and } V_{K_x}K_x V_{L_x}L_x - V_{K_x}^2 L_x = 0$$
\[ F_{K_m} > 0, F_{L_m} > 0, F_{K_m}K_m > 0, F_{L_m}L_m > 0, \text{ and } F_{K_m}^{2}F_{L_m}L_m - F_{K_m}^2 = 0 \]

where subscripts denote the corresponding partial derivatives. Also, it is assumed that \( G_v > 0 \) (and hence \( G_{K_x} > 0 \) and \( G_{L_x} > 0 \), and \( G_z > 0 \). More generally, we henceforth denote the production function in the exportable industry as \( Y_x = G(K_x, L_x, z) \). Capital is assumed to be sector-specific and hence it cannot instantaneously be shifted between industries, whereas labour is assumed to be costlessly mobile between industries. Further, we assume that factor intensity reversals and specialization in production in this economy will not occur.

As mentioned above, a fundamental assumption governing producer behaviour is that firms in both sectors pursue a forward-looking investment strategy aimed at maximizing their discounted cash flows. Since the capital stock in each firm is fixed in the short-run, each firm chooses the variable factors of production in order to maximize the short-run profit. The exportable firm's problem in the short-run is to

\[
\text{maximize } \pi_x = Y_x - wL_x - p_mz \quad \text{subject to } Y_x = G(K_x, L_x, z)
\]

and the importable firm's problem in the short-run is to

\[
\text{maximize } \pi_m = p_my_m - wL_m \quad \text{subject to } y_m = F(K_m, L_m)
\]

where \( \pi_x \) and \( \pi_m \) are the real profits of the respective firms and \( w \) is the real wage rate, all in units of exportable goods. Since the real wages effect is not our main concern in this chapter, we further assume that the the real wage is fixed, and this implies that unemployment may be generated by policy shocks. See, however, Chapter 5 for a comprehensive analysis of the response of real wages.

By conducting maximization we can obtain the optimal labour demand and intermediate demand functions of each industry such that \( L_x = L_x(p_m, K_x), L_m = L_m(p_m, K_m) \), and \( z = z(p_m, K_x) \), and hence output supply function \( Y_x = Y_x(p_m, K_x) \) and \( y_m = y_m(p_m, K_m) \). Then, by inserting the optimal input demand functions into the maximand, we obtain the restricted profit functions \( \pi_x = \pi_x(p_m, K_x) \) and \( \pi_m = \pi_m(p_m, K_m) \) where
$\partial \pi_x/\partial p_m = \pi_{xp} < 0$, $\partial \pi_x/\partial k_x = \pi_{xK} > 0$, $\partial \pi_m/\partial p_m = \pi_{mp} > 0$, and $\partial \pi_m/\partial k_m = \pi_{mk} > 0$.

Assuming that each restricted profit function is strictly concave in the respective capital stock (i.e., diminishing returns to capital in the $\pi$ function), we sign $\partial \pi_{xK}/\partial k_x = \pi_{xx} < 0$ and $\partial \pi_{mk}/\partial k_m = \pi_{mm} < 0$. Notice that the fixed real wage rate is omitted from all functions above.

In deriving the investment cost function in each industry, we need to make an assumption about how new capital goods are created. To highlight the effects of tariff cuts, we assume that only importable goods are used in capital creation. This assumption might be a restrictive one, but it reflects the fact that a substantial portion of any new investment in resource-poor developing countries consists of imported capital goods, as Buffie [1986] has emphasized.

Suppose that new capital goods, say machines, have to be installed before they can be used in production. Then, total investment expenditure in each industry, $\chi_x$, $\chi_m$, is assumed to be given by the following:

$$\chi_x = p_m[\ell_x + \phi(\ell_x)]; \text{ exportable industry}$$

$$\chi_m = p_m[\ell_m + \sigma(\ell_m)]; \text{ importable industry}$$

where $\ell_x$, $\ell_m$ are the gross additions to installed capital. The investment cost function in each industry, $\chi_x$ and $\chi_m$, consists of the costs of purchasing new capital goods and the installation cost function, $\phi$ and $\sigma$, which have the properties that $\phi(0) = 0$, $\phi'(0) = 0$, $\phi'' > 0$, $\phi''' > 0$, and $\sigma(0) = 0$, $\sigma'(0) = 0$, $\sigma'' > 0$, and $\sigma''' > 0$: investment becomes more expensive as more investment is made in each industry. The investment cost function can be specified in an implicit form:

(1) 

$$\chi_m = \chi_m(p_m, \ell_m)$$

$$\chi_x = \chi_x(p_m, \ell_x)$$

where all partial derivatives are positive.\(^3\)

\(^3\)Note that we exclude the possibility of importing investment goods in the current period for inventory.
The firm's objective is to maximize the present value of its dividend or long term profit, subject to the accumulation constraint which specifies how the firm's capital stock evolves over time as a consequence of investment. The dividend in each period is the profit net of investment expenditure, i.e., \(D_x = \pi_x - \chi_x\) and \(D_m = \pi_m - \chi_m\). Each firm solves the following investment problem:

\[
\text{(2-1)} \quad \text{maximize} \int_0^\infty \left[ \pi_x(p_m, K_x) - \chi_x(p_m, I_x) \right] e^{-\delta t} \, dt
\]

subject to \(\dot{K}_x = I_x - \delta K_x\)

and \(K_x(0) = K_{x0}\)

\[
\text{(2-2)} \quad \text{maximize} \int_0^\infty \left[ \pi_m(p_m, K_m) - \chi_m(p_m, I_m) \right] e^{-\delta t} \, dt
\]

subject to \(\dot{K}_m = I_m - \delta K_m\)

and \(K_m(0) = K_{m0}\)

where we have assumed that the firm's net cash flows \((D_x \text{ and } D_m)\) are distributed instantaneously to the owners of the firm. The rate of depreciation, \(\delta\), is assumed to be identical in both industries. Throughout the paper, a dot notation represents the time derivative of the corresponding variable, e.g., \(\dot{K} = dK/dt\). The solution procedures for each firm's investment problem are virtually the same, and therefore we will henceforth concentrate on the intertemporal solution and its dynamics solely for the exportable industry. The dynamics of the importable industry will be dealt with when we examine and compare the adjustment paths in the two industries in response to tariff liberalization experiments.

The current value Hamiltonian for the exportable firm's maximization problem is:

purpose only, In other words, if the investment goods are once imported, then it should be installed in that period. This assumption is important when we consider the intertemporal substitution effects (in investment) of temporary tariff reform.
\[ H_x = [\pi_x(p_m, K_x) - \chi_x(p_m, I_x)] + \lambda_x(I_x - \delta K_x) \]

where \( \lambda_x \) is the costate variable associated with the accumulation constraint in the exportable industry. First-order conditions for this problem, as derived in the Appendix 4.1, yield the following set of relations:

\[ \lambda_x = \frac{\partial \chi_x}{\partial I_x}(p_m, I_x) \]  
\[ \dot{\lambda}_x = (r + \delta)\lambda_x - \pi_x K(p_m, \ldots) \]

In addition, the transversality condition must be satisfied:

\[ \lim_{t \to \infty} \lambda_x K_x e^{-rt} = 0 \]

Equation (3) can be interpreted as requiring that the value at time \( t \) say, of having an additional unit of capital (\( \lambda_x \)) equals its marginal cost \( (\partial \chi_x / \partial I_x) \). Equation (4) describes the evolution of the marginal value of installed capital over time.\(^4\) From equation (3), the level of investment can be determined as an implicit function of the marginal value of installed capital, i.e.,

\[ I_x = I_x(\lambda_x, p_m) \]

where \( \partial I_x / \partial \lambda_x = I_{x\lambda} > 0 \) and \( \partial I_x / \partial p_m = I_{xp} < 0 \). If \( \lambda_x \) were known, the level of optimal investment in the exportable industry could be calculated according to equation (6).

**Consumers**

To generate demand, as simply as possible, we assume that there is a single, infinitively-lived representative consumer, who maximizes the present value of utility from consuming the exportable good. The consumer is endowed with labour which is sold to the two representative industries, and also owns both firms in the economy. This entitles the consumer to the flow of profits net of investment incurred in each sector.

\(^4\)Note that we assume that Arrow and Kurz's [1970] Sufficiency Theorem is satisfied.
Consumers also receive the interest income from their holdings of foreign bonds and any lump-sum transfers from the government. Then, the consumer's problem is to choose the time path of consumption to maximize intertemporal utility, subject to the intertemporal budget constraint:

\[(7-1) \quad \int_0^\infty u(c_x)e^{-\gamma t} \, dt\]

subject to

\[(7-2) \quad \dot{b} = rb + w(L_x + L_m) + (D_x + D_m) + S - c_x\]

and the initial condition

\[(7-3) \quad b(0) = b_0\]

and the boundary condition

\[(7-4) \quad \lim_{t \to \infty} be^{-\gamma t} = 0\]

where \(c_x\) is the consumption of exportable goods, \(b\) is the holdings of foreign bonds measured in units of export goods, the sum of \(D_x\) and \(D_m\) is the firms' real cash flows distributed to the household, and \(S\) is the government's lump-sum transfer payments. The consumer's subjective discount factor, \(\gamma\), is assumed to be constant. The utility function \(u(.)\) is assumed to be increasing, twice differentiable, and strictly quasi-concave in its arguments. It also satisfies the Inada conditions.

The current value Hamiltonian for the household problem is given by:

\[(8) \quad H = u(c_x) + \mu[rb + w(L_x + L_m) + (D_x + D_m) + S - c_x]\]

where \(\mu\) is the costate variable associated with the wealth accumulation condition, \(7-2\), and can be interpreted as the shadow price in terms of foregone utility of accumulating a unit of wealth. The first order conditions for this problem are:
Note that the constancy of $\gamma$ and $r$ in (10) implies that the level of consumption must remain constant over time.\(^5\) Equation (9) implies that the consumer's decision variable, $c_x$, is a function of $\mu$, the unique shadow price of wealth, i.e., $c_x = c_x(\mu)$. Then, optimal consumption would remain at its steady-state level at all times. This implies that residents will smooth consumption over time yielding a constant level of consumption for any given path of lifetime income. We can derive $\mu$ by integrating (7-2), using (7-3) and (7-4), and by substituting $c_x$ into the integrated lifetime budget constraint, as a function of predetermined variables and income terms, i.e., $\mu = \mu(b_0, w(L_x + L_m) + (D_x + D_m))$.

**Government**

The government in this paper plays only a simple redistributional role. It receives tariff revenues from firms and redistributes them to consumers in a lump-sum manner:\(^6\)

$$S = \tau((p_m z + x_m + x_x) - p_m^* y_m)$$

where the three terms in small bracket of the RHS denote tariff revenues collected from the consumption of importables used for the current production in the exportable firm, and capital creation in both firms. The RHS as a whole represents net imports.

Substituting equation (11) into (7-2), using the definition of firm's cash flows, yields the following economy-wide budget constraint:

$$\dot{b} = rb + y_x(K_x, p_m) + p_m^* y_m(K_m, p_m) - c_x - x_x(I_x, p_m) - x_m(I_m, p_m)$$

where $y_x$ denotes net real output (GDP) in the exportable firm which is equal to gross real output minus real intermediate consumption ($y_x = Y_x - p_m z$). Thus, $y_x(K_x, p_m) - c_x$ is net exports and $p_m^* y_m(K_m, p_m) - x_x(I_x, p_m) - x_m(I_m, p_m)$ represents net imports.

\(^5\) Here we impose the condition that $r = \gamma$ to ensure the steady-state with a positive and finite consumption level.

\(^6\) Unlike Chapter 3, the role of government is simplified since we do not consider monetary variables in this analysis. One may include the government's investment in the model.
Equation (12) states that the net accumulation of foreign bonds is equal to the current account surplus, i.e., income net of absorption, as should be the case in any well-defined open economy analysis.

4.3 Dynamics of the System

Combining all agents' efficiency conditions, we can summarize (and reproduce) the equilibrium conditions for the whole economy as follows:

\begin{align*}
(13-1) & \quad u'(c_x) = \tilde{\mu} \\
(13-2) & \quad I_x = I_x(\lambda_x, p_m) \\
(13-2)' & \quad I_m = I_m(\lambda_m, p_m) \\
(13-3) & \quad \dot{k}_x = I_x(\lambda_x, p_m) - \delta k_x \\
(13-3)' & \quad \dot{k}_m = I_m(\lambda_m, p_m) - \delta k_m \\
(13-4) & \quad \dot{\lambda}_x = (r + \delta) \lambda_x - \pi_{x}(p_m, k_x) \\
(13-4)' & \quad \dot{\lambda}_m = (r + \delta) \lambda_m - \pi_{m}(p_m, k_m) \\
(13-5) & \quad \dot{b} = b + y_x(k_x, p_m) + p_m y_m(k_m, p_m) - c_x - x_x(I_x, p_m) - x_m(I_m, p_m)
\end{align*}

where the equations for the importable industry, (13-2)', (13-3)', and (13-4)' are derived by taking exactly the same procedure as above in the exportable industry.

Equations (13-1) is the consumer's usual static optimality condition. Equations (13-2) and (13-2)' represent the respective firms' optimal static investment function. Two sets of two differential equations, (13-3)-(13-4) and (13-3)'-(13-4)', describe the respective firm's investment dynamics. Finally, equation (13-5) constitutes the economy's current account balance. Since the solutions of the first two sets of dynamic systems, (13-3)-(13-4) and (13-3)'-(13-4)', are virtually the same (other than in notation), for the sake of
determining the essential dynamics only we may aggregate these two industries into one industry, without loss of generality. Let \( K = K_x + K_m, I = I_x + I_m, \lambda = \lambda_x + \lambda_m, \Pi_K = \Pi_{K_x} + \Pi_{K_m}, \chi = \chi_x + \chi_m, \) and \( y = y_x + p_m y_m, \) then (13-3)-(13-4), (13-3)'-(13-4)', and (13-5) can be reduced to a system of three differential equations:

\[
\begin{align*}
\dot{K} &= I(p_m, \lambda) - \delta K \\
\dot{\lambda} &= (r + \delta)\lambda - \Pi_{K}(p_m, K) \\
\dot{b} &= rb + y(p_m, \kappa) - c_x - \chi(p_m, \lambda)
\end{align*}
\]

where \( \Pi_K (\equiv \partial \Pi / \partial K) \) represents the real return to industry's total capital stock. Notice that some of the partial derivative signs have now become ambiguous: \( \partial \Pi_K / \partial p_m = \Pi_{Kp_m} \geq 0, \partial y/\partial p_m = y_{pm} \geq 0, \) and other signs remain the same, i.e., \( \partial I / \partial \lambda = I_\lambda > 0, \partial I / \partial p_m = I_{pm} < 0, \partial \Pi_K / \partial K = \Pi_{KK} < 0, \partial y/\partial K = y_K > 0, \partial \chi / \partial I = \chi_I > 0, \partial \chi / \partial \lambda = \chi_\lambda > 0, \) and \( \partial \chi / \partial p_m = \chi_{pm} > 0. \) Note that equations (13-6) and (13-7) will be divided into the two original systems whenever necessary, particularly when we examine the effects of tariffs. Now the essential dynamic system consists of (13-6), (13-7), and (13-8). The system is recursive in the sense that the dynamic behaviour of \( b \) is affected by the dynamics of \( K \) and \( \lambda, \) but not conversely. Therefore, we can either solve the dynamics of \( K \) and \( \lambda \) first from (13-6) and (13-7), then solve for \( b \) from (13-8) using the solution of \( K \) and \( \lambda, \) or we can solve these three differential equations simultaneously in terms of \( K, \lambda, \) and \( b. \)

Linearizing the systems around the point where \( K = \lambda = b = 0 \) yields

\[
\begin{bmatrix}
\dot{K} \\
\dot{\lambda} \\
\dot{b}
\end{bmatrix} = \Theta\begin{bmatrix}
K - \bar{K} \\
\lambda - \bar{\lambda} \\
b - \bar{b}
\end{bmatrix}
\]

where a tilde on \( \bar{K}, \bar{\lambda}, \) and \( \bar{b} \) represents the steady-state value of the corresponding variables. The coefficient matrix of the dynamic system, \( \Theta, \) can be represented as:
As shown in the Appendix 4.2, the system exhibits the saddle point equilibrium, and the slope of the saddle path in \((\lambda, K)\) space and \((K, b)\) space, respectively, is negative. This means that in \((\lambda, K)\) space the shadow price of capital and the capital stock move in opposite directions along the stable trajectory, and that in \((K, b)\) space the total capital stock is positively related with the current account deficit along the stable path. See Calvo [1987b] and Gandolfo [1980], for dynamic stability analyses.

\textit{Steady-State Equilibrium}

The model's long-run steady-state is obtained when the time derivatives of the shadow price of capital, the capital stock, and the current account are all simultaneously zero. As mentioned, the dynamics of \(b\) is completely determined by the dynamics of \(\lambda\) and \(K\), we thus focus on the steady-state solution of \(\lambda\) and \(K\), using the phase diagram in \((\lambda, K)\) space.

The upper quadrant of Figure 4.1 (henceforth UF-1) presents the phase-diagrammatic demonstration for the model's steady-state equilibrium in \((\lambda, K)\) space. The crossing point of equations \(\dot{K} = 0\) and \(\dot{\lambda} = 0\) in UF-1 determines the long-run equilibrium values of the capital stock, \(\bar{K}\), and the marginal value of capital, \(\bar{\lambda}\). Given this equilibrium value for the market value of an extra unit of capital, the equilibrium level of investment is selected according to equations (13-2) and (13-2)'.

It is straightforward to show that the slope of the locus of \(\dot{K} = 0\) is positive and that of \(\dot{\lambda} = 0\) is negative. That is,

\[
\frac{d\lambda}{dK} \bigg|_{K=\bar{K}} = \frac{\delta}{I_\lambda} > 0
\]
The upward sloping $\dot{K} = 0$ locus indicates that if the capital stock increases slightly, investment must rise in order to keep the rate of capital accumulation at zero. Given the price of importable goods, the only way to raise investment is through an increase of the shadow price of capital. The $\dot{\lambda} = 0$ locus is downward sloping because a slight increase in $K$ lowers the return to capital (note: $\pi$ is concave in $K$), and hence requires a fall in the shadow price of capital to keep the rate of change in the marginal value of capital at zero. The stable arm SS, formally derived in equation (A14) in the Appendix, is drawn to be sloping downward.

Now imagine that an economy is initially at $K_0$ in UF-1 where the total capital stock is below the steady-state level. As long as no future shock is anticipated, the system must
lie on the saddle path, SS. Thus, the corresponding shadow value of capital is \( \lambda_0 \) where its value is higher than the steady-state value. Since \( I = I(\lambda, p_m) \) with \( I_\lambda > 0 \) and \( p_m \) given, higher \( \lambda \) implies a higher investment, i.e., we have the level to keep \( K \) at \( K_0 \). The capital stock will be increasing over time toward its steady-state value, as \( \lambda \) converges to its long-run equilibrium value. The dynamics of the current account is drawn in the lower quadrant of Figure 4.1 (henceforth LF-1) and can be explained as follows. An initial starting level of the current account is given by \( b_0 \) which corresponds to \( (K_0, \lambda_0) \) in UF-1. As we can see, the transition toward the steady-state point, \( e \), is characterized by a rising the capital stock and a falling current account balance along the stable path, SS.

### 4.4 Steady-State Effects of Trade Liberalization

A perfect foresight equilibrium implies that the adjustment paths during the transition is partly determined by the firm's rational expectations about the long-run equilibrium. In order to facilitate discussions of the transitional dynamic paths in response to policy shocks, it is useful to discuss briefly the long-run effects of trade liberalization. Trade liberalization in this study is a reduction of a tariff rate on any imported goods.

Suppose that tariff rates are lowered unexpectedly. Firms envisage with perfect foresight that this tariff reduction will be maintained forever. Given the assumption that firms' capital creation requires importable goods, investment in both industries will unambiguously and directly increase in response to a tariff reduction, as will the capital stock in each industry. The effects on the returns to capital will, however, be different in each industry, and this difference is at the core of the whole dynamic analysis. We first discuss the responses in the exportable industry. Given the real wage rate and the non-substitutability between value-added and intermediates, a lower intermediate importable price increases profitability and hence the real return to capital. This raises the shadow value of capital which in turn indirectly induces further investment, although the real return to capital diminishes as the capital stock in the exportable industry is accumulated. The long-run response of the shadow value of capital is ambiguous. Obviously, \( \lambda_x \) must
rise initially since a tariff reduction raises the firm's return to capital. However, as the capital stock is accumulated, the firm's real rate of return to capital diminishes, which in turn lowers the shadow value of capital. The overall effect on \( \lambda_x \) depends on these two opposite forces, although it is obvious that tariff reductions contribute to the augmentation of the capital stock in the exportable industry. The algebraic representations of the long-run effects of tariff reduction on the capital stock and the shadow price of capital in the exportable industry are given by:

\[
\frac{d\tilde{K}_x}{dp_m} = \frac{I_{xp}(r + \delta) + I_{x} \pi_{xm}}{\delta (r + \delta) - I_{x} \pi_{xx}} < 0
\]

\[
\frac{d\tilde{\lambda}_x}{dp_m} = \frac{I_{xp} \pi_{xx} + \delta \pi_{xp}}{\delta (r + \delta) - I_{x} \pi_{xx}} \geq 0
\]

where a tilde denotes the corresponding steady-state values.

The effects on the importable industry turn out to be contractionary. Since tariff cuts imply a lower output price in the importable industry, the profitability in the importable industry is dampened. The real wage rigidity causes unemployment in the importable industry. The loss in profitability causes the real return to capital in the importable industry to fall. Although tariff reductions directly increase investment by reducing the cost, the real return to capital diminishes over time. The marginal value for capital, \( \lambda_m \), unambiguously falls. But the capital stock in the new equilibrium is not determinate since an increase in investment causes the capital stock to rise, but a fall in the return to capital has a decumulation effect. The algebraic expressions are the same as (18) and (19), except for notation and the opposite signs of \( \pi_{xp} < 0 \) (exportables) and \( \pi_{mp} > 0 \) (importables). Therefore, for the importable industry, \( d\tilde{\lambda}_m/dp_m \geq 0 \) and \( d\lambda_m/dp_m > 0 \). The plausible case may be that in the long-run the capital stock in the importable industry falls, and the marginal value for capital in the exportable industry rises following a reduction of tariffs, and henceforth we assume that \( d\tilde{\lambda}_m/dp_m < 0 \) and \( d\tilde{K}_m/dp_m > 0 \). Note that one would expect that a cut in protection will unambiguously shrink the importable
industry. But this may not happen in our case since the importable goods are used to increase the capital stock (sector-specific). If this effect is sufficiently large enough to offset the negative effect of the tariff cut on the real return to capital, the importable industry may not shrink from liberalization.

It is predictable that the long-run effects on the stock of foreign bonds are ambiguous. To see this, consider the following algebraic representation for the effects of lower tariffs on $b$:

\[
\frac{db}{dp_m} = \frac{1}{r} \left[ \chi_{x} \frac{d\lambda_x}{dp_m} + \chi_{m} \frac{d\lambda_m}{dp_m} \right] - \left[ y_x K_{x} \frac{dK_x}{dp_m} + y_m K_{m} \frac{dK_m}{dp_m} \right] - (A_x + A_m) \geq 0
\]

where $A_x = y_{xp} - \chi_{xp} < 0$ and $A_m = p_{y, m} y_{1, mp} - \chi_{mp} \geq 0$. Also, the sign of $A_x + A_m \geq 0$, and would be positive if a rise in net exports outweighs a fall in net imports.

In equation (20) the effects on the holding of foreign bonds of a tariff reduction are determined via three channels: changes in the marginal value of capital in each industry, changes in the capital stock in each industry, and changes in net income (income minus investment costs). First, since there is no effect on consumer's savings, changes in the economy's net income stem from changes in output net of investment expenditure in both industries. Net output in the exportable industry will rise since its output has risen and its investment costs have fallen, whereas net output in the importable industry can go either way because both output and investment costs have fallen. Second, as explained, the marginal value for capital and the capital stock move oppositely in each industry, so that an additional ambiguity arises in signing the changes in $b$. Thus, whether the stock of foreign bond will increase or decrease in the new steady-state equilibrium depends upon these two composite forces, and is difficult to sign a priori.

4.5 Timing of Trade Reform and Transitional Dynamics

We turn now to an examination of the transitional dynamics following a tariff
reduction. Our main objective here is to characterize the transitional adjustment paths using a phase diagram, with particular emphasis on the implications of the timing of tariff reform. To do this, we will group policy experiments into two types depending on whether the shock is permanent or temporary (both unanticipated). We can also distinguish immediate shocks from pre-announced shocks. We shall demonstrate the transitional dynamics of $k$ and $\lambda$ first, and then make use of the recursivity of the system to examine the dynamic relations between the capital stock and the current account. The dynamics governing both industries will be dealt with, but explanations are mostly devoted to the responses of the exportable industry since the explanations for the importable industry are analogous. However, both industries must be compared, otherwise the implications of the effects of the timing of reform policy on crucial variables may be missed.

*Permanent Trade Liberalization*

In the case of permanent tariff liberalization, we assume that lower tariffs are implemented unexpectedly, and they stay forever at the lower levels. The upper quadrant of Figure 4.2, UF-2, demonstrates the transitional adjustment paths of the exportable industry in $(\lambda_x, K_x)$ space following a permanent and immediate tariff reduction. Its partial effect on the current account is sketched in the lower quadrant of Figure 4.2, LF-2. Point $e$ in both quadrants represents an initial equilibrium. Also, the line SS in both phase diagrams is a stable trajectory which enters point $e$. Note that its slope has been obtained by (A14) and (A15) in the Appendix 4.2, respectively. Now we examine how these loci will shift in response to reform.

First, we have to determine how lower tariffs affect the zero time-derivative loci in $(\lambda_x, K_x)$ space. Equation (13-4) can be used to analyze the shift of the $\dot{\lambda}_x = 0$ locus. As the tariff rate, $\tau$, falls, the domestic price of intermediates and capital goods will correspondingly fall. The returns to capital, the rightmost term in equation (13-5) rises. In order for $\dot{\lambda}_x$ to remain zero, $\lambda_x$ must rise. Therefore, the $\dot{\lambda}_x = 0$ schedule will shift upward. The amount of shift can be readily calculated by letting $\dot{\lambda}_x$ equal zero, and
obtaining the partial derivative expression that \( \partial \lambda_x / \partial p_m \bigg|_{\dot{k}_x = 0} = (r + \delta)/\pi_x < 0 \). Likewise, a shift in the \( \dot{k}_x = 0 \) locus can be examined from equation (13-3). Intuitively, a lower price of importable capital goods encourages investment. To keep the firm’s accumulation constraint at zero for a given \( \lambda_x \), the capital stock must rise. Thus, the \( \dot{k}_x = 0 \) locus will shift to the right. The amount of shift in the \( \dot{k}_x = 0 \) locus alone is given by \( \partial k_x / \partial p_m \bigg|_{k_x = 0} = I_x / \delta < 0 \).

Because equation (19) has an ambiguous sign, we do not know which zero-derivative locus will shift relatively further in UF-2. The assumption that \( d\lambda_x/dp_m < 0 \), which was made in Section 4, implies that \( \dot{\lambda}_x = 0 \) locus shifts further. The \( \dot{k}_x = 0 \) locus shifts less
because if it shifts more, then the real returns to capital will diminish enough to offset the increase in $\lambda_x$ associated with a lower price of capital goods. Hence, the new steady-state point $e'$ is consistent with the explanation provided in the previous section.

In sum, both loci have shifted from $\lambda_x = 0$ to $\hat{\lambda}'_x = 0$, and from $\hat{k}_x = 0$ to $\hat{k}'_x = 0$, respectively, but $\hat{\lambda}_x = 0$ has shifted out more. The location of the new steady-state, $e'$, can be found by setting $\hat{\lambda}_x = 0$ and $\hat{k}_x = 0$ simultaneously, and solving for $\lambda_x$ and $K_x$, using the post-shock values of the tariff rate. We see that the values of both $\lambda_x$ and $K_x$ are higher in the new long-run equilibrium.

What do, then, the transitional paths look like? Because $\lambda_x$ is a jump variable, when tariff policy changes, $\lambda_x$ initially jumps up vertically to the point on the new saddle path, and then decreases over time as the capital stock gradually increases. The initial shift of the saddle path from $SS$ to $S'S'$ (jump in $\lambda_x$ from point $e$ to point $q$) following a tariff cut, using that $(\lambda_x(0) - \tilde{\lambda}_x) = (\pi_{xx}/r + \delta - \nu_1)/(K_x(0) - \tilde{K}_x)$ [see (A10) and (A14)], is given by:

$$
\begin{align*}
\frac{d\lambda_x(0)}{dp_m} &= \frac{d\lambda_x}{dp_m} - \frac{\pi_{xx}}{r + \delta - \nu_2} \frac{d\tilde{K}_x}{dp_m} < 0
\end{align*}
$$

Equation (21) indicates that the initial response of $\lambda_x$ depends on the steady-state effects of the tariff cut on the steady-state values of $\lambda_x$ and $K_x$. Since $d\lambda_x/dp_m < 0$ (assumed above) and $d\tilde{K}_x/dp_m < 0$, the saddle path has shifted upward after a reduction in $\tau$. The adjustment process continues until the economy reaches a new long-run equilibrium.

We now turn to LF-2 where we have the negative slope along the stable path in $(b, K)$ space, as derived in (A15) in the Appendix. Before further discussion, we should note that LF-2 in Figure 4.2 refers to partial effects of investment in the exportable sector on the current account. In LF-2, the current account balance in transition is represented by the new saddle path $S'S'$. It is flatter than the old one, $SS$. The slope of the initial saddle path in $(b, K)$ space is given by \( \{y_{xK}(p_0) - (\pi_{xx}/r + \delta - \nu_1)/(\nu_1 - r) \} \), where $p_0$ denotes an initial price in equilibrium. The slope of the new saddle path associated with a
lower value of $p_m$ can be written as $\left\{ \left( y_x K(p_m^1) - \pi_x x / r + \delta - v_1 \right) / (v_1 - r) \right\}$, where $p_m^1$ denotes a new import price. Obviously, given constant parameters, $p_m^1 < p_m^0$ implies that the slope of the saddle path is flatter at the new price associated with the fall in $\tau$. Therefore, the new steady-state is determined by point $e'$, where a new capital stock crosses the stable path. In Figure 4.2, the movement from $q$ to $e'$ in UF-2 corresponds to the movement along $e e'$ on $s's'$ in LF-2. From this Figure, we can see that the response to tariff cuts in the exportable industry acts to reduce foreign bonds, which is brought about by a deterioration in the trade balance. The assumption which generates the deterioration in the trade balance is that an increase in the investment expenditure in the exportable industry associated with the tariff reduction more than offsets an increase in its marginal value of capital.

A new steady state which is associated with a higher capital stock in UF-2, corresponds to a lower current account balance in LF-2. Also, during the transitional adjustment, a rising capital stock is related to a falling current account balance. Note that a deterioration in the current account occurs smoothly since neither the capital stock nor the current account is a jump variable. Therefore, during the transitional adjustment, as the capital stock smoothly increases following reform, the current account balance is smoothly reduced. From the consumers' point of view, consumption not being affected, changes in their holdings of foreign bonds are only possible through changes in the current account balance.

The dynamics in the importable industry discussed in Section 4 are sketched in Figure 4.3. Since the steady-state effects in each industry are explained above, the only remaining (and noticeable) difference is their dynamics of transition. That is, the co-state variable for the exportable industry, $\lambda_x$, initially jumps up, while the co-state variable for the importable industry, $\lambda_m$, initially jumps down. In addition, the slope of saddle path in $(b, K)$ space now becomes steeper. Other dynamic behaviour may analogously be explained using UF-3 and LF-3 in Figure 4.3. Note again that LF-3 in Figure 4.3 refers to partial effects of investment (caused by a tariff reduction) in the importable sector on the current account. The response in the importable industry leads the current account to
improve if a decline in the output of importables brought about by the tariff reduction is less than (in absolute value) an increase in the investment expenditure of the importable sector. Figure 4.3 is drawn under this assumption. In LF-3, along e e' on the new saddle path, s's', the current account balance smoothly improves.

In sum, from the partial effects of investment brought about by tariff reductions in each sector, as shown in LF-2 and LF-3, respectively, we can conclude that the overall transitional effects on the current account of permanent trade reform are ambiguous.

Temporary Trade Liberalization

Now suppose that the government tariff liberalization policy is not expected to be maintained forever. This is the case where the government liberalization policy is perceived to be temporary by the private agents. Firms anticipate with perfect foresight that tariffs will return to their original higher level at some known time in the future. The transitional dynamics of this temporary tariff reduction are different from its permanent counterpart in both industries because temporary policies in general have an implementation date as well as a cancelling date (assuming the announcement date and the cancellation date coincide). In our model, we assume that a tariff reduction policy will be maintained for some time, say for T years, and after that the tariff rate will be going up to its pre-shock level. Hence, the price of importable goods is such that $p_m(t) = p_m^1(t)$ when $0 \leq t \leq T$, and $p_m(t) = p_m^0(t)$ when $t > T$. Note once again that $p_m^0(t)$ is the initial equilibrium price of importable goods associated with the initial tariff rate, and $p_m^1(t)$ denotes the price in the more liberalized trade regime. We know that $t^0 > t^1$ and hence $p_m^0 > p_m^1$.

Let us start from the case of exportable industry. A temporary drop in the price of imports leads to upward jump in the costate variable, $\lambda_x$. The jump in $\lambda_x$ occurs because a fall in $p_m$ raises the returns to capital, at least for some period. However, the jump in $\lambda_x$ is not all the way up to the point on the new stable trajectory for a permanent counterpart simply because the firm knows that the policy will not be permanent.
It can be shown that the initial jump in $\lambda_x$ is smaller than the one made in the case of permanent tariff reduction (see below). Solving for $\lambda_x$ by integration (using an integrating factor of $e^{-(r+\delta)t}$) in equation (13-4) yields

$$\lambda_x(t) = \int_0^T \pi_xK(p_m, K_x)e^{-(r+\delta)t} dt$$

where $\lambda_x(t)$ shows how the market value of the exportable firm changes in response to marginal changes in its capital stock. Equation (22) may be written as

$$\lambda_x(t) = \int_0^T \pi_xK(p_m, K_x)e^{-(r+\delta)t} dt + \int_0^\infty \pi_xK(p_m, K_x)e^{-(r+\delta)t} dt$$
where the lefthand (righthand) of the inequality represents the equilibrium value of the real return to capital in the case of a temporary (permanent) tariff reduction. The inequality implies that the initial shift in the saddle path is smaller in the case of a temporary tariff reduction. The initial shift of the saddle path is dependent upon the characteristics of the firm's production structure and other parameter values, including tariff rates, and more importantly the degree of temporariness. Moreover, the degree of temporariness in tariff cuts affects industries in opposite ways.

In order to highlight the relationship between the temporariness of reform and the dynamic behaviour of the shadow value of capital, capital stock, and the current account, we consider equation (23) again. Let us assume that the public anticipates that the tariff will go up at the date \( T \) and the value of \( A_x \) at time \( T \) be \( A_x(T) \). As \( T \) becomes larger, i.e. as the liberalization policy becomes longer, \( A_x(T) \) becomes larger as well. As \( T \) approaches eventually to infinity, a temporary policy would become permanent. The opposite interpretation for a very temporary policy can also be applied. Recognizing this, we first characterize the dynamics of a temporary tariff reduction.

Consider UF-4 in Figure 4.4 for the dynamics of \( A_x \) and \( K_x \), and compare the instantaneous change in \( A_x \) following a temporary tariff cut with that following a permanent tariff cut. Under the temporary cut \( A_x \) jumps up to point \( q' \). As a result of this rise in \( A_x \), capital begins to accumulate and \( A_x \) starts to fall, as characterized in the permanent experiments. When \( A_x \) rises, investment also rises, but not as much as in the case of a permanent shock. Hence, the system moves toward the right, as under the permanent tariff reduction. At the same time, as the remaining period of lower importable prices becomes gradually shorter, \( A_x \) starts to fall back toward its initial level. This pushes the system downward. As \( A_x \) falls, so does investment. Eventually, a point is reached where investment just covers depreciation of the higher capital stock. In UF-4, that point occurs at \( d \) where the dynamic path crosses the \( \dot{k}_x = 0 \) locus.
After point d, $\lambda_x$ is still declining and the system is moving downward and to the left since investment is not enough to offset depreciation and hence the capital stock begins to decline. This is an important feature of a temporary policy. The system will reach a point, $d'$, where the capital stock is still higher than its original steady-state level, but $\lambda_x$ is too low, so that past $d' \lambda_x$ begins to rise. In the new steady-state $e''$ we have a higher capital stock and higher shadow price of capital. Temporary tariff reduction has permanent effects in this case (see the explanation below).

In LF-4, the partial effects of investment in the exportable industry caused by a temporary tariff cut on the current account are shown, and compared to the effects of a permanent tariff cut. The higher investment following the rise in $\lambda_x$ leads the current account to deficit. The current account deficit occurs smoothly as the capital stock is accumulated. The movement along $q'd'$ in UF-4 corresponds to the movements along $ed'$ or $s''$ in LF-4. In both parts of Figure 4.4, point $d'$ indicates the time when the tariff is restored to its original level. At this point, the capital stock has increased, but correspondingly the holdings of foreign bonds have reduced. After the tariff returns to its original higher level, the increased capital stock and smaller foreign bonds become to serve as initial conditions governing the dynamics beyond that time. In a definitive solution type of equation (A9) in the Appendix 4.2, $A_j$ ($j = 1, 2, 3$) are partly related to the initial conditions such that $A_j = [K_0 - \bar{K}, \lambda_0 - \bar{\lambda}, b_0 - \bar{b}]$, and these $A_j$ ($j = 1, 2, 3$) partly determine the new steady-state equilibrium. Since rational firms perfectly know that there will be no change in the tariff once it is returned to its orginal level, the relevant saddle path after that time is represented as $s''s''$ in both parts of Figure 4.4, and it is parallel to the initial saddle path, $ss$, since the relative price is returned to its original level by the reversal of tariff reform.

Thus, $\lambda_x$, $K_x$, and $b$ do not return to their initial steady-state equilibrium values in the long-run. This means that the temporary reduction of tariff leads to a permanent increase of the capital stock, accompanied by a permanent reduction of the holdings of foreign bonds. While the lower importable price prevailed, it induced higher investment and

---

7Note that $A_j$ ($j = 1, 2, 3$) are arbitrary scalars associated with their initial values.
lower bond holdings which affect subsequent initial conditions, which in turn influences
the subsequent steady-state [Sen and Turnovsky, 1989].

Eventually, in the new steady-state after the temporary reform, the capital stock in the
exportable industry has increased, but not as much as in the case of a permanent tariff
cut. Correspondingly, the current account balance has declined, but by less than under
the permanent reform. Analogous explanations can be provided for the dynamics of the
importable industry, for which Figure 4.3 can be referred to again.

**Policy Temporariness and the Current Account**
In his paper, Calvo [1988] demonstrated the relationship between policy temporariness, the real exchange rate, and the current account. On the basis of his consumption-saving dynamics (no investment dynamics), he derived a negative relationship between the degree of policy temporariness and the current account. That is, the shorter the period where trade is liberalized, the larger is aggregate consumption during the liberalization period—the larger, in other words, the current-account deficit. In our analyses of investment dynamics within a framework of sector-specific capital, with the assumptions made above, we found that the exportable sector leads the current account to deficit. But this deficit generated by the exportable sector is smaller as the time horizon of a temporary tariff cut becomes shorter. On the other hand, the importable sector contributes to the current account surplus, with this surplus caused by the importable sector becoming smaller as the time horizon becomes shorter. Hence, if the effects of a tariff reduction on the importable industry dominates over its effects on the exportable industry during the transitional adjustment period, then policy temporariness worsens the current account. If the opposite, then the result will be reversed.

![Diagram of Degree of Temporariness: Exportables](image)

**FIGURE 4.5 DEGREE OF TEMPORARINESS: EXPORTABLES**

To see this point, we consider the behaviour of the marginal value for capital in Figure 4.5 where the exportable industry responds to temporary tariff cuts for a period of T. If T
is relatively large, the initial jump in \( \lambda_x \) will also be large (e.g., point q'), but not larger than for a permanent cut. Two points, q' and q'', are drawn, to which \( \lambda_x \) jumps in response to different periods of temporary tariff reductions. They reflect that as the duration of temporary tariff reductions becomes shorter, the jump in \( \lambda_x \) is also smaller, which in turn implies a smaller investment increase and thus a smaller increase in the capital stock in the new steady-state. Obviously, the current account deficit will be smaller as the tariff liberalization period ends earlier.

The locus, J, which connects a series of possible new steady-states brought about by temporary policies with different time horizons, is represented in Figure 4.5, where we see that the new equilibrium value of \( \lambda_x \) will be at a maximum at e' (for a permanent reform), and becomes smaller as \( T \) goes to zero. Likewise, the responses in the importable industry are sketched in Figure 4.6. As reform becomes short-lived, the jump in \( \lambda_m \) is smaller, which implies a higher value of \( \lambda_m \) in the new equilibrium.

This will lead the economy to higher investment, and hence will act as a strong force towards current account deficits. We may summarize these results in the following proposition:
Proposition 4.1 As the time horizon of tariff liberalization policy becomes shorter, the marginal value of capital and hence investment in the exportable (importable) industry becomes smaller (larger).

Proof. Let an initial jump in \( \lambda_x \) in response to a permanent tariff reduction be \( \lambda^P_x(t) \) and in response to a temporary tariff reduction be \( \lambda^I_x(t) \). Since investment in transition is solely determined by the marginal value of capital, we need to show that \( \lambda^P_x(t) > \lambda^I_x(t) \) and the derivative \( \frac{d}{dT} (\lambda^P_x(t) - \lambda^I_x(t)) \) with respect to \( T \) is negative. Then

\[
\lambda^P_x(t) = \int_0^T \pi_x K(p_{m^1}, \cdots) e^{-(r+\delta)t} \, dt
\]

\[
\lambda^I_x(t) = \int_0^T \pi_x K(p_{m^1}, \cdots) e^{-(r+\delta)t} \, dt + \int_T^\infty \pi_x K(p_{m^1}, \cdots) e^{-(r+\delta)t} \, dt
\]

We can obtain by performing integration on \( \lambda^P_x(t) \) and \( \lambda^I_x(t) \):

\[
\lambda^P_x(t) = \frac{1}{r+\delta} \pi_x K(p_{m^1}, \cdots)
\]

\[
\lambda^I_x(t) = \frac{1}{r+\delta} \pi_x K(p_{m^1}, \cdots) + e^{-(r+\delta)T} [\pi_x K(p_{m^0}, \cdots) - \pi_x K(p_{m^1}, \cdots)]
\]

Since \( p^1_m < p^0_m \) and \( \pi_x K(p^1_{m^1}, \cdots) > \pi_x K(p^0_{m^1}, \cdots) \), and hence \( \lambda^P_x(t) - \lambda^I_x(t) > 0 \). Now define \( \lambda^P_x(t) - \lambda^I_x(t) = \psi(t) \), then we can obtain that

\[
\frac{d\psi(t)}{dT} = (r+\delta)e^{-(r+\delta)T}[\pi_x K(p^0_{m^1}, \cdots) - \pi_x K(p^1_{m^1}, \cdots)] < 0
\]

which means that as \( T \) reduces, the difference of \( \lambda \) is rising, which means that \( \lambda^I_x(t) \) becomes smaller at a given \( \lambda^P_x(t) \). Note that in the importable industry, \( \lambda^P_m(t) - \lambda^I_m(t) < 0 \), and hence as \( T \) reduces, the difference of \( \lambda \) is also increasing. But this means that \( \lambda^I_m(t) \) becomes larger at a given \( \lambda^P_m(t) \). Q.E.D.
Resource Allocation and Policy Temporariness

The above discussion on temporary reform is analogous to the case where specific-capital is moving from an industry which is inefficient to the one which is productive in the long run. For a conventional analysis, see Mussa [1978]. For our discussion, we may assume that capital is flowing out from the importable industry into the exportable industry following reform. Let us now define $I_x$ as the outflow of capital from the importable to the exportable industry. We also assume that $I_x$ is an increasing function of the difference between the shadow prices of capital in the two industries and the price of investment goods, that is, $I_x = I_x(\lambda_x - \lambda_m, p_m)$ where $\partial I_x / \partial (\lambda_x - \lambda_m) > 0$ and $\partial I_x / \partial p_m < 0.8$ Let $(\lambda_x - \lambda_m)$ be $\Omega$, and let the difference between the returns to capital in the two industries be $R(p_m)$ where $R = \pi_x K - \pi_m K$ and $R' < 0$. Then the two dynamic equations which govern the reduced system are $\dot{K}_x = I_x(\Omega, p_m) - \delta K_x$ and $\dot{\Omega} = (r + \delta)\Omega - R(p_m)$. We employ the same concept of the time horizon of temporary policy discussed above. Then, we have the following proposition:

Proposition 4.2 As the time horizon of temporary tariff reduction becomes shorter, the resource allocation effects of trade reform are dampened.9

Proof. A smaller resource allocation effect of trade reform implies that the outflow of capital from the importable to the exportable industry, $I_x$, is smaller, due to a reduction in the discrepancy of the marginal value of capital between the two industries. Thus, what we need to show is that $d\Omega(t)/dT < 0$, which is equivalent to showing that $d(\Omega^T(t) - \Omega^T(t))/dT < 0$ where superscripts have the same interpretation as before. Now the proof is exactly analogous to the previous proof. By integrating the difference of the shadow price of capital between the two sectors, we obtain:

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8 We assume that the outflow of capital is in the form of the investment good which is imported, so that $I_x$ is still a function of $p_m$.

9 Rodrik [1989c], in a different framework, derives this type of result. He argues that a higher level of investment is consistent with higher level of credibility, which in turn implies that a lower level of investment is related to noncredibility of trade reform. Calvo [1988, p. 471] concludes that incredible reform is functionally equivalent to temporariness.
\[ \Omega(t) = \int_0^\infty (\pi_{xK} - \pi_{mK}) e^{-(r+\delta)t} \, dt = \int_0^\infty R(p_m) e^{-(r+\delta)t} \, dt \]

where we can see that the difference in the marginal values of capital is equal to the present value of expected future differences in the real returns to capital. Next, integrating \( \Omega(t) \) for each tariff experiment exactly in the same manner as before, we obtain the difference of \( \Omega(t) \) between the two tariff experiments. If we differentiate this difference with respect to \( T \), we obtain

\[ \frac{d(QP(t) - \Omega'(t))}{dT} = (r + \delta) e^{(r+\delta)T} [R(p_m^0) - R(p_m)] < 0 \]

where \( QP(t) - \Omega'(t) > 0 \). Given a certain level of \( QP(t) \), \( d(QP(t) - \Omega'(t))/dT < 0 \) means that \( \Omega'(t) \) falls as \( T \) falls. It means that as \( T \) is reduced, capital outflows from the importable sector would be reduced since the difference of the real rate of return to capital in present value term becomes smaller when the period of tariff reform ends earlier, i.e., \( \Omega'(t) \) falls. Q.E.D.

**Pre-Announced Tariff Cut**

Suppose that instead of implementing a tariff reform immediately, the government announces that it will occur in the future (at some known time). The results in this case are expected to be somewhat different although the initial and new steady-states are precisely the same as in the case of an immediate implementation. Thus, the basic elements of the phase diagram are identical to Figure 4.2, but the dynamic paths of the variables become slightly different. Again we will concentrate on the exportable industry in Figure 4.7.

When a tariff reduction policy is announced, \( \lambda_x \) rises part of the way toward its new steady-state value, from point e to q, but not as much as it would if the reform took effect immediately. Hence, the nature of the initial rise in \( \lambda_x \) is the same as in the case of an immediate but temporary tariff reduction. The reason, however, is different. Here, \( \lambda_x \) rises despite the high present tariff because the firm eventually gains in the returns to
capital by the implementation of a lower tariff. Note that the speculative behaviour of the in purchasing imported investment goods is excluded by the assumption that imported investment goods should be installed in the period that imports occur. Also, the existence of the adjustment costs forces the firm to invest only when the marginal cost of installed capital equals the marginal gain of an additional unit of investment goods. Since the firm knows that purchasing the investment goods after the tariff cut is as costly as before the reform, shifting all investment across time is unprofitable, and hence the intertemporal substitution in investment does not take place in our case even though the price of imported investment goods will become cheaper tomorrow.

After the initial rise in \( \lambda_x \), the system will follow the original differential equations with the same values of exogenous variables until the implementation date. That is, the system moves gradually to the right and upward until the tariff is actually lowered. Since the model is required to attain the steady-state ultimately, it must be on the new saddle path exactly at the moment of actual implementation of the tariff reform. In Figure 4.7, point \( q' \) on the new stable path \( S'S' \) represents the implementation date. After that, the system moves down along this stable path toward the new long-run equilibrium. Note
that in this case of pre-announced reform, $\lambda_x$ does not jump vertically at the moment of policy implementation. Instead, $\lambda_x$ smoothly reaches the new stable trajectory on implementation according to $\lambda_x(t)$, i.e., equation (22). The continuity of $\lambda_x$ at time $T$ (implementation date) is derived in the Appendix 4.3.

Then, what is the difference between implementing the tariff reform immediately and announcing the reform in advance? A noticeable consequence is that the capital stock is lower relative to what it would be under an immediate reform during the period between announcement and implementation.$^{10}$ This is because the firm’s return to capital is lower before implementation when the tariff is relatively high. Lower returns to capital discourage investment, and will drive down the capital stock. Once the tariff is lowered, investment returns to normal and the returns to capital will then go up, and so will the capital stock.

Correspondingly, the current account balance rises (relatively) during the period between announcement and actual implementation, since investment is reduced by lower returns to capital before tariffs are lowered. After the implementation of a lower tariff ($\eta'$ in Figure 4.7), the current account balance will decline since the capital stock begins to rise. In the long-run, the economy will move down along the stable path, $s's'$, resulting in a higher capital stock in the exportable industry. The current account in the new steady-state will have deteriorated. The dynamics for the importable industry are analogous, so we omit them here.

Note that the response of the firm to the pre-announced tariff cut is qualitatively different from that of consumers. Although it is ambiguous whether the firm’s response to announcement would generate a current account deficit or surplus, the firm would not postpone its investment simply because it is cheaper tomorrow, due to the existence of the adjustment costs. The intertemporal substitution in investment, in the presence of the adjustment costs, would not occur, and hence there is no intertemporal effect on the current account caused by investment.$^{11}$ The reduction of the capital stock in the

---

$^{10}$That is, $K_x$ rises faster in the case of immediate reform case.

$^{11}$Note that if the installation of imported investment goods can be postponed across periods (i.e., inventory is allowed), then the intertemporal substitution in investment can occur by the announcement, which acts to
exportable industry before implementation occurs not because of the firm's postponement of investment but because of the firm's lower return to capital when the tariff is relatively high. This makes the current account improve relatively between announcement and implementation.

However, consider the consumption sector. If the importable goods were consumed, then it would be optimal for consumers to postpone their consumption to the future if the importables are relatively cheaper tomorrow. Hence, the intertemporal substitution in consumption occurs through the intertemporal relative price change, which is different from the behaviour of the firm. This can act to increase the current account balance today, and the current account balance will decline over time after implementation. So the current account can be affected by the intertemporal substitution in consumption. However, in general intertemporal distortions take place in both consumption and investment. On the industry side, it occurs via changes in the real return to capital caused by the announcement, whereas in the consumption side the intertemporal distortion occurs due to the changes in the intertemporal relative price of imports. Note that these announcement effects assume that the government's policy announcement is fully credible to the public.

4.6 Conclusion

This chapter has demonstrated that the timing of tariff liberalization is crucial in determining the dynamics of investment and the current account following the tariff reform. Both permanent and temporary tariff reductions have been shown to contribute to capital accumulation in the exportable industry, though the steady-state capital stock is different in magnitude, depending upon timing. But the basic direction of movement in both policy experiments is the same within the industry.

However, we have shown that the dynamics in transition of the two policies are different. In the exportable industry the initial jump in the shadow value of capital is

improve the current account in the present period.
smaller for a temporary tariff cut, and will reach a minimum when the time horizon of temporariness approaches to zero (i.e., no cut at all). A different story applies in the importable industry, as mentioned. This implies that in net terms the marginal value for capital in the economy as a whole can go either way, and so can the economy's current account. Hence, analytically, it is difficult to determine the relationship between tariff reform, capital accumulation, and the current account. Numerical simulation may provide more definitive results, enabling us to derive some policy recommendations.

The result obtained for each industry in terms of timing of reform may be interpreted in the context of intersectoral capital mobility. Setting the consumption gain aside, trade reform in our model works only to the extent that it reallocates resources. Therefore, the success of trade liberalization in this case can be measured by the extent to which capital (putting labour aside) moves in response to reform... In our analyses, the "less productive" industry may be the importable industry and the "more efficient" industry the exportable industry. Our discussion demonstrated that as the duration of tariff reform becomes shorter, the resource movement from the importable into the exportable industry is dampened. Besides from the intertemporal consumption distortion caused by temporary reform (see Chapters 3 and 5), this investment distortion in terms of resource switching constitutes another cost of temporary trade liberalization.
APPENDIX TO CHAPTER 4

4.1 Firm's Optimization Problem

The Hamiltonian is (ignoring subscripts x and m)

\[ H = [\pi(p, w, p_m, K) - c(p_m, I)] e^{rt} + \mu(I - \delta K) \]

The first order conditions are

\[ \frac{\partial H}{\partial t} = 0: \quad \mu = \frac{\partial c}{\partial t} e^{-rt} \]

\[ \frac{\partial H}{\partial K} = -\dot{\mu}: \quad \frac{\partial \pi}{\partial K} e^{-rt} - \delta\mu = -\dot{\mu} \]

\[ \frac{\partial H}{\partial \lambda} = \dot{\lambda}: \quad \dot{\lambda} = 1 - \delta K \]

Define the current value multiplier as \( \lambda = \mu e^{rt} \). Then, \( \dot{\mu} = (\dot{\lambda} - i\lambda)e^{-rt} \). Substituting these into (A2) and (A3) respectively yields

\[ \lambda = \frac{\partial c}{\partial t}(p_m, I) \]

\[ \dot{\lambda} = (r + \delta)\lambda - \frac{\partial \pi}{\partial K}(p, w, p_m, K) \]

These are equations (3) and (4) of the text where subscript x is attached.

4.2 Solution to Dynamic System

The characteristic values for the coefficient matrix, \( \Theta \), are the solutions of the following polynomial equation:

\[ c_0 v^3 - c_1 v^2 + c_2 v - c_3 \]

where \( c_j \) (j = 1, 2, 3) is the sum of all principal minors of order j, and \( c_0 = 1 \). It can be easily verified that
Applying the Descartes rules of signs for stability of the system, we can see that there are one continuation of sign in $c_j$ and two changes of sign in $c_j$ in the characteristic equation. This implies that there is one negative root (or negative real part of complex conjugate) and two positive roots, which can ensure that given the initial values of $K$ and $b$ ($K_0$ and $b_0$), there exists a unique convergent path (saddle path) satisfying the systems of dynamic equations. The general solution to equation (14) in the text is given by:

\[
\begin{bmatrix}
K(t) \\
\lambda(t) \\
b(t)
\end{bmatrix} =
\begin{bmatrix}
\alpha_{11} & \alpha_{12} & \alpha_{13} \\
\alpha_{21} & \alpha_{22} & \alpha_{23} \\
\alpha_{31} & \alpha_{32} & \alpha_{33}
\end{bmatrix}
\begin{bmatrix}
A_1e^{\nu_1t} \\
A_2e^{\nu_2t} \\
A_3e^{\nu_3t}
\end{bmatrix} +
\begin{bmatrix}
\tilde{K} \\
\tilde{\lambda} \\
\tilde{b}
\end{bmatrix}
\]

where $A_j$ ($j = 1, 2, 3$) are arbitrary scalars associated with their initial values, and $\alpha_j = [\alpha_{1j}, \alpha_{2j}, \alpha_{3j}]$ is the non-zero eigen vector associated with the corresponding eigen value, $\nu_j$. Let us define $\nu_1$ as negative part of the eigen value. It is then necessary to let $A_2 = A_3 = 0$ for ensuring convergent paths. From the general solution, choosing $A_2 = A_3 = 0$ we obtain the solutions that $K - \tilde{K} = A_1\alpha_{11}e^{\nu_1t}$, $\lambda - \tilde{\lambda} = A_1\alpha_{21}e^{\nu_1t}$, and $b - \tilde{b} = A_1\alpha_{31}e^{\nu_1t}$. We will concentrate on the stability of $(\lambda, K)$ space since the dynamics of $(K, b)$ can be traced afterwards. Ignoring the unstable part of the root, we can see that

\[
\frac{\lambda - \tilde{\lambda}}{K - \tilde{K}} = \frac{A_1\alpha_{21}e^{\nu_1t}}{A_1\alpha_{11}e^{\nu_1t}} = \frac{\alpha_{11}}{\alpha_{21}}
\]

Therefore, the stable path enters $(\tilde{\lambda}, \tilde{K})$ with slope $\alpha_{21}/\alpha_{11}$.

---

12 Descartes rules of signs: (i) the number of positive roots can not exceed the number of changes of sign in $c_j$, and (ii) the number of negative roots can not exceed the number of continuations of sign in $c_j$ in the characteristic equation.
Now we know that \([\Theta - v_j^1]\alpha_j = 0\), where \(J\) is the identity matrix. It then follows that:

(A11) \[-(\delta + v_j)\alpha_{1j} + I_1\alpha_{2j} = 0\]

(A12) \[-\Pi_{KK}\alpha_{1j} + (r + \delta - v_j)\alpha_{2j} = 0\]

(A13) \[y_K\alpha_{1j} - \chi_1\alpha_{2j} + (r - v_j)\alpha_{3j} = 0\]

From (A12) we obtain the slope of saddle path \((j = 1)\):

(A14) \[\frac{\alpha_{21}}{\alpha_{11}} = \frac{\Pi_{KK}}{r + \delta - v_1} < 0\]

This indicates that that the shadow price of capital and the capital stock moves in opposite directions along the saddle path in \((\lambda, k)\) space. Similarly, the slope of the saddle path in \((K, b)\) space can be obtained by substituting \(\alpha_{2j} = \alpha_{1j}(\Pi_{KK}/r + \delta - v_1)\) for \(j = 1\) into equation (A13):

(A15) \[\frac{b - \delta}{K - \bar{K}} = \frac{\alpha_{31}}{\alpha_{11}} = \left[\frac{y_K - \frac{\Pi_{KK}}{r + \delta - v_1}}{(v_1 - r)}\right] < 0\]

which indicates that the total capital stock is negatively related with the current account surplus along the stable paths.

4.3 Continuity of \(\lambda\) in Preannounced Tariff Cut

Let the date of implementation of the tariff reform be \(T\) and the value of \(\lambda_x\) at that time be \(\lambda_x(T)\). Then the price of importable goods can be \(p_m(t) = p_m^0(t^0)\) when \(0 \leq t \leq T\), and \(p_m(t) = p_m^1(t^1)\) when \(t \geq T\), where \(t^0 > t^1\) and hence \(p_m^0 > p_m^1\). Then, consider the value of \(\lambda_x\) at an arbitrary date of \(\Lambda\) which is very close to implementation date. What we would like to show is that \(\lim_{\Lambda \to T} \lambda_x(T - \Lambda) = \lambda_x(T)\). By conducting integration on \(\lambda_x(T)\) and \(\lambda_x(T - \Lambda)\), respectively, we can obtain:
\begin{align}
\lambda_x(T) &= \pi_{xK}(p_m^0;\ldots)e^{-(r+\delta)\bar{T}} - \pi_{xK}(p_m^1;\ldots)e^{-(r+\delta)T} - \pi_{xK}(p_m^0;\ldots) \\
\lambda_x(T - \Lambda) &= \pi_{xK}(p_m^0;\ldots)e^{-(r+\delta)\bar{T}} + \pi_{xK}(p_m^0;\ldots)e^{-(r+\delta)\Lambda} \\
&\quad - \pi_{xK}(p_m^1;\ldots)e^{-(r+\delta)\bar{T}}
\end{align}

which shows that \( \lim_{\Lambda \to 0} \lambda_x(T - \Lambda) = \lambda_x(T) \), namely, \( \lambda_x \) is continuous at the moment of implementation, \text{T. Q.E.D.}
CHAPTER 5

OPTIMAL SPEED OF TRADE AND CAPITAL ACCOUNT REFORM: THE ROLE OF IMPERFECT CREDIBILITY

5.1 Introduction

A number of trade liberalization experiences in developing countries have provided a lesson that to be successful the reform should be credible to the public. If it is not credible and is expected to be reversed in the near future, the private agents would not respond in the normal way, but would make their economic decisions according to their anticipation of future liberalization reversal. In such circumstances the costs of the lack of credibility may be substantial and the reform is likely to fail in the end. The World Bank 19-country study illustrates that trade liberalization programs have been reversed many times [Michaely, et.al., 1991]. Notwithstanding various reasons for unsuccessful reforms in different countries at different points in time, research has indicated that a lack of credibility is one of the main obstacles to success. What are the economic consequences of an imperfectly credible trade reform? What is the nature of the costs of a lack of credibility? In this chapter, we would like to organize discussion around these questions.

Let us start with the intuition. Put investment aside, imagine a representative consumer whose budget is intertemporally balanced, and consider a trade reform in the form of a tariff reduction. If there is no other distortion free trade policy achieves the first-best. But what will happen if the government's free trade policy which is intended (and announced) to be permanent, is not believed by the private sector? If the private sector anticipates that the current reform will be short-lived, the optimality of free trade would then be broken since expectations themselves can create an intertemporal distortion in resource allocation.
That is, an anticipation of future reform reversal will alter (raise) the intertemporal relative price index, and hence an intertemporal distortion in consumption occurs. As a result, the consumer's consumption spending on imports will then be switched towards the present period, generating excessive consumption in the current period. If the consumer can borrow freely, then overborrowing may be optimal to finance relatively cheap present consumption. The eventual consequence would be a fall in saving, deficits in the current account, and increasing foreign debt, etc. This noncredible reform will fail in the end, and, as Rodrik [1989b, p. 3] argues, it may be worse than no-reform.¹

In a simple illustrative model, we will show that the perceived imperfectly credible trade reform acts to create an intertemporal distortion in the economy, and is thus suboptimal. The main channel is the consumption-based rate of real interest in the intertemporal optimizing framework. The anticipation of future tariff reimposition reduces the consumption-based real interest rate (raises the real discount rate), inducing the consumers to substitute their consumption away from the future period towards the current period. The current account balance in the present period will, ceteris paribus, deteriorate. The important consequence is that the economy will suffer from an anticipated (but not actually realized) future protectionism in precisely the same direction that it would from an actual reversal to protectionism. The perceived noncredibility makes reform suboptimal, which would have been optimal if credible. As Calvo [1987a] and Rodrik [1989a, 1989b] have emphasized, noncredible reform policy will necessarily be short-lived, and is functionally identical to the failure of reform. Free trade policy is Pareto optimal if and only if it is credible to the public.

This is a simple but an appealing result, and is demonstrated in Section 2 using a formal model. It may be weakened (or strengthened) in a more general intertemporal framework since there will be additional channels other than the consumption rate of real interest through which welfare is affected. For example, the anticipation of a future tariff

¹Rodrik [1989c, 1989d] investigates the costs of noncredible reform in the investment side, arguing that the profitability of resource reallocation depends on whether the present value of expected benefits is bigger than the costs of resource allocation. If the reform lacks credibility, the investor's adjustment would not occur since they know that the benefits of reform will disappear shortly, and they may not recover the costs borne.
can affect welfare through other variables such as the real exchange rate, real wages, real
financial interest rates, employment, output, and investment, etc. We will examine the
real wage effect through which the expected future reversal will affect welfare and the
current account (Sections 3 and 4).

If the individual's choice variables are consumption and labour in each period, a rise
in goods price in either period will certainly distort the choice between consumption and
leisure within and between periods. If there is gross substitutability between consumption
and leisure, an expected future tariff will result in a higher price index in the future,
which will induce individuals to increase (reduce) leisure (labour) in both periods. The
demand for labour (in the importable sector in our case) will rise. Consequently, the
equilibrium real wage rate will adjust upward to restore the labour market equilibrium in
both periods. This rise in the real wages acts to improve welfare. Thus, it is shown that
the welfare effect of the future tariff can be alleviated by the rise in the real wages.
Overall, the welfare-reducing effect of the future tariff is ambiguous. It can be alleviated
if the substitution effect outweighs the income effect. However, we demonstrate that the
suboptimality of noncredible trade reform is still valid under certain circumstances.

Also, we derive a condition under which gradual reform is optimal (Section 5). That
is, there exists a positive tariff in the current period which maximizes the individual's
welfare, and the optimal first-period tariff is shown to be proportional to the probability
of future tariff reimposition. As long as the gradual reform does not influence the
government's credibility of reform, a slower rate of trade liberalization – i.e., a non-zero
tariff in period 1 and a zero-tariff in the next period rather than a zero tariff in both
periods – is optimal.

We also introduce capital account restrictions in the form of a tax on capital inflows
(Section 6), and argue that the conventional sequencing of liberalization in the balance of
payments (trade reform first) is favoured especially when trade reform is credible. This is

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2See Edwards [1987a] and Ostry [1988] for the real exchange rate effects of a temporary tariff or the terms of
trade. Bean [1986] for the real wages effect of a temporary terms of trade change. See also Aizenman [1991],
in trade reform.

3So will be the effect on the current account of a future tariff.
because the effects of the relaxation of capital controls in the presence of credibility problem may possibly be immiserizing if the distortion due to the lack of credibility is severe. This leads to a proposition that if the economy suffers from the lack of credibility of trade reform, it may wish to maintain capital controls to mitigate the intertemporal distortion caused by imperfect credibility [Calvo, 1988].

We draw conclusions in Section 7, and finally some algebraic calculations are contained in the Appendix.

5.2 Suboptimality of Incredible Trade Reform: An Illustration

This section formally illustrates the channel through which the imperfectly credible tariff reform affects welfare, using a simple intertemporal framework. It highlights the change in the consumption-based rate of real interest in response to the anticipation of future tariffs. We assume that the private agents anticipate future reimposition of tariffs with perfect foresight (or with probability one), so that we may regard the effects of incredible trade reform as being equivalent to the known effects of future tariff reimposition.

Consider a small open economy where the economy's production pattern is completely specialized. It consumes only import goods which are not produced domestically, and produces export goods which are not consumed in the home country. The price of export goods is taken as the numeraire and is assumed to be unity. Let $p_t$ be the relative price of the import goods in terms of the export goods in period $t$. The factors of production are assumed to be fixed so that individual's income may be regarded as manna-type wealth in terms of the numeraire good. The residents in this economy live only two periods. The consumer's preference is then represented as

$$u = u(c_1, c_2)$$
where \( c_t \) is the consumption of imports in period \( t \) and \( u \) is the utility function which is assumed to possess the usual properties. The corresponding intertemporal expenditure function is defined as the minimum expenditure to achieve the target utility level, \( \bar{u} \), at given prices:

\[
E = E(p_1, \delta p_2, u) = \min_{c_1, c_2} \{ p_1 c_1 + \delta p_2 c_2 \mid u(c_1, c_2) \geq \bar{u} \}
\]

where \( \delta \) is the consumer's fixed discount rate which is one over one plus the real interest rate in terms of the export goods. The intertemporal expenditure function \( E(\cdot) \) is twice differentiable, increasing in all of its arguments, concave, and linearly homogeneous in prices. The time-separability of the utility function implies that \( E(\cdot) \) is weakly separable between periods. Assuming that there is no distortion in international capital movements, the consumer's domestic discount factor is equal to the world discount factor. Income is just equal to the present value of manna-type wealth in terms of exports, \( R^1 + \delta R^2 \), where \( R^1 \) is the revenue function in period \( t \).

Imports are subject to tariffs. Denoting \( \tau_t \) as a period-\( t \) ad valorem tariff rate and assuming that the relative foreign price of the importable good in each period is such that \( p_1^* = p_2^* = p^* = 1 \), then, the domestic relative price of imports to exports can be written as \( p_1 = 1 + \tau_1 \) and \( p_2 = 1 + \tau_2 \). Tariff revenues collected in period \( t \) are assumed to be redistributed to the consumers in the same period in a nondistorting way, and hence they constitute a part of consumer's wealth. Note that with no variable production tariffs act as just a consumption tax. The intertemporal budget constraint with a tariff-restricted equilibrium at both dates is

\[
E[1 + \tau_1, \delta(1 + \tau_2), u] = R^1 + \delta R^2 + \tau_1 E_1 + \delta \tau_2 E_2
\]

where \( E_t \) denotes the partial derivative with respect to the \( t \)'th argument in the expenditure function, which is the compensated demand function for imports in period \( t \). \( R^1 \) is the exogenous income in period \( t \) in terms of the export goods, and \( \tau_t E_t \) is tariff revenues in

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\(^4\)See Chapter 3 for the usual properties of the utility function.
period $t$. In order to focus on the real discount factor or the consumption rate of real interest, we may rewrite the intertemporal budget constraint by normalizing expenditure by the period-1 price index, $p_1$, using the linear homogeneity of the expenditure function,

$$E(1, \alpha_2, u) = R^1 + \delta R^2 + \tau_1 E_1 + \delta \tau_2 E_2$$

where $E(1, \alpha_2, u) = \min\{c_1 + \alpha_2 c_2 | u(c_1, c_2) \geq u\}$, and so equation (4) represents the intertemporal equilibrium measured in real terms, that is, in terms of units of period-1 price index. The real discount factor is given by

$$\alpha_2 = \frac{\delta (1 + \tau_2)}{1 + \tau_1}$$

The expenditure function in equation (3) is homogeneous of degree 1 and hence the compensated demand function for imports in each period is homogeneous of degree zero in prices, so that the Euler theorem provides the relationships, $(1 + \tau_1)E_{21} + \delta (1 + \tau_2)E_{22} = 0$ and $(1 + \tau_1)E_{11} + \delta (1 + \tau_2)E_{21} = 0$. Therefore, we derive the following relationships:

$$\alpha_2 = -\frac{E_{21}}{E_{22}}, \quad \text{and} \quad \alpha_2 = -\frac{E_{11}}{E_{12}}$$

which shows that the consumer's real discount rate can be represented by the ratio of intertemporal changes to atemporal changes in the level of consumption.

Now suppose that the government has eliminated tariffs overnight, and also has announced that its free trade policy will be maintained forever in the future. Let us assume, however, that past history has revealed that this kind of reform is likely to end prematurely, and hence the sustainability of the current reform is also under disbelief.\(^5\)

We shall show that free trade policy, if it is not credible, is not optimal. Totally differentiate equation (4) to obtain the welfare effect of future tariffs, assuming that $\tau_1$ has already been eliminated:

\(^5\)This means that the credibility level is assumed to be exogenous.
\[ (7) \quad \frac{du}{dt_2} = \frac{\delta \tau_2 E_{22} \frac{d\alpha_2}{dt_2}}{E_u(1 - \tau_2 E_{2u}/E_u)} < 0 \]

where \(E_u\) is the inverse of the marginal utility of wealth, \(E_{2u}\) captures the income effect in period-2 consumption which will be positive if both the present and future goods are normal, \(E_{2u}/E_u\) equals \(\partial c_2(1, \alpha_2, a)/\partial a\) and represents the marginal propensity to consume in period 2 which is between zero and unity, where \(c_2(\cdot)\) is the Marshallian demand function for imports in period 2 and \(a\) is real wealth, and \(E_{22} = \partial E_{2}\partial p_2\) is the slope of the compensated import demand function in period 2 which is negative (the own substitution effect). As we can see in (7), the anticipation of future tariffs has the effect of reducing welfare by raising the consumer's real discount factor \((\frac{d\alpha_2}{dt_2} = \delta/(1 + \tau_1) > 0)\).

A quick check proves that if \(\frac{d\alpha_2}{dt_2} = 0\), then there will be no welfare effect of future tariffs, emphasizing the intertemporal channel through which welfare is influenced.

**Optimal Speed of Tariff Liberalization**

The above simple examination suggests that whenever the public does not assign full credibility about the government commitment on trade reform, the complete removal of a distortion may not necessarily be optimal. The next relevant question is, "Would a positive tariff then be optimal when there is a future tariff?" An equivalent question is, "Is a gradual tariff liberalization superior to a once-and-for-all liberalization when the public expects future reversal of reform?" Our answer is that when there is a strict positive value of expected future tariffs, a positive period-1 tariff, or equivalently, a gradual tariff reduction, acts to improve welfare via raising the consumption-based rate of real interest. To see how this works, totally differentiate equation (4) with initial tariffs in both periods to yield

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6 Alternatively, welfare reduces via a reduction in the rate of real interest for consumption, that is, we can see that \(\frac{dp}{dt_2} = -\delta p/(\alpha_2(1 + \tau_1)) < 0\) where \(p\) is the consumption rate of real interest.
(8) \[
\frac{du}{d\tau_1} = \frac{\tau_1 E_{12} + \delta \tau_2 E_{22} - E_2}{\Omega} \frac{d\alpha_2}{d\tau_1} + E_1 \geq 0
\]

where \( \Omega = E_u - \tau_1 E_{1u} - \delta \tau_2 E_{2u} \in (0, 1) \) with normality of goods in both periods. As mentioned, the term \( E_{12} > 0 \) represents the intertemporal substitution effect of a future tariff and \( E_{22} < 0 \) captures the atemporal own substitution effect.

Since \( d\alpha_2/d\tau_1 = -\alpha_2/(1 + \tau_1) < 0 \), consumption is now induced to shift towards the future with a decreased real discount rate, \( \alpha_2 \). Therefore, the intertemporal distortion created by the imperfect credibility of the abrupt tariff liberalization can be mitigated by the slower rate of liberalization, i.e., the imposition of a positive period-1 tariff. This acts to raise welfare. Note that again if \( \alpha_2 \) is not altered in response to a change in \( \tau_1 \), then there is no welfare effect of a period-1 tariff. Thus, as presented in (6), we can conclude that the welfare effect depends on the relative strength of the atemporal negative effect of the first-period tariff to its positive intertemporal effect on welfare. Notice that if the welfare effect is evaluated around the initial zero-tariff in period 1, the slower rate of tariff liberalization unambiguously acts to enhance welfare in the presence of a credibility problem. The sign of equation (8) is then positive: a gradual tariff liberalization would be welfare increasing. The channel is an intertemporal consumption equalization effect of a gradual tariff reduction.

The formula for the optimal tariff liberalization can be obtained by setting \( du/d\tau_1 = 0 \): 8

(9) \[
\hat{\tau}_1 = -\frac{\delta \tau_2 E_{21}}{E_{11}}
\]

which is strictly positive as long as the future tariff, \( \tau_2 \), is strictly positive. Note that \( d\hat{\tau}_1/d\tau_2 > 0 \). Using \( 1/\alpha_2 = -E_{21}/E_{11} \), we can rewrite the period-1 tariff formula as

(10) \[
\hat{\tau}_1 = \frac{\delta \tau_2}{\alpha_2}
\]

7Using the intertemporal budget constraint, we can readily verify \( E_{1u}/E_u + \delta E_{2u}/E_u = 1 \).

8See Tower (1977) for the distinction between the optimal tariff and the maximum revenue tariff.
The reasoning behind the optimal first-period tariff formula is that the higher the tariff expected in the future, the greater is the distortion in the real discount factor, $\alpha_2$, and the more it would be worth incurring an atemporal distortion in the form of a period-1 tariff in order to reduce a distortion in $\alpha_2$ due to a high $\tau_2$. Thus, a higher expected future tariff is positively associated with a higher optimal level of the first-period tariff. It is through this connection that a gradual tariff liberalization could be a superior strategy to a cold-turkey one, especially if the government's credibility is in doubt. This line of argument was made by Edwards and van Wijnbergen [1986], Froot [1988], and Rodrik [1989a], among others.

The results obtained in this simple analysis clearly demonstrate that the role of imperfect credibility of trade reform is to incur a distortion in the consumer's intertemporal consumption allocation through the channel of the changes in the consumption-based real interest rate. As indicated, this is a robust result in the sense that even in a more complicated framework, the essential equation via which welfare or the current account is affected is not broken, although it may be weakened. We now turn to a more general model.

5.3 A More General Framework

In this section we examine additional channels, e.g., changes in wage rates, via which the expected future tariffs will affect welfare and the current account. It is expected that the existence of future tariffs can distort the consumer's choice between consumption and leisure, inducing them to consume more leisure (less labour) in both periods. The consumption wage will rise consequently, and firm's future labour demand will rise. This change in real wages influences other critical variables such as the current account and welfare. To examine these additional effects using duality functions, it will be necessary to make use of a more general expenditure function which incorporates the

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9If we imagine a consumption composite-leisure composite space [(c, L) space], future tariffs will make the slope of the indifference curve in (c, L) flatter. See Razin and Svensson [1983].
assumption that the consumer's utility is also dependent upon factor supplies [Dixit and
Norman, 1980, pp. 63-64].

Consider a small open economy in a two-period framework. There are two goods in
period \( t \), imports \( (c_m) \) and exports \( (c_x) \), both of which are produced and consumed at
home. The supply of labour in each period can be treated as if it were a negative good.
We assume that the utility function is time-separable, with preferences in each period
being homothetic. Consumer's preferences are represented by a general expenditure
function, for which the derivation (using a diagram) is demonstrated in Appendix 5.1. It
is defined as

\[
E[p_1(p_m, 1), \delta p_2(p_m, 1), w_1, \delta w_2, u] = \min \{p_1(p_m, 1)c_1 + \delta p_2(p_m, 1)c_2 - \\
w_1L_1 - \delta w_2L_2; u(c_m, c_x, c_m, c_x, L_1, L_2) \geq \tilde{u}\}
\]

where \( p_t \) is the unit expenditure function, \( w_t \) is the real wage rate, \( p_m \) is the relative price
of imports, \( c_t \), \( c_m \) and \( c_x \) are composite consumption, consumption of imports, and
consumption of exports, respectively, and \( L_t \) is the supply of labour, all in period \( t \). The
discount factor, \( \delta \), is the same as in the previous Section. The export good is again taken
as the numeraire (its price equals unity), so that all real variables are measured in terms of
exports.

The general expenditure function can be interpreted as the present value of the
minimum lump-sum income (subsidization) required to achieve a target level of expected
utility, when prices of consumption are \( p_1 \) and \( p_2 \), and factor prices are \( w_1 \) and \( w_2 \). The
properties of the general expenditure function can be derived in the same way as those of
standard envelope functions, and so we just list them: \( E(\cdot) \) is increasing in \( p_1 \), decreasing
in \( w_1 \), concave, and homogenous of degree one in \( (p_1, w_1) \) jointly. Also, its partial
derivatives possess similar properties to the standard ones:

\[
E_{p_1}(\cdot) = \frac{\partial E(\cdot)}{\partial p_1} = c_t(\cdot)
\]

\[10\] This implies that consumers take a multi-stage optimization procedure. See Appendix 5.1.
\[ E_{m_1}(\cdot) = \frac{\partial E(\cdot)}{\partial p_{m_1}} = \frac{\partial E(\cdot)}{\partial p_{1}} \frac{\partial p_{1}}{\partial p_{m_1}} = c_1(\cdot) p_1 = c_{m_1}(\cdot), \]

\[ E_{w_1}(\cdot) = \frac{\partial E(\cdot)}{\partial w_1} = -L_1^x \]

It follows that \( c_1(\cdot) \) is the compensated demand for overall consumption in period 1, \( c_{m_1}(\cdot) \) is the compensated demand function for imports in period 1, \( p_1 \) denotes consumption shares of imports in period 1, and \( L_1^x \) is the compensated labour supply function in period 1.\(^{11} \)

On the production side we assume that the technology is well-behaved and separable between periods. We define the firm's restricted profit function in period 1 as

\[ \Pi^1(p_{m_1}, 1, w_1) = \max \{ p_{m_1}y_{m_1} + y_{x_1} - w_1L_1^x : f(y_{1}, L_1) = 0 \}, \quad (t = 1, 2) \]

where \( y_{m_1} \) and \( y_{x_1} \) are output of the import and export goods in period 1, respectively. Capital stocks are assumed to be fixed and hence are omitted in both sides. Hotelling's Lemma provides us the usual properties of the profit function:

\[ \Pi^1_1(\cdot) = y_{m_1}(p_{m_1}, 1, w_1) \]

\[ \Pi^1_2(\cdot) = y_{x_1}(p_{m_1}, 1, w_1) \]

\[ \Pi^1_3(\cdot) = -L_1^x(p_{m_1}, 1, w_1) \]

where \( \Pi^1_j \) is the partial derivative of the profit function in period 1 with respect to the j'th argument in \( \Pi^1 \), so that \( \Pi^1_1 \) and \( \Pi^1_2 \) are period-1 output supply function of imports and exports, respectively, and \( -\Pi^1_3 \) is the labour demand function in period 1. Note that \( \Pi^1 \) is convex and homogeneous of degree one in \( (p_{m_1}, 1, w_1) \) jointly. The present value of lifetime profit then can be written as

\[ \Pi(p_{m_1}, \delta p_{m_2}, 1, w_1, \delta w_2) = \Pi^1(p_{m_1}, 1, w_1) + \delta \Pi^2(p_{m_2}, 1, w_2) \]

\(^{11}\) Note that because the labour supply function in each period is a compensated one, the possibility of backward-bending would not arise.
To deal with the credibility issue, we maintain the assumption that the level of credibility is exogenously given. That is, the public completely knows the government type it faces, and they anticipate with some strictly positive probability that this type of government would reimpose tariffs in the future. For simplicity, we assume that as a result the price of imports in period 2 is distributed binomially. The household expects future tariffs with probability $\zeta$, and zero tariffs in period 2 with probability $(1 - \zeta)$. That is, $p_{m2} = 1$ with probability $(1 - \zeta)$ and $p_{m2} = 1 + \tau_2$ with probability $\zeta$.

Assuming a weak form of certainty-equivalence of the second period tariff, the effects of a change in the probability of a tariff in period 2 can be made arbitrarily close to the effects of a realized actual tariff in period 2. This is the approach that Froot [1987] adopted. Therefore, we assume that agents make their decision as if the price of imports in period 2 is $1 + \zeta \tau_2$ with certainty:

\[(12) \quad p_{m2} = \zeta(1 + \tau_2) + (1 - \zeta) = 1 + \zeta \tau_2\]

The initial equilibrium in this economy is characterized by trade reform (zero tariffs in period 1) and absence of capital controls ($\delta = \delta^*$, domestic discount rate = world discount rate). The only problem is that the present trade reform is not credible to the public, and hence they perceive a positive probability of future reversal of trade reform. The equilibrium conditions are:

\[(13) \quad E[p_1(p_{m1}, 1), \delta p_2(p_{m2}, 1), w_1, \delta w_2, u] = \Pi^1(p_{m1}, 1, w_1) + \delta \Pi^2(p_{m2}, 1, w_2) + \delta(p_{m2} - 1)(E_2 - \Pi^2)\]

\[(14) \quad E_3[p_1(p_{m1}, 1), \delta p_2(p_{m2}, 1), w_1, \delta w_2, u] = \Pi^3(p_{m1}, 1, w_1)\]

\[(15) \quad E_4[p_1(p_{m1}, 1), \delta p_2(p_{m2}, 1), w_1, \delta w_2, u] = \Pi^3(p_{m2}, 1, w_2)\]

---

12See Froot [1988, pp. 76-77] for the elaboration of the treatment of a random price in duality theory. He argues (and verifies) that a small but positive period-2 tariff will guarantee the signs of the Hicksian substitution matrix to remain the same as in the certainty case.
where (13) is the intertemporal budget constraint which equates the present value of the income terms with that of the expenditure term.\(^{13}\) The third term on the RHS in (13) is the present value of the expected tariff revenue collected (and redistributed) in that period. \(E_t\) are the partial derivatives of \(E(\cdot)\) with respect to the \(t\)th argument in \(E(\cdot)\).\(^{14}\) Equations (14) and (15) are the labour market equilibrium conditions in period 1 and 2, respectively, and represent the equality of worker's labour supply function with firm's labour demand function in each period. Before proceeding to the comparative statics, we may require a clarification of signs of the partial derivatives:

\[
\begin{align*}
E_{p_1 p_1} < 0, & E_{p_2 p_2} < 0, E_{11}, E_{22} < 0: \text{slopes of the Hicksian demand curves}, \\
E_{p_m p_t} < 0 & \quad (t = 1, 2), \\
E_{p_m p_j} > 0, & \quad (t \neq j, t, j = 1, 2), \\
E_{33}, E_{44} < 0: & \text{compensated demand for leisure}, \\
E_{p_t p_j} > 0, & \quad (t \neq j, t, j = 1, 2), \\
E_{p_t w_j}, E_{p_m w_j} > 0 & \quad (t, j = 1, 2), \\
E_{ij} > 0 & \quad (t \neq j, t, j = 1, 2, 3, 4): \text{gross substitutability in consumption and leisure}, \\
E_{uu}, E_{p_j} > 0 & \quad (t = 1, 2, 3, 4 \text{ and } j = 1, 2): \text{income effect of normal goods}, \\
\Pi_{11}^1 > 0: & \text{slopes of supply of importable goods in period } t, \\
\Pi_{33}^1 > 0: & \text{negative slopes of labour demand in period } t, \\
\Pi_{13}^1 < 0: & \text{factor normality}
\end{align*}
\]

The positive signs of cross partial derivatives between periods are based on the preference assumption that the utility function is weakly time-separable, with tastes in

\(^{13}\)When there is variable factor supply, the usual GDP function (revenue function) may not be a proper tool. Instead, the profit function would be more suitable. See Dixit and Norman [1980].

\(^{14}\)Note that the first and the second arguments in \(E\) are \(p_{m1}\) and \(p_{m2}\) (not \(p_1\) and \(p_2\)) respectively.
each period being homothetic. The partial derivatives of consumption and labour will be explained as we conduct the analyses.\textsuperscript{15}

5.4 Incredible Trade Reform, Real Wages and Welfare

Three issues will be examined and discussed in this framework. First, we examine the adjustment of the real wage rate in each period in response to expectation of a future tariff. Then, we investigate how the current account in the present period will be affected when the real wages respond endogenously.\textsuperscript{16} Third, we show under what conditions the suboptimality of imperfectly credible trade reform will still be valid in this general model.

To examine how the real wages respond to a price change, we consider the labour market equilibrium condition in each period. Given the exogenous parameters, total differentiation of equations (14)-(15) yields the solutions for the endogeneous variables, \( w_1 \) and \( w_2 \), as a function of the probability of future tariffs only, enabling us to see how the real wages adjust in response to the future tariff. A diagrammatic approach is more useful than algebra in this case. Suppose that the labour market in each period is initially cleared, as drawn in Figure 5.1. The \( N^1N^1 \) and \( N^2N^2 \) equilibrium schedules respectively represent the loci of the combinations of \( w_1 \) and \( w_2 \) that clear the period-1 and period-2 labour markets. For simplicity, the loci are drawn such that at an initial equilibrium, \( e \), the real wage rate in each period is quantitatively identical, namely, \( w_1^e = w_2^e \), so that point \( e \) is on the 45 degree line. The verification that the two loci have positive slopes is straightforward:

\[
\left. \frac{\partial w_1}{\partial w_2} \right|_{N_1N_1} = \frac{-E_{34}}{E_{33} - \Pi_{33}^1} > 0
\]

\textsuperscript{15}For example, \( E_{33} < 0 \) implies that a rise in \( w_1 \) causes a rise in the supply of labour \( (\partial L/L \partial w_1 > 0) \) and a rise in the demand for labour \( (\partial L/L \partial w_1 < 0, \ i.e., \Pi_{33}^1 > 0) \). There is also an intertemporal substitution effect of a rise in \( w_1 \); the increased real wage rate today induces the consumer to substitute towards leisure (less work) in the next period \( (\partial L/L \partial w_1 < 0, \ i.e., \ E_{34} > 0) \). Diagrammatic analyses about the choice between consumption-leisure composite, labour 1-labour 2, and consumption 1-consumption 2 appear in Razin and Svensson [1983].

\textsuperscript{16}See Figure 6.3 in Chapter 6 for the trend of wages in Korea during the reform period in the 1980s.
(17) \[
\frac{d\tilde{w}_1}{d\tilde{w}_2}\bigg|_{N_2N_2} = \frac{(E_{44} - \Pi_{33}^2)}{-E_{43}} > 0
\]

Also, the \( N^2N^2 \) schedule is shown to be steeper than the \( N^1N^1 \) schedule by making the usual stability assumption in the labour market.\(^{17}\)

(18) \[
\frac{d\tilde{w}_1}{d\tilde{w}_2}\bigg|_{N_1N_1} - \frac{d\tilde{w}_1}{d\tilde{w}_2}\bigg|_{N_2N_2} = \frac{(E_{33} - \Pi_{33}^1)(E_{44} - \Pi_{33}^2) - E_{43}E_{34}}{(E_{33} - \Pi_{33}^1)E_{43}} < 0
\]

\[17\] Suppose that the continuous time version of the labour market dynamic behaviour in each period is such that the changes in the real wages in each period depend on the excess demand for labour:

\[
\dot{w}_1 = \kappa_1[E_3(t) - \Pi_3^1(t)] \\
\dot{w}_2 = \kappa_2[E_4(t) - \Pi_3^2(t)]
\]

where \( \kappa_1 \) and \( \kappa_2 > 0 \). Using Taylor-series expansions of the above equations around \( \tilde{w}_1 \) and \( \tilde{w}_2 \), dropping higher-order terms, we obtain

\[
\begin{bmatrix}
\dot{w}_1 \\
\dot{w}_2
\end{bmatrix} =
\begin{bmatrix}
\kappa_1(E_{33} - \Pi_{33}^1) & \kappa_1E_{34} \\
\kappa_2E_{43} & \kappa_2(E_{44} - \Pi_{33}^2)
\end{bmatrix}
\begin{bmatrix}
\tilde{w}_1 - \tilde{w}_1 \\
\tilde{w}_2 - \tilde{w}_2
\end{bmatrix}
\]

Denoting the RHS 2x2 matrix as \( \Theta \), stability of the system requires

\[
\det \Theta > 0 \text{ and } \text{tr} \Theta < 0
\]

which implies that

\[
\Sigma_{33}E_{44} - \Sigma_{34}E_{43} > 0 \text{ and } \Sigma_{33} - \Pi_{33}^1 + \Sigma_{44} - \Pi_{33}^2 < 0.
\]

FIGURE 5.1 REAL WAGES IN INTERTEMPORAL EQUILIBRIUM

The intuition of the positive slopes in both loci can be explained as follows. Consider a rise in the real wage rate in period 1. Workers would work more in the present period,
which will create excess supply of labour in period 1 ($L_1^* \uparrow$): own intratemporal substitution effect. The rise in the opportunity cost of leisure in period 1 will substitute leisure away from period 1 into period 2, causing an incipient excess demand for leisure in period 2 (reduced supply of labour in period 2), which reinforces excess supply of labour in period 1 through the intertemporal substitution effect. Period-2 labour market will be affected by the intertemporal substitution effects only ($L_2^* \downarrow$).

By contrast, a rise in the real wage rate in period 2 will remove the excess supply of labour in period 1 through the intertemporal substitution effect. It will also eliminate the excess demand for leisure in period 2 through both own atemporal and intertemporal substitutions. The required rise in $w_1$ to clear the period-1 market, however, is larger in magnitude than the rise needed to clear the labour market in period 2. The reasoning is that a change in the real wage in period 1, for example, always has a larger effect on excess supply in that period than the other period since both intratemporal and intertemporal effects have influenced the period-1 market. The formal algebra for this explanation is just equation (18).

**Future Tariffs and Real Wages**

We now turn to examine the effects of future tariff liberalization reversal. The effects of the expected future tariff will be evaluated at a point where the period-2 expected tariff rate is initially zero. First, the quantative magnitude of the vertical shift in the $N_1N_1$ schedule is given by $\frac{dw_1}{d\zeta} \bigg|_{N_1N_1} = -\delta t_2 E_{w_1p_2} p_2^2/[E_{33} - \Pi_{33}] > 0$. A rise in the future price of imports affects the real wage rate in period 1. First, the price index rises due to a rise in the future tariff, which generates a fall in the consumption composite. Second, the fall in the consumption composite results in a rise in the leisure composite, causing a reduction in the labour supply in period 1 (in both periods). As a result, the real wage rate in period 1 must rise to clear the labour market. Therefore, the magnitude of the shift in the $N_1N_1$ schedule depends on both the degree of changes in the labour supply and demand in period 1 which is affected by a future goods price rise. Notice that if $E_{32} = E_{w_1p_2} p_2^2 = 0$, then $N_1N_1$ schedule would not move.
The shift in the $N_2 N_2$ schedule can also be readily calculated and is given by
\[ \frac{dw_2}{d\zeta} \bigg|_{N_2 N_2} = -\delta \tau_2 [\delta E w_2 P_2^{-1} - \Pi_3^2]/[E_{44} - \Pi_3^2] > 0. \]
In this case, a rise in $p_{m2}$ will raise the price index in period 2, which results in a fall in overall consumption in that period. As a consequence, labour supply in period 2 will fall which will induce $w_2$ to rise to restore the labour market equilibrium in that period. There is also the supply side effect: the demand for labour in the import competing industry will rise in period 2 as the product wage falls. Hence, the rise in $\zeta$ shifts both $N_1 N_1$ and $N_2 N_2$ upwards, implying that the equilibrium real wages rise at both dates. This is illustrated in Figure 5.2.

The algebraic expressions for the changes in the real wages evaluated at $\zeta = 0$ are given by
\[
\frac{dw_1}{d\zeta} \bigg|_{\zeta=0} = \frac{\delta \tau_2 [E_{44} (\delta E_{42} - \Pi_3^2) - E_{32} (E_{44} - \Pi_3^2)]}{(E_{33} - \Pi_3^1) (E_{44} - \Pi_3^2) - \delta E_{34} E_{43}} > 0
\]
\[
\frac{dw_2}{d\zeta} \bigg|_{\zeta=0} = \frac{\delta \tau_2 [E_{43} E_{32} (\delta E_{42} - \Pi_3^1) (E_{33} - \Pi_3^1)]}{(E_{33} - \Pi_3^1) (E_{44} - \Pi_3^2) - \delta E_{34} E_{43}} > 0
\]

In (19) and (20), there is no priori presumption whether the rise in the equilibrium real wage in the current period is greater or smaller than the rise in the future wage. Either consequence is possible, and both possibilities are depicted in Figures 5.3 and 5.4. If we evaluate (19) and (20) at initial positive future tariffs, then we will have an additional first order income effect which makes the signs ambiguous, see Appendix 5.2.
That is, the current account surplus in period 1 is the income term (profit and wage income) minus expenditure in that period. The change in the current account in the present period is given by

\[
dCA_1 = -\delta_2 \pi_2^2 [w_1 E_{w_1 p_2} + p_1 E_{p_1 p_2}] \delta \zeta - [w_1 E_{33} + p_1 E_{p_1 w_1}] \, dw_1 \\
- \delta [w_1 E_{34} + p_1 E_{p_1 w_2}] \, dw_2 - [w_1 E_{3u} + p_1 E_{p_1 u}] \, du
\]
We can identify 4 terms that affect the current account in (21); the first term is the substitution effects of the reimposition of future tariffs on the current account — intertemporal substitution between consumption and leisure \((E_{w_1p_2})\) and between consumptions \((E_{p_1w_2})\). Obviously, assuming that goods and leisure are normal and gross substitutes in both periods, future tariffs induce consumers to substitute consumption away from period 2 into period 1, resulting a deterioration in the current account. Furthermore, labour income falls following a reduction in the supply of labour in both periods.

The second and third term express the indirect real wage effects on the current account balance. As shown above, if these terms are evaluated at an initial zero future tariffs, both \(dw_1\) and \(dw_2\) are positive. An increase in the period-2 real wage will unambiguously magnify the current account deficit in period 1 via intertemporal substitution in consumption and leisure towards period 1 \((E_{w_1} > 0, E_{p_1w_2} > 0)\). An increase in the period-1 real wage has an ambiguous effect on the current account since the intratemporal effect of a change in the real wage rate in period 1 on the labour supply and consumption in the same period (period 1) have an opposite sign \((E_{w_1} < 0, E_{p_1w_1} > 0)\). The final term represents the effect of a change in utility (real income) induced by a rise in future tariffs.
on the current account. This effect will worsen the current account balance because real income falls due to less labour \((E_{3u} > 0)\) and more consumption in period 1 \((E_{p1u} > 0)\). If in the third term, the real wage effect on consumption in period 1 outweighs the real wage effect on labour supply, then the change in the real wage rate in period 1 will also make the current account worse. All these effects will contribute to a current account deficit in the current period in response to future reversal of liberalization. Note, however, that as mentioned in footnote (18), these interpretations are based on the evaluation of (21) at a zero future tariff, so that the first order income effect is ignored. This implies that the effect of a future reversal of reform on the current account will become more ambiguous when evaluated at \(\zeta > 0\).

**Suboptimality of Incredible Free Trade Policy**

What is the welfare consequence of the lack of credibility in trade liberalization when the real wage is endogenously determined? To see this, consider

\[
(22) \quad (E_u - \delta \xi \tau_2 E_{2u}) \, du = \delta \xi \tau_2 \tau_2 [\delta(E_{p2p2}p_{12}^2p_{12}^2 + E_{p2}p_{21}^2) - \Pi_{11}^2] \, d\xi
+ (\delta \xi \tau_2 E_{p2w,1}) \, dw_1 + \delta \xi \tau_2 (\delta E_{p2w,1}p_{12}^2 - \Pi_{13}^2) \, dw_2
\]

A change in utility results from three terms on the RHS of (22): the real wage effect in each period, and the own substitution effect on consumption and production.

Since we have shown that a rise in \(\zeta\) raises \(w_1\) and \(w_2\) (with no first order income effect), with \(E_{p2w,1}p_{12}^2 = E_{23} > 0\) and \(E_{p2w,2}p_{12}^2 = E_{24} > 0\), welfare will be improved with an increase in \(\zeta\). Next, \(E_{p2p2}p_{12}^2p_{12}^2 + E_{p2}p_{11}^2\) in \(d\xi\) term is just equal to \(E_{22}\) which is a negative own substitution effect in consumption (atemporal). The atemporal substitution effect comes from the fact that a higher expected price of imports in period 2 reduces the consumption of imports in that period \((p_{12}^2 < 0)\). In addition, the increased price index reduces the overall consumption in that period \((E_{p2}p_{2} < 0)\). Both represent a reduction in consumption, and these act to reduce welfare. The net effect on welfare is thus
ambiguous, but welfare change is proportional to initial distortions in period 2, namely, a period-2 tariff, $\zeta \tau_2$.\footnote{Note, in equation (22), that $du = 0$ when $\zeta \tau_2 = 0$.}

On the production side, a higher price of imports in period 2 renders output of import competing firm to rise ($\Pi^2_{11} > 0$). Given the wage-rental ratio (and the capital-labour ratio, $k$) in period 2, output in the export sector is expected to fall correspondingly. At the margin it would be expected that $p_{m2} \Pi^2_{11} = \Pi^2_{21}$. Also, as shown, an increase in $\zeta$ increases $w_1$ and $w_2$ (with no first-order income effect), which causes the economy's wage-rental ratio to rise. Thus, as represented in Figure 5.5, the output mix of importables-exportables moves to $e'$ from $e$. As a result of the future tariff expectation, the importable sector gains competitiveness and the exportable sector loses, and the economy produces more importables and less exportables.\footnote{In Figure 5.5, points $m$ and $x$ indicate a specialization point for imports and exports, respectively.}

![Figure 5.5](image)

**FIGURE 5.5 HIGHER WAGE AND DECLINING EXPORTS DUE TO INCREDIBILITY OF REFORM**

Now if we introduce first-order income effects by evaluating the real wage response at an initial point where $\zeta \tau_2 > 0$, then the real wage response itself depends on the relative strength of the income and substitution effects. This is because a rise in future tariffs will
reduce labour supply by the substitution effect (so \(w_2\) must rise to restore equilibrium) on the one hand, but the future tariffs will also induce workers to work more in order to meet the relatively expensive consumption at both dates, on the other. The latter income effect forces real wages to fall to restore equilibrium in the market, which has a negative welfare implication. Therefore, the overall welfare effect will become more ambiguous.

The conditions under which the future tariff lowers welfare are: (i) the substitution effect of future tariffs in the labour markets exceeds the income effect, (ii) a direct consumption-reducing effect outweighs the consumption-increasing effect of the indirect wage rise at both dates. Then, welfare will decline with the probability of liberalization reversal, suggesting that an incredible tariff liberalization policy is suboptimal. The exact condition for this suboptimality is provided in Appendix 5.3.

5.5 Optimal Speed of Tariff Reform

As examined in the previous section, the existence of the probability of future tariff reimposition results in suboptimal resource allocation across time. This suggests a positive period-1 tariff as a second-best instrument to alleviate an intertemporal distortion caused by the expectations of future reversal of trade reform. We differentiate equations (13)-(15) simultaneously, after adding period-1 tariff revenue, \(\tau_1(E_1 - \Pi_1)\), on the RHS of (13), and investigates the change in welfare in response to a period-1 tariff:

\[
(E_u - \tau_1 E_{1u} - \delta \zeta \tau_2 E_{2u}) du = \\
[\tau_1(E_{1p}, p_1 | p_1 + E_{p_1}, p_{11} - \Pi_{11}) + \delta \zeta \tau_2 E_{p_2}, p_1 | p_1^2] d\tau_1 \\
+ [\tau_1(E_{1p}, p_1 - \Pi_{13}) + \delta \zeta \tau_2 E_{p_2}, p_1^2] dw_1 \\
+ [\tau_1 \delta E_{14} + \delta \zeta \tau_2(\delta E_{p_2}, p_1^2 - \Pi_{13})] dw_2
\]

The explanations for the effects of the first-period tariff on welfare are analogous to the explanations for equation (22).

\[22\]If we use the weighted-average price index which incorporates the real wage effects in the export as well as import competing sector, i.e., \(w = \frac{W}{P_x, P_m}\). The likely consequence is that the welfare increasing effect of a rise in the real wages will be dampened via falling the real wage index, magnifying the suboptimality of noncredible reform.
Dealing with both $\tau_1$ and $\zeta \tau_2$ in the model generates another dimension of complexity in substitution and income effects in both periods. The basic channels, however, can similarly be decomposed into two terms: consumption effect and real wages effect, both atemporal as well as intertemporal. The term $E_{p_1} p_1 | p_1^2 + E_{p_1} p_1^2 - \Pi_1^2$ in $\delta t_1$ is simply equal to $E_{11}$ which is a negative atemporal own substitution effect in consumption, and it comes from the fact that $p_1^2 < 0$ as well as $E_{p_1} p_2 < 0$. Both terms represent that atemporal substitution in consumption has negative welfare implications. However, there is also an intertemporal substitution effect in consumption, which acts to improve welfare as the consumption rate of real interest rises with $\tau_1$. Overall spending is then switched through the price index effect into tomorrow, being represented by $E_{21} = E_{p_2} p_1 | p_1^2 > 0$. Thus, if the intertemporal consumption substitution effect outweighs the intratemporal effect, then the imposition of period-1 tariff will act to improve welfare. Next, the period-1 tariff also changes the individual's labour supply decision and the firm's labour demand decision, which will in turn affect the equilibrium real wages in both periods. If we assume that real wages in both periods rise with a period-1 tariff, then the overall welfare will improve as a result of a period-1 tariff.

However, a change in the real wage in response to a change in the period-1 tariff in the presence of tariffs in both periods (and initial positive tariffs in both periods) becomes more complicated, as revealed in the algebraic expressions in Appendix 5.3. Rather than going through this algebra, we will investigate the main channels through which the first period tariff affects the real wages in both periods. Intratemporally, an increase in $\tau_1$ raises the overall price index, which will reduce (increase) the commodity consumption (leisure) in period 1. The supply of labour in that period will be reduced, while the demand for labour in period 1 will increase. The real wage rate in period 1 will increase to restore the labour market equilibrium. Also, the intertemporal substitution effect

---

23 If we evaluate, as before, this term at around free trade equilibrium in period 1, then clearly the small bracket will disappear, only intertemporal positive effect of a period-1 tariff on welfare remaining.

24 This is so because the real wage effect on welfare in both periods is unambiguously positive since within period the higher real wage increases the opportunity cost of leisure, and hence increases consumption in the same period via substitution. Between periods, since the overall wage index has risen by a rise in the real wage rate, say in period 1, a substitution from leisure into consumption will occur in both periods. Hence consumption in period 2 will increase as well.
reinforces the rise in real wage rates: the period-1 tariff induces individuals to consume (goods and leisure) less in period 1. The supply of labour in period 1 will decrease. The equilibrium real wage rate in that period must adjust upwards to clear the market.

Analogous explanations can be provided for the period-2 wage response to the period-1 tariff. Since we need to evaluate the differentiated terms at an initial point where $\tau_1$ and $\zeta \tau_2$ take positive values, we now have first order income effects which act to offset the substitution effect. Hence, the real wage change in response to tariffs evaluated at initial positive tariffs in both dates is not unambiguous, depending on the relative strength of the substitution and income effects. To find the optimal tariff, the complete expression for the effect of the period-1 tariff on welfare is given by

$$
\frac{du}{d\tau_1} = \frac{1}{\Delta^1} \left\{ (-\tau_1 \Sigma_{13} - \delta \zeta \tau_2 E_{23}) (\Sigma_{31} E_{44} - \delta E_{34} E_{41})
+ (\tau_1 \delta E_{14} + \delta \zeta \tau_2 E_{24})(\Sigma_{31} E_{43} - \Sigma_{33} E_{44})
+ (\tau_1 \Sigma_{11} + \delta \zeta \tau_2 E_{21})(\Sigma_{33} E_{44} - \delta E_{34} E_{43}) \right\} \geq 0
$$

where notations for $\Sigma_{ij}$ and $\Delta^1$ are spelled out in Appendix 5.2. As predicted, if the substitution effect outweighs the income effect, then $du/d\tau_1$ will be positive (see below). To obtain the optimal level of the first-period tariff, $\hat{\tau}_1$, we set $du/d\tau_1 = 0$ and after some manipulation, we obtain

$$
\hat{\tau}_1 = \zeta \Lambda
$$

where $\Lambda = \frac{-\delta \zeta_2 (\Sigma_{24} A + E_{21} B - E_{23} C)}{\delta E_{14} A + \Sigma_{11} B - \Sigma_{13} C}$, with

$$A = \Sigma_{31} E_{43} - \Sigma_{33} E_{41} > 0, \quad B = \Sigma_{33} E_{44} - \delta E_{34} E_{43} > 0, \quad \text{and} \quad C = \Sigma_{31} E_{44} - \delta E_{34} E_{41} < 0.$$

The optimal first-period tariff formula has an intuitive explanation: it demonstrates that the optimal tariff level in the first period is proportional to the level of the probability of tariff liberalization reversal. The numerator is negative, and the denominator is negative provided that $|\Sigma_{11} B| > |\delta E_{14} A - \Sigma_{13} C|$, i.e., that the absolute value of the net negative effect on consumption and production in period 1 of the tariff is greater than the
positive effects on consumption in period 1 of the changes in the real wage rates in both periods induced by period-1 tariff. The larger the negative net consumption effect is, the bigger the optimal first period tariff would be. Consequently, the higher is the probability of liberalization reversal, the greater is the intertemporal distortion, and the more it is worth the cost of incurring an atemporal distortion through the period-1 tariff, which will act to mitigate the intertemporal distortion. For any given level of credibility, welfare will be improved with an ex post non-zero level of tariff in period 1.

5.6 Capital Account Liberalization with Future Tariffs

The analyses so far have been based on the assumption of perfect international capital mobility. In order to find the implications of the role of capital control in the presence of an expectation of future reversal of trade reform, we examine the effects of capital account liberalization on welfare when future tariffs are anticipated. To do this, we model capital control as a tax on capital inflows and add tax revenues on capital to the RHS of the intertemporal equilibrium condition (13). Let \( B \) be the amount of borrowing in period 1, and \( (r - r^*) \) be the unit tax on capital inflows. Hence, a tax on capital inflows is identified as the wedge between the world interest rate and the domestic rate. Then \( \delta (r - r^*) \) is the present value per unit capital tax revenues collected in period 2, and equals \( (\delta^* - \delta) / \delta^* \). Let this be \( \theta \). Then \( \theta B \) is included on the RHS in (13).

The quantity of capital inflow in period 1 is equal to the current account deficit in that period, so that \( B = p_1 E_p + w_1 E_3 - \Pi_1 \). In this case, a relaxation of capital controls means raising \( \delta \) (reducing \( r \)).\(^{26}\) Totally differentiate (13) (after adding \( \theta B \)) to obtain the change in utility in response to a change in the domestic discount rate:

\[
(26) \quad (E_u - \delta \zeta \tau_2 E_{2u} - \theta \pi_{1u}) \, du = [\theta (p_1 E_{p1} w_1 + w_1 E_{33}) + \delta \zeta \tau_2 E_{23}] \, dw_1 \\
+ [\delta \theta (p_1 E_{p1} w_2 + w_1 E_{34}) + \delta \zeta \tau_2 (\delta E_{24} - \Pi_1 \delta)] \, dw_2
\]

\(^{25}\)We assume that the country is a net borrower.

\(^{26}\)Note that trade has already been liberalized in period 1 (a zero tariff in period 1), but there is a probability of reversal.
\[-[\theta p_1(p_2E_{p_1p_2} + w_2E_{p_1w_2}) + \theta w_1(p_2E_{w_1p_2} + w_2E_{34})] - \\
\delta_5^x r_2(p_2E_{p_2p_2} p^2_1 + w_2E_{24}) \right) \right) d\delta \]

As in (22) and (23), welfare is affected through changes in the real wages at each date and a change in the discount rate itself. For simplicity, we assume that \(|p_1E_{p_1w_1}| > |w_1E_{33}|\) in the \(dw_1\) term and \(dw_1 = -(p_2E_{w_1p_2} + w_2E_{34})/(E_{33} - \Pi_{13})d\delta > 0, dw_2 = -
(p_2E_{w_2p_2} + w_2E_{44})/(\delta E_{33} - \Pi_{33})d\delta > 0\), with no first order income effect being considered as before. Hence, changes in the real wages following the capital account liberalization act to improve welfare. However, in this case the own effect of capital account liberalization (the \(d\delta\) term in (26)) is ambiguous even though we assume \(|p_2E_{p_2p_2} p^2_1| < |w_2E_{24}|\) since there is future tariff anticipation.

The intuition is that reducing taxes on capital inflows \((\theta_1, \delta^t)\) will make present consumption relatively more inexpensive, and hence consumers will consume more in period 1 by the intertemporal substitution, and this acts to improve welfare. However, the expected future tariff has already induced individuals to consume more in period 1. There is therefore too much consumption (too little saving) in the current period. This is shown by the terms \((1/2k^2_{p_1p_1} + w_2E_{p_1w_2})\) and \((p_2E_{w_1p_2} + w_2E_{3})\) in the first two terms in \(d\delta\).

These act to remove a welfare increasing effect from a capital account liberalization. This has a sequencing implication. Conducting trade reform before capital control has been relaxed, may plausibly improve welfare if there were no anticipation of future reversal, i.e., if it is fully credible to the public. The presence of a probability of future tariff reimposition can act to remove the welfare gain from a trade reform because in the current period there is too much consumption. An appropriate sequencing of reform may be necessary, but is only meaningful especially when the reform itself is credible. If the distortion generated by the noncredible nature of reform has already been sufficiently large, then the capital account liberalization may be immiserizing; maintaining capital controls may have the effect of mitigating the credibility problem. See Calvo [1988] for this point in a different model.
The formula for the optimal capital control tax rate is provided in equation (A13) in Appendix 5.3, and shows that it is also proportional to the probability of future reversal of trade reform. We can confirm that if there is no probability of reversal of the free trade policy ($\zeta = 0$), removal of the capital tax would be optimal. The optimal taxation on foreign borrowing in period 1 plays a role of equalizing consumption across the periods.

5.7 Conclusion

This chapter has mainly discussed the welfare effects of an imperfectly credible trade liberalization policy. Moving from a simple to a more general intertemporal framework, we have shown that under plausible conditions noncredible reform is suboptimal. The deterioration of welfare is proportional to the probability of future reversal of reform. The implication on the optimal speed of trade reform is that there exists a strictly positive tariff level in period 1 which maximize individual's welfare, favouring gradualism. This is because the intertemporal distortion created by the noncredibility of abrupt reform is alleviated by the slower rate of reform.

The welfare effect of the relaxation of capital controls has also been examined. It was demonstrated that under plausible conditions a capital account liberalization after trade reform will bring about a welfare gain if trade reform itself is credible. However, if the public questions the viability of the current trade reform, then the welfare-deteriorating effect of noncredibility may offset the beneficial effect of the capital account liberalization. The net welfare effect might be negative if the distortion created by the credibility problem of trade reform is too large. This suggests that if there is a credibility problem of trade reform, capital controls could be used to equalize consumption across the periods. The implication for sequencing is that the order of "trade account first" is to be preferred especially when the government faces a credibility problem.

Some results may be model-specific. However, regardless of different modelling strategies, our analyses have clearly indicated that the reform must be credible to the public, otherwise it will create an intertemporal distortion. Although this distortion can be
mitigated by the real wage effect, our results suggest that if the intertemporal distortion caused by incredibility of reform is too large (and offsets the wealth-raising effect), then it operates to reduce the individual's welfare. Noncredible trade reform is not optimal, and may be worse than no-reform at all. This is a robust conclusion of this chapter.
APPENDIX TO CHAPTER 5

5.1 Derivation of General Expenditure Function

Assume that the utility function is separable intertemporally, as well as separable in goods and labour. The utility function is:

\[ u(c_{m1}, c_{x1}, c_{m2}, c_{x2}, L_1, L_2) = u[c(c_{m1}, c_{x1}), c_2(c_{m2}, c_{x2})], L(L_1, L_2)] \]

where \( c \) is consumption composite, \( L \) is labour composite, \( c_t = (c_{m1}, c_{x1}) \) denotes subutility (or real spending) in period \( t \) of the consumption of imports, \( c_{m1} \), and exports, \( c_{x1} \). Both \( c_1 \) and \( c_2 \) possess the expected utility property and are assumed to be homothetic and be homogeneous of degree one. \( L_t \) is labour supply in period \( t \).

Maximization is done step by step [Deaton and Muellbauer, 1980]. First, a representative consumer will maximize the present value of the expected utility by choosing \( c \) and \( L \), subject to the intertemporal budget constraint (assuming equality):

Choose \( c \) and \( L \) to maximize \( u(c, L) \) st. \( pc - wL = 0 \)

The demand for consumption composite and the supply of labour as a function of \( p \), \( w \), and \( pc - wL \) are obtained. In a dual manner, minimizing \( pc - wL \) to achieve the target utility, \( \bar{u} \), defines the expenditure function for the consumption and labour composites:

\[ E(p, w, u) = \min \{pc - wL: u(c, L) \geq \bar{u}\} \]

Next, the consumption of goods and the supply of labour in each period can be obtained from choosing \( L_1 \) and \( L_2 \) to minimize \( L(L_1, L_2) \) subject to \( w_1L_1 + \delta w_2L_2 = wL \). Also choosing \( c_1 \) and \( c_2 \) to maximize \( c(c_1, c_2) \) given that \( p_1c_1 + \delta p_2c_2 = pc \). These define the expenditure function for the consumption and labour in each period, and hence the intertemporal expenditure function:

\[ E(p_1, \delta p_2, w_1, \delta w_2, u) = \min \{p_1c_1 + \delta p_2c_2 - w_1L_1 - \delta w_2L_2: u(c_1, c_2, L_1, L_2) \geq \bar{u}\} \]
where labour in each period is treated as a negative good. Finally, we choose $c_m$ and $c_x$ to minimize the cost of attaining subutility $c_t$ in period $t$ subject to $c_t (c_m, c_x) \geq 1$. This defines each period's unit expenditure function (or consumption-based price index), $p_t$ and $p_2$, where $p_t$ is the minimum expenditure needed to achieve the unit level of subutility in that period, with given relative prices of $p_m$ and 1:

$$p_t (p_m, 1) = \min [p_m c_m + c_x; 1 \leq c_t (c_m, c_x)].$$

Integrating these steps defines the general intertemporal expenditure function, equation (11) of the text. A diagrammatic exposition in Figure 5.6 would be useful.

![Diagram](image)

FIGURE 5.6 DIAGRAMMATIC DERIVATION OF $E(p, w, u)$.

**NOTE**

1. OS: lump-sum subsidization
   (pc - wL > 0)
   OT: lump-sum taxation
   (pc - wL < 0)
   At O: pc - wL = 0
2. Slopes of indifference curves: real wage rates
3. Indifference curve cannot be backward bending since it is a Hicksian one.
5.2 Differentiation of the System of Equations

We incorporate three distortions into the model: period-1 tariffs, period-2 tariffs, and a tax in capital inflows. The model becomes the following three equations:

\[(A1) \quad E[p_1(p_{m1}, 1), \delta p_2(p_{m2}, 1), w_1, \delta w_2, u] = \Pi^1(p_{m1}, 1, w_1) + \delta \Pi^2(p_{m2}, 1, w_2) + \tau_1(E_1 - \Pi_1^1) + \delta (p_{m2} - 1)(E_2 - \Pi_2^1) + \theta B\]

\[(A2) \quad -E_3[p_1(p_{m1}, 1), \delta p_2(p_{m2}, 1), w_1, \delta w_2, u] = -\Pi_3^1(p_{m1}, 1, w_1)\]

\[(A3) \quad -E_4[p_1(p_{m1}, 1), \delta p_2(p_{m2}, 1), w_1, \delta w_2, u] = -\Pi_3^2(p_{m2}, 1, w_2)\]

Totally differentiate the systems of equations (A1)-(A3), allowing six variables (three endogenous and three exogenous) are changing at the same time, to obtain the following basic matrix system:

\[
\begin{bmatrix}
-(\Psi_{13} + \theta \Gamma_{13}) & -(\Psi_{14} + \theta \delta \Gamma_{14}) & \Omega - \theta \Gamma_{1u} \\
\Sigma_{33} & \delta E_{34} & E_{3u} \\
E_{43} & \Sigma_{44} & E_{4u}
\end{bmatrix}
\begin{bmatrix}
dw_1 \\
dw_2 \\
u \end{bmatrix} =
\begin{bmatrix}
\Psi_{11} + \theta \Gamma_{11} & \tau_2(\Psi_{12} + \theta \delta \Gamma_{12}) & \omega_{12} + \theta (\Xi_{12} - \tau_1 \Phi_{12}) \\
-\Sigma_{31} & -\delta \tau_2 E_{32} & -\Phi_{32} \\
-E_{41} & -\tau_2 \Sigma_{42} & -\Phi_{42}
\end{bmatrix}
\begin{bmatrix}
d\tau_1 \\
d\zeta \\
d\delta
\end{bmatrix}
\]

where

\[
\begin{align*}
\Sigma_{11} &= E_{11} - \Pi_{11}^1 < 0, & \Sigma_{22} &= \delta E_{22} - \Pi_{21}^2 < 0, \\
\Sigma_{33} &= E_{33} - \Pi_{33}^1 < 0, & \Sigma_{44} &= \delta E_{44} - \Pi_{23}^2 < 0, \\
\Sigma_{13} &= E_{13} - \Pi_{13}^1 > 0, & \Sigma_{31} &= E_{31} - \Pi_{31}^1 > 0, \\
\Sigma_{24} &= \delta E_{24} - \Pi_{13}^2 > 0, & \Sigma_{42} &= \delta E_{42} - \Pi_{31}^2 > 0, \\
\Psi_{11} &= \tau_1 \Sigma_{11} + \delta \zeta \tau_2 E_{21} \geq 0, & \Psi_{12} &= \tau_1 \delta E_{12} + \delta \zeta \tau_2 E_{22} \geq 0, \\
\Psi_{13} &= \tau_1 \Sigma_{13} + \delta \zeta \tau_2 E_{23} > 0, & \Psi_{14} &= \delta \tau_1 E_{14} + \delta \zeta \tau_2 E_{24} > 0, \\
\omega_{12} &= \tau_1 \Phi_{12} + \delta \zeta \tau_2 \Phi_{22} \geq 0, & \pi_{11} &= p_1 E_{p1} p_{m1} + w_1 E_{31} \geq 0,
\end{align*}
\]
\[ \pi_{12} = p_1 E_{P_1 P_{m2}} + w_1 E_{32} > 0, \]
\[ \pi_{14} = p_1 E_{P_1 w_2} + w_1 E_{34} > 0, \]
\[ \phi_{12} = p_2 E_{P_{m1} P_2} + w_2 E_{14} > 0, \]
\[ \phi_{32} = p_2 E_{w_1 P_2} + w_2 E_{34} > 0, \]
\[ \phi_{12} = p_2 E_{P_{m1} P_2} + w_2 E_{w_1 w_2} > 0, \]
\[ \Gamma_{12} = \tau_1 E_{12} + \pi_{12} > 0, \]
\[ \Gamma_{14} = \tau_1 E_{14} + \pi_{14} > 0, \]
\[ \Xi_{12} = p_1 \Phi_{12} + w_1 \Phi_{32} > 0, \]
\[ \Omega_2 = E_u - \delta \zeta \tau_2 E_{2u} > 0 \]
\[ E_{22} = E_{P_{m1} P_2} P_1^2 p_1^2 + E_{P_2 P_1} p_1^2 < 0, \]
\[ E_{13} = E_{P_1 w_1} p_1^2 > 0, \]
\[ E_{1u} = E_{P_1 w_1} p_1^2 > 0, \]
\[ E_{24} = E_{P_2 w_2} P_1^2 > 0, \]
\[ E_{p_{m1} P_1} = E_{P_{m1} P_1} p_1^1 < 0, \]
\[ E_{p_{m2} P_1} = E_{P_{m2} P_1} p_1^2 < 0, \]
\[ \pi_{13} = p_1 E_{P_1 w_1} + w_1 E_{33} \geq 0, \]
\[ \pi_{1u} = p_1 E_{P_1 u} + w_1 E_{3u} > 0, \]
\[ \phi_{22} = p_2 E_{P_{m2} P_2} + w_2 E_{24} \geq 0, \]
\[ \phi_{42} = p_2 E_{w_3 P_2} + w_2 E_{44} \geq 0, \]
\[ \Gamma_{11} = \tau_1 \Sigma_{11} + \pi_{11} \geq 0, \]
\[ \Gamma_{13} = \tau_1 \Sigma_{13} + \pi_{13} \geq 0, \]
\[ \Omega = E_u - \tau_1 E_{1u} - \delta \zeta \tau_2 E_{2u} > 0, \]
\[ E_{11} = E_{p_{m1} P_1} p_1^1 < 0, \]
\[ E_{12} = E_{P_{m2} P_1} p_1^2 > 0, \]
\[ E_{14} = E_{p_{m2} P_1} p_1^2 > 0, \]
\[ E_{23} = E_{p_{m1} P_1} p_1^1 < 0, \]
\[ E_{p_{m2} P_1} = E_{P_{m2} P_1} p_1^2 < 0, \]
\[ E_{p_{m1} P_1} = E_{P_{m1} P_1} p_1^1 < 0, \]
\[ E_{p_{m2} P_1} = E_{P_{m2} P_1} p_1^2 < 0, \]

The determinant of the system, which is given by a 3x3 matrix of the LHS i.e. equation (A.4), is

\[ \Delta = -(\Psi_{13} + \Theta_{13}) (\delta E_{34} E_{4u} - E_{3u} E_{44}) \]
\[ + (\Psi_{14} + \Theta_{14}) (\Sigma_{33} E_{4u} - E_{3u} E_{43}) \]
\[ + (\Omega - \Theta_{1u}) (\Sigma_{33} E_{44} - \delta E_{34} E_{43}) \geq 0 \]

To evaluate changes in endogenous variables in response to exogenous shocks at relevant undistorted initial points, the determinant should be reduced as follows:

\[ \Delta^1 = -(\tau_{1} \Sigma_{13} + \delta \zeta \tau_2 E_{23}) (\delta E_{34} E_{4u} - E_{3u} E_{44}) \]
\[ + (\tau_1 \delta E_{14} + \delta \zeta \tau_2 E_{24}) (\Sigma_{33} E_{4u} - E_{3u} E_{43}) \]
\[ + (E_u - \tau_1 E_{1u} - \delta \zeta \tau_2 E_{2u}) (\Sigma_{33} E_{44} - \delta E_{34} E_{43}) \geq 0 \]
\[ \Delta^2 = -(\delta \tau_2 \Sigma_{23} - \theta \pi_{13}) (\delta E_{34} E_{4u} - E_{3u} \Sigma_{44}) \\
+ (\delta \tau_2 \Sigma_{24} - \theta \pi_{14}) (\Sigma_{33} E_{4u} - E_{3u} E_{43}) \\
+ (E_u - \delta \tau_2 E_{2u} + \theta \pi_{1u}) (\Sigma_{33} \Sigma_{44} - \delta E_{34} E_{43}) \geq 0 \]

\[ \Delta^3 = -\delta \tau_2 E_{23} (\delta E_{34} E_{4u} - E_{3u} \Sigma_{44}) \\
+ \delta \tau_2 \Sigma_{24} (\Sigma_{33} E_{4u} - E_{3u} E_{43}) \\
+ (E_u - \delta \tau_2 E_{2u}) (\Sigma_{33} \Sigma_{44} - \delta E_{34} E_{43}) \geq 0 \]

\[ \Delta^4 = E_u (\Sigma_{33} \Sigma_{44} - \delta E_{34} E_{43}) > 0 \]

where \( \Delta^1 \) is evaluated at a point where there are a zero capital tax and positive tariffs in both periods, \( \Delta^2 \) is evaluated at a zero tariff and positive capital tax in period 1 and positive tariffs in period 2, \( \Delta^3 \) is evaluated at a zero tariff and a zero capital tax in period 1 and positive tariff in period 2, and finally \( \Delta^4 \) is evaluated at \( \tau_1 = \zeta \tau_2 = \theta = 0 \) initially, and \( \Delta^4 \) is positive (see footnote (13)).

5.3 Comparative Statics

\[
\left. \frac{d u_t}{d \zeta} \right|_{t_1, \theta = 0} = \frac{1}{\Delta^3} \begin{bmatrix} -\delta \tau_2 E_{23} & -\delta \tau_2 \Sigma_{24} & \delta \tau_2 \Sigma_{22} \\ \Sigma_{33} & \delta E_{34} & -\delta \tau_2 E_{32} \\ E_{43} & \Sigma_{44} & -\delta \tau_2 \Sigma_{42} \end{bmatrix} \\
= \frac{\delta \tau_2}{\Delta^3} \left[ \delta \tau_2 E_{23} (\delta E_{34} \Sigma_{42} - E_{32} \Sigma_{44}) \right. \\
+ \tau_2 \Sigma_{24} (\delta E_{43} E_{32} - \Sigma_{33} \Sigma_{42}) \\
+ \tau_2 \Sigma_{22} (\Sigma_{33} \Sigma_{44} - \delta E_{34} E_{43}) \right] \geq 0 \\
\left. \frac{d w_t}{d \zeta} \right|_{t_1, \theta = 0} = \frac{1}{\Delta^3} \begin{bmatrix} \delta \tau_2 \tau_2 \Sigma_{22} - \delta \tau_2 \Sigma_{24} & \Omega_2 \\ \delta \tau_2 E_{32} & \delta E_{34} & E_{3u} \\ -\tau_2 \Sigma_{42} & \Sigma_{44} & E_{4u} \end{bmatrix} 
\]
\[
\begin{align*}
\frac{\partial t_2}{\partial \zeta} &= \frac{\delta t_2}{\Delta^3} [\zeta t_2 \Sigma_{22}(\delta E_{34}E_{4u} - E_{3u}\Sigma_{44}) \\
&\quad + \zeta t_2 \Sigma_{24}(E_{3u}\Sigma_{42} - E_{32}E_{4u}) \\
&\quad + \Omega_2(\delta E_{34}\Sigma_{42} - E_{32}\Sigma_{44})] \geq 0
\end{align*}
\]

(A6') \[
\frac{\partial w_1}{\partial \zeta} \bigg|_{t_1, \theta = 0} = \frac{\delta t_2}{\Delta^4} [E_u(\delta E_{34}\Sigma_{42} - E_{32}\Sigma_{44})] 
\]

\[
\begin{align*}
= \frac{\delta t_2 [E_{34}(\delta E_{42} - \Pi_{31}) - E_{32}(E_{44} - \Pi_{33})]}{(E_{33} - \Pi_{31}) (E_{44} - \Pi_{33}) - \delta E_{34}E_{43}} > 0
\end{align*}
\]

\[
\begin{align*}
\frac{\partial w_2}{\partial \zeta} \bigg|_{t_1, \theta = 0} &= \frac{1}{\Delta^3} \begin{bmatrix}
-\delta \zeta t_2 \tau_2 & \delta \zeta t_2 \Sigma_{22} & \Omega_2 \\
\Sigma_{33} & -\delta t_2 \Sigma_{42} & E_{3u} \\
E_{43} & -\delta t_2 \Sigma_{42} & E_{4u}
\end{bmatrix}
\end{align*}
\]

(A7) \[
\begin{align*}
&= \frac{\delta t_2}{\Delta^3} [ -\delta \zeta t_2 \Sigma_{23}(E_{3u}\Sigma_{42} - E_{32}E_{4u}) \\
&\quad + \zeta t_2 \Sigma_{22}(\Sigma_{33}E_{4u} - E_{3u}E_{43}) \\
&\quad + \Omega_2(E_{32}E_{43} - \Sigma_{33}\Sigma_{42})] \geq 0
\end{align*}
\]

(A7') \[
\begin{align*}
\frac{\partial w_2}{\partial \zeta} \bigg|_{t_1, \theta = 0} &= \frac{\delta t_2}{\Delta^4} [E_u(E_{32}E_{43} - \Sigma_{42}\Sigma_{33})] 
\end{align*}
\]

\[
\begin{align*}
&= \frac{\delta t_2 [E_{43}(\delta E_{42} - \Pi_{31}) - E_{42}(E_{44} - \Pi_{33})]}{(E_{33} - \Pi_{31}) (E_{44} - \Pi_{33}) - \delta E_{34}E_{43}} > 0 
\end{align*}
\]

(A8) \[
\begin{align*}
\frac{du}{d\tau_1} \bigg|_{\theta = 0} &= \frac{1}{\Delta^1} \begin{bmatrix}
-\tau_1 \Sigma_{43} - \delta \zeta t_2 \Sigma_{42} & -\tau_1 \delta E_{44} - \delta \zeta t_2 \Sigma_{24} & \tau_1 \Sigma_{11} + \delta \zeta t_2 \Sigma_{21} \\
\Sigma_{33} & \delta E_{34} & -\Sigma_{31} \\
E_{43} & \Sigma_{44} & E_{41}
\end{bmatrix}
\end{align*}
\]

\[
\begin{align*}
&= \frac{1}{\Delta^1} [ - (\tau_1 \Sigma_{13} + \delta \zeta t_2 \Sigma_{23}) (\Sigma_{31}\Sigma_{44} - \delta E_{44}E_{41}) \\
&\quad + (\tau_1 \delta E_{14} + \delta \zeta t_2 \Sigma_{24})(\Sigma_{31}E_{43} - \Sigma_{33}E_{44}) \\
&\quad + (\tau_1 \Sigma_{11} + \delta \zeta t_2 \Sigma_{21})(\Sigma_{33}\Sigma_{44} - \delta E_{34}E_{43})] \geq 0
\end{align*}
\]
To obtain \( \dot{\tau}_1 \), we set \( \frac{du}{d\tau_1} = 0 \) and we do some after manipulation, we obtain

\[
\dot{\tau}_1 = \frac{-\delta \zeta \tau_2 (\Sigma_{24} A + E_{23} B - E_{21} C)}{\delta E_{14} A + \Sigma_{11} B - \Sigma_{13} C}
\]

where \( A = \Sigma_{31} E_{43} - \Sigma_{33} E_{41} \), \( B = \Sigma_{33} \Sigma_{44} - \delta E_{34} E_{43} \), and \( C = \Sigma_{31} \Sigma_{44} - \delta E_{34} E_{41} \).

\[
\frac{dw_1}{d\tau_1} \bigg|_{0=0} = \frac{1}{\Delta^1} \left[ \begin{array}{cccc}
\tau_1 \Sigma_{11} + \delta \zeta \tau_2 E_{23} & -\tau_1 \delta E_{14} + \delta \zeta \tau_2 \Sigma_{24} & \Omega & \\
-\Sigma_{31} & \delta E_{34} & E_{3u} & \\
-E_{41} & \Sigma_{44} & E_{4u} & \\
\end{array} \right]
\]

\[
= \frac{1}{\Delta^1} \left[ (\tau_1 \Sigma_{11} + \delta \zeta \tau_2 E_{23}) (\delta E_{34} E_{4u} - E_{3u} \Sigma_{44}) \right.
\]

\[
+ (\tau_1 \delta E_{14} + \delta \zeta \tau_2 \Sigma_{24}) (E_{3u} E_{41} - \Sigma_{31} E_{4u}) \]

\[
+ \Omega (\delta E_{34} E_{41} - \Sigma_{31} \Sigma_{44}) \geq 0
\]

\[
\frac{dw_1}{d\tau_1} \bigg|_{0=0} = \frac{1}{\Delta^3} \left[ \begin{array}{cccc}
\delta \zeta \tau_2 E_{21} (\delta E_{34} E_{4u} - E_{3u} \Sigma_{44}) \right.
\]

\[
+ \delta \zeta \tau_2 \Sigma_{24} (E_{3u} E_{41} - \Sigma_{31} E_{4u}) \]

\[
+ \Omega_2 (\delta E_{34} E_{41} - \Sigma_{31} \Sigma_{44}) \geq 0
\]

\[
\frac{dw_2}{d\tau_1} \bigg|_{0=0} = \frac{1}{\Delta^1} \left[ \begin{array}{cccc}
-\tau_1 \Sigma_{13} - \delta \zeta \tau_2 E_{23} & \tau_1 \Sigma_{11} + \delta \zeta \tau_2 E_{21} & \Omega_2 & \\
\Sigma_{33} & -\Sigma_{31} & E_{3u} & \\
E_{43} & -E_{41} & E_{4u} & \\
\end{array} \right]
\]
\[ \frac{d\omega_2}{dt_1} \bigg|_{\theta_1, \theta_2 = 0} = \frac{1}{\Delta^3} \left[ - \delta \zeta \tau_2 E_{23}(E_{34} - \Sigma_{44}) \right. \]
\[ \left. - \delta \zeta \tau_2 E_{21}(\Sigma_{33}E_{44} - E_{34}E_{43}) + \Omega(\Sigma_{31}E_{43} - \Sigma_{33}E_{41}) \right] \geq 0 \]

\[ (A11)' \]

\[ \frac{d\omega}{d\theta} \bigg|_{\theta_1, \theta_2 = 0} = \frac{1}{\Delta^2} \left[ \begin{array}{ccc}
-\delta \zeta \tau_2 E_{23} + \theta \pi_{13} & -\delta \zeta \tau_2 \Sigma_{24} - \theta \delta \pi_{14} & \delta \zeta \tau_2 \Phi_{22} - \theta \Xi_{12} \\
\Sigma_{33} & \delta E_{34} & -\Phi_{32} \\
E_{43} & \Sigma_{44} & -\Phi_{42}
\end{array} \right] \]
\[ = \frac{1}{\Delta^2} \left[ - (\delta \zeta \tau_2 E_{23} + \theta \pi_{13}) (\Phi_{32}E_{44} - \delta E_{34} \Phi_{42}) \right. \]
\[ + (\delta \zeta \tau_2 \Sigma_{24} + \theta \delta \pi_{14}) (\Phi_{32}E_{43} - \Sigma_{33} \Phi_{42}) \]
\[ + (\delta \zeta \tau_2 \Phi_{22} + \theta \Xi_{12}) (\Sigma_{33} \Sigma_{44} - \delta E_{34} E_{43}) \right] \geq 0 \]

\[ (A12)' \]

By setting \( du/d\theta = 0 \), we can obtain the optimal capital tax rate in period 1 in the presence of future tariffs:

\[ (A13) \]

\[ \hat{\theta} = \frac{\delta \zeta \tau_2 (E_{23} a - \Sigma_{24} b - \Phi_{22} c)}{-\pi_{13} a + \delta \pi_{14} b + \Xi_{12} c} \]

where \( a = \Phi_{32} \Sigma_{44} - \delta E_{34} \Phi_{42} \), \( b = \Phi_{32} E_{43} - \Sigma_{33} \Phi_{42} \), and \( c = \Sigma_{33} E_{44} - \delta E_{34} E_{43} \).
CHAPTER 6

TRADE LIBERALIZATION IN KOREA

6.1 The Korean Economy: Recent Trends

The Korean economy has achieved rapid growth at an average rate of 8.2% during the past few decades, transforming itself effectively from a stagnant agricultural economy to a prominent industrializing country. In the 1980s, per capita GNP more than doubled (from 2000 U.S dollars to 4130 U.S dollars). The economy boomed with the unemployment rate of an average 3%. During the same period, Korea recorded its first trade surplus (1986). This remarkable economic performance in the mid-1980s was attributable not only to the so-called three lows, low world interest rates, low U.S. dollar, and low oil prices, but to the government's effective structural adjustment program conducted through the early 1980s. However, since 1989, a relatively unfavourable external environment coupled with internal socio-political instability has led Korea to a weaker economic performance.

Table 6.1 shows the recent trends of the Korean economy in terms of its size and structure. As was the case in the 1970s, the manufacturing sector played a leading role in overall growth in the 1980s, growing at an average of 15% during 1983-88 whereas the agriculture sector recorded a much lower growth rate 6% during the same period. The dominance of the manufacturing sector is also reflected in the sectoral employment structure which shows an increasing trend of employment in manufacturing (and services) sector, with a declining trend in agricultural sector employment.

The investment to GNP ratio also increased continuously, from 32% in 1980 to a level of 37% in 1990.
### TABLE 6.1 STRUCTURAL ECONOMIC PATTERN: KOREA, 1980-1990, SELECTIVE YEARS ¹)

<table>
<thead>
<tr>
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<td>18.0</td>
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<td>3.5</td>
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</tr>
<tr>
<td>Service</td>
<td>2.2</td>
<td>10.5</td>
<td>12.9</td>
<td>12.7</td>
<td>8.3</td>
<td>11.7</td>
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<td><strong>GNP per capita⁴)</strong></td>
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<td>20.1</td>
<td>25.1</td>
<td>41.3</td>
<td>49.9</td>
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<td><strong>Employed structure</strong></td>
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<td>23.6</td>
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<tr>
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<td>23.3</td>
<td>25.9</td>
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<td>Service</td>
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<td><strong>Unemployment rate</strong></td>
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<td>3.8</td>
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<td><strong>Ratio to GNP</strong></td>
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<td>40.5</td>
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<tr>
<td>Govt' budget balance⁵)</td>
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<td>1.8</td>
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<td>32.8</td>
<td>38.1</td>
<td>35.3</td>
<td>35.3</td>
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<tr>
<td><strong>Growth rate (%) of</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>16.3</td>
<td>19.6</td>
<td>36.2</td>
<td>28.4</td>
<td>2.8</td>
<td>4.2</td>
</tr>
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<td>29.9</td>
<td>26.3</td>
<td>18.6</td>
<td>13.6</td>
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<tr>
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<td>12.3</td>
<td>-6.4</td>
<td>-4.8</td>
<td>-3.0</td>
<td>-2.1</td>
</tr>
</tbody>
</table>


**Notes:**
¹) Based on constant 1985 prices.
²) Includes forestry and fishing.
³) Includes mining.
⁴) U.S. hundred dollars.
⁵) Minus figures indicate deficits.
The domestic saving ratio was very low relative to the investment ratio during 1980-1983 (as it was in the 1970s) and hence foreign borrowing served as a major factor for economic development. However, throughout the 1980s, domestic saving increased whereas foreign saving decreased. From 1986 to 1989, domestic saving exceeded investment, generating surpluses in the current account during that period. The current account reached a record surplus of U.S. 14.3 billion dollars (8% of GNP) in 1988. Correspondingly, holdings of foreign assets increased from 9.2% of GNP in 1986 to 11.4% in 1989, and the ratio of external liabilities to GNP peaked in 1983 (51% of GNP), but was down to 9% of GNP by 1990.

Table 6.1 also shows Korea's trade openness and dependency. The GNP share of exports was an average 39% while the imports share was 37%, during 1983-1988, constituting a trade ratio of 76% of GNP. Also, Korea's exports have mostly been the engine of growth. They recorded an annual average growth rate of 28% during the same periods, although in 1989 exports grew only by 2.4%. In 1989, the Korean economy produced a relatively weak growth rate of 6.7% (from 12.4% in 1988), although it has started to recover slightly during 1990-1991. The recovery in economic growth, however, has mainly been due to a large increase in the private sector's consumption and investment, especially in construction, not due to export growth. During 1989-1991, export volumes declined by 6.5% and the growth rate of exports has been an average 3%, which is the worst performance since the early 1960s. This sharp deterioration in Korea's export competitiveness has largely been attributable to the appreciation of the Korean currency over the past three years and successive increases in wages prompted by the union movement following democratic reforms since 1987. The world recession during this period could be another cause for Korea's weak performance in exports.

Imports also grew at an average of 24% during 1983-1988. This high import growth rate in the mid-1980s stemmed from Korea's trade liberalization programs resumed in

---

1Korea's export-GNP ratio was only 6% in the early 1960s whereas Japan has maintained a nearly constant ratio of exports to GNP during the whole period of growth. Korea's outward-oriented strategy is thus a kind of German style, rather than a Japanese style [Dornbusch and Park, 1987]

2Data for 1991 is based on unofficial statistics.
1984. In particular, during 1989-1990 when the value of exports was only U.S. 5.6 billion dollars (3% annual increase), the value of imports was U.S. 33.2 billion dollars, indicating a large increase in imports following the second trade reform (16% annual average increase). There would be little doubt that the trade liberalization programs implemented in the 1980s, especially the second episode, have caused this rise in imports, contributing to deficits in the current account. Ironically, during the first reform program of 1984-1988, an increasing current account surplus was shown whereas during the early stage of the second program (1989-1993) a massive current account deficit has appeared.

These conflicting consequences suggest that some important issues in Korea's recent trade liberalization have yet to be resolved. How intensive have they been in terms of their scope, speed, and timing (announcement)? What were the adjustment patterns in the Korean industries, especially in the exportable sector, in response to reform? Has there been a sequencing problem between trade and capital account liberalization? Has there been a government credibility problem? These are the issues discussed in this chapter. Our objective is to establish an illustrative picture of the scope and impact of trade liberalization programs of the 1980s.3

The chapter begins with a background review of Korea's trade regime and its liberalization policy (Section 2). Then, we describe the broad picture of the 4 episodes of trade liberalization during 1965-1990, focusing, however, on the two major episodes of the 1980s implemented (or under implementation) in 1984-1988 and 1989-1993 (Section 3). An overall trade liberalization index is also constructed. We then explain the adjustment patterns in terms of production, imports and exports, real exchange rates, real wages, and investment, following these trade liberalization programs (Section 4). Next, Section 5 discusses Korea's liberalization of the capital account transactions in the 1980s. Finally, we summarize and draw some implications of Korea's trade reform for the

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3 This chapter, however, contains substantial background materials for conducting a simulation analysis in the next chapter.
question of sequencing, timing, speed and credibility of reform (Section 6). A chronology of Korea's major trade reform is contained in the Appendix Table.

6.2 Korea's Trade Policy: A Background Review

In the early stages of economic development (1960s-1970s) when Korea was severely constrained by a shortage of domestic savings and foreign exchange holdings, Korea's economic regime was characterized by development mercantilism [Young, 1987]. It tried to maximize export earnings and to minimize foreign exchange outflows. Trade policy was thus composed of a comprehensive export-promotion scheme as well as strong import restrictions in the form of both QRs and high tariffs. This trade regime was considered of a key to limiting the size of the current account deficit and promoting infant industries.

In the 1970s, the Korean government concentrated on promoting heavy and chemical industries. Trade policy was also established in line with this heavy and chemical industry promotion policy. A nation-wide campaign was conducted by the government to urge investment in the heavy and chemical industries, such as chemical, nonferrous metal, steel, electronics, automobile, and shipbuilding industries. Extensive government intervention in resource mobilization was intensified throughout these stages. Various discriminatory incentives were introduced in the form of special tax exemptions, preferential credit allocation, and state provision of industrial infrastructure to promote investment in these industries. These industries were also protected from foreign competition by high import barriers. However, the export-led growth policy was not abandoned, and hence exporting finns were allowed access to imported intermediate inputs relatively freely. A high level of investment in heavy and chemical industries and also a strong export growth in the light industries generated an economic boom in the mid- to late 1970s. Eventually, these contributed to remarkable growth from 1972-1979.

4 Apart from additional bank loans, Public Employee Superannuation Fund and National Investment Fund were channeled into heavy and chemical industries with often negative interest rates.
5 The economy was booming further from the performance in the Middle East construction market.
However, unintended side effects appeared. Excessive investment in heavy industries caused wage to rise, which in turn transmitted into the light industries, reducing their international competitiveness. At the same time, the heavy and chemical industries appeared to suffer from excess capacity from the late 1970s. Accordingly, their financial position deteriorated and they relied heavily on government assistance and rescheduling of bank loans. A selective import liberalization program was implemented during 1978-1979 as one way of moderating the excessive internal economic boom.

Since then, the government has reoriented its policies to stress stabilization cum liberalization. Trade policy was not an exception. However, the economy was vulnerable to both the second oil shock and domestic political instability, which resulted in a negative growth rate in 1980. Trade liberalization programs were interrupted with severe debate continuing on those measures at that difficult time. To restore growth, a wide range of structural adjustment programs was launched from 1981. One was to resume trade liberalization measures.

In December 1983 the government announced a five-year tariff reduction schedule along with a QRs liberalization plan, to be implemented in the period of 1984-1988. Its own goal was to reallocate resources efficiently by reducing protection in domestic industries and exposing them to international competition. The exchange rate was allowed to depreciate (including a 20% devaluation in 1980). In addition to import liberalization, there was also a reduction in export assistance. As a result of this reform, Korea’s trade regime progressed towards a more liberal regime in 1988.

A deterioration in the current account in the short-run were not revealed during the reform in the middle of 1980s. Exports increased more than imports. As a result, the trade account as well as the current account improved steadily even before the three lows appeared. Korea’s trade liberalization episode, which started from 1984, provides a lesson that trade liberalization, if it is supported by appropriate exchange-rate or other stabilization policies, need not result in balance of payment problems.

6Estimates for 1980 indicates that Korea’s share in total manufacturing exports of the developing countries were decreased from 17.3% in 1978 to 15.8% and 15.3% in 1979 and 1980, respectively [Young, 1986]. Eventually, the economy was led to produce the negative growth rate at -3.7% in 1980.
As the country's trade surplus expanded from 1986, Korea began to face serious pressures for a substantial opening-up of the economy from both home and abroad. That is, the government was forced to perceive that chronic protection would aggravate international trade frictions and would ultimately jeopardize continued access to foreign export markets. Korea's export-led high growth would then no longer be sustainable. On the other hand internally, there has been a widespread view that it would not be desirable for excessive trade surpluses to be achieved at the expense of domestic consumption. Needless restrictions on external transactions would reduce national welfare, and hence certainly postpone the improvement of the domestic real standard of living.

In particular, even after the full implementation of the trade reforms of 1984-1988, tariffs on household's consumption of imports remained high, which caused a number of undesirable consequences. Apart from the welfare issue, the gap between domestic and foreign prices of imports induced smuggling and black market activities. Moreover, the slowness of the reform on consumer goods reduced the government's credibility. In these circumstances, the government had to accommodate the internal and external economic environment and announced in December 1988 a five-year schedule of further tariff reductions for the period of 1989-1993.

6.3 Trade Liberalization

The trade liberalization implemented during 1965-1967 can be characterized as the loosening of quantitative restrictions on import goods. Trade reform was virtually discontinued until 1977, however, mainly because of the deterioration in the balance of payment accounts. The import liberalization program of 1978-1979 further loosened the quantitative restrictions and reduced tariffs on a few selective import goods. The program was temporarily discontinued until the government's announcement of further trade reform in 1983. There were other minor attempt to reduce protection during 1967-1977, but they

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7 In the analytical frameworks in Chapters 3, 4, 5, and 7 we define trade liberalization as a reduction of tariffs. Since the main objective of this Chapter is to illustrate the scope and substance of Korea's overall trade reform programs, we include QR liberalization in the overall trade liberalization term.
were often halted by unfavourable economic and political developments. In sum, trade reforms in the seventies were implemented on an immediate, discretionary and an intermittent basis. There was neither announcement before implementation, nor was there any organized mid- to long term plan for reform. The programs were mostly concentrated on reducing QRs, and were implemented very gradually.

These earlier liberalization episodes (until the 1970s) are now well documented in both the classic NBER Country Study by Frank, Kim, and Westphal [1975] and the recent World Bank Country Study (Volume 2) written by Kim [1991]. The resultant import liberalization ratio in Korea was 68% in the late 1979, and the legal tariff rate on all commodities was lowered from an annual average of 32% during 1960-1977 to 24.9% in 1979 under the 8-digit CCCN classification. Detailed discussion related to these historical episodes is not our focus here, and we turn to the more recent episodes.


One of the features of trade reform in the 1980s is that it has been begun after its announcement. The reform program conducted during 1984-1988 was announced in 1983. This is mainly to provide firms with sufficient time to prepare for adjustment. Quantitative restrictions were continuously relaxed during this period. As a result, the import liberalization ratio (ILR) was raised from 80.4% in 1983 to 94.8% in 1988 (Table 6.2). In particular, the ILR in the manufacturing sector was raised from 76% to 97% during this period. Efforts were also made to reorganize and to reduce the tariff rates on imports.

The main contents of the program of tariff cuts were: (i) tariffs on non-competing (competing) raw materials were reduced from 0-30% in 1983 to 5% (10%) in 1988, (ii) tariffs on intermediate imported manufacturing goods were reduced from 15-50% in 1983

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9 The import liberalization ratio (ILR) here is defined as the ratio of the number of automatic import approval to total number of goods (at a certain commodity classification system).
10 The international commodity classification system was unified to the Harmonized System (HS) from 1987. The old systems were CCCN (151 country used), TSUSA (U.S.A.), and CTC (Canada). Korea used CCCN until 1988, and was replaced by HS from 1989.
to 20% in 1988, (iii) tariffs on consumer's final goods were reduced from 40-80% in 1983 to 40% in 1984 and 20% in 1988, but tariffs on luxury imports were reduced to 50% in 1984 and to 30% in 1988, and (iv) among agricultural products, tariffs on fodder were reduced from 20% to 7%, but tariffs on basic crops (rice, barley, wheat, etc); and other crops (fruit, vegetables, non-food crops, etc) and livestock breeding were maintained at 5% and 30-50% level, respectively.

TABLE 6.2 IMPORT LIBERALIZATION RATIO (ILR) BY INDUSTRY (%)^1
KOREA, 1980-1991, SELECTIVE YEARS

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>55.9</td>
<td>66.4</td>
<td>68.4</td>
<td>71.9</td>
<td>83.3</td>
<td>84.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>70.0</td>
<td>89.7</td>
<td>97.3</td>
<td>99.6</td>
<td>99.8</td>
<td>99.9</td>
</tr>
<tr>
<td>Average (all)</td>
<td>68.6</td>
<td>87.7</td>
<td>95.2</td>
<td>95.5</td>
<td>96.4</td>
<td>97.2</td>
</tr>
</tbody>
</table>

Notes: (1) ILR = number of automatic import approval/total number of goods (at the 8-digit level level under CCCN as of 1984. For 1990 and 1993, it is based on 10-digit level of HS (Harmonized System) as of 1989.

As a result, the average tariff rates were reduced from 23.7% in 1982-1983 to 18.1% in 1988 (see Table 6.3). During the same period the central tariff rates (see notes in Table 6.3) were also reduced from 29.6% to 20%. However, despite the reform programs, Korea's trade regime as of 1988 was still protectionist compared to other countries (NICs and developed), as revealed in Table 6.4.

In 1988, the second five-year tariff liberalization schedule for the period of 1989-1993 was unveiled. It was mainly the current account surplus shown in 1986-1987 that prompted Korea to accelerate its existing trade liberalization policy. Unlike the first episode, the liberalization in QRSs was not much an important part of this reform, since the ILR in 1989 had already reached 95.5% (98.9% by 1993), and that for the manufactured goods was 99.6% in 1989 (refer to Table 6.2 again). The important element of this reform was tariff reform, as described below.
TABLE 6.3 AVERAGE TARIFF RATE BY INDUSTRY (%)  
KOREA, 1982-1993, SELECTIVE YEARS

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>31.4</td>
<td>29.6</td>
<td>28.8</td>
<td>25.2</td>
<td>20.6</td>
<td>17.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>22.6</td>
<td>20.6</td>
<td>20.3</td>
<td>16.9</td>
<td>9.7</td>
<td>6.1</td>
</tr>
<tr>
<td>Central (all)²</td>
<td>29.6</td>
<td>26.4</td>
<td>23.2</td>
<td>20.0</td>
<td>13.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Average (all)</td>
<td>23.7</td>
<td>21.9</td>
<td>21.3</td>
<td>18.1</td>
<td>11.4</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Notes: (1) Announced rates, and the same (see Table 6.2) commodity classified systems are applied.
(2) Central tariff indicates the tariff rate around which the majority of goods are applied.
(3) Rates are based on 8-digit CCCN for all years.

TABLE 6.4 INTERNATIONAL COMPARISON OF TARIFF RATES, 1988 (%)

<table>
<thead>
<tr>
<th></th>
<th>Korea</th>
<th>Taiwan</th>
<th>Isreal</th>
<th>Japan</th>
<th>U.S.</th>
<th>E.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (all)</td>
<td>18.1</td>
<td>11.7</td>
<td>9.2</td>
<td>5.9</td>
<td>6.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>15.9</td>
<td>9.5</td>
<td>8.1</td>
<td>4.6</td>
<td>6.1</td>
<td>6.7</td>
</tr>
<tr>
<td>Central (all)</td>
<td>20.0</td>
<td>10.0</td>
<td>9.1</td>
<td>4.5</td>
<td>5.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>


First, tariffs on non-competitive raw materials (128 items in HS) were cut to 1-2% in 1989 (and will be maintained until 1993) whereas those on competitive ones (214 items in HS) will be reduced gradually from 10% in 1988 to 3% in 1993. Second, tariffs on primary processed intermediate inputs were lowered from 10-20% in 1988 to 10% in 1989, and will be lowered to 5% by 1993.¹² Also, the rate of 20% on almost all manufactured goods (intermediate or final) was reduced to 15% in 1989 and is to go down further to 8% by 1993. Third, this rule of 15% in 1989 and 8% by 1993 was also applied to general consumer goods. However, reductions in rates for high tariff items

¹²For those items that are already internationally competitive, the rates were cut sharply to 5% in 1989.
(932 luxury goods), whose tariffs ranged from 30% to 50%, were far more gradual, reducing annually to 20%, 16%, 13%, 10%, and 8% during 1989-1993.

Finally, the rate reduction for agro-fishery products were the same in principle as the manufactured goods. Items whose rates were cut sharply were raw farm products, domestically unavailable items, and former high tariff goods and processed food made of imported material. However, tariffs on certain cash crops have not been reduced since they are still subject to QRs. Tariff adjustments alone were regarded as impractical and ineffective. Note, however, that the government has proposed the 1992-1994 program and the subsequent 1995-1996 plan to reduce the remaining QRs restrictions on agricultural import covered by GATT BOP Article XVIII:B waiver (see footnote 13). Accordingly, a tariff reduction plan for agricultural products is expected to be established.

In its efforts to focus on tariff cuts for finished goods which have relatively higher rates, the government has lowered the degree of tariff escalation in accordance with the stage of production, i.e., raw materials, intermediate inputs, and finished products. The average tariff rates for raw materials will be reduced from 9.3% in 1988 to 2.8% in 1993, for intermediate inputs from 17.1% to 7%, and for finished goods from 19.1% to 7.1%.

Figure 6.1 shows this trend.

The distribution of tariffs was also changed considerably through this tariff reform plan. The central tariff level will fall from 20% in 1988 to 8% in 1993, that is, around 80% of all commodities classified by HS will be under 8% tariffs by 1993. Consequently, the average tariff rate will be lowered from 18.1% in 1988 to 7.9% by 1993 (see Table 6.3 again). Both tables 6.2 and 6.3 indicate the gradual progress towards a more liberal trade regime. In a completing stage of the Uruguay Round Negotiations, Korea will inevitably be moving towards status as a GATT Article 11 Country away from status as a GATT Article 18 Country.14

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13 Table 4 shows a gradual decrease of average legislated tariffs, but tariffs on selected products were often raised. In particular, from 1976 to 1978 when the Korean economy was concentrating on the forstering of heavy industry, the tariffs on heavy-industry products were substantially raised. This is why tariff reduction was always the main concern but remained limited in scope.

14 The GATT Article 11 Country includes a country in which all quantitative restrictions are removed, whereas the GATT Article 18 Country is a country where some QRs are allowed to defend a deterioration of the balance of payments. Section 18 is applied to most developing countries.
Import Liberalization Index

In Papageorgiou, Michaely, and Choksi [1991], the degree of trade liberalization in 19 countries is presented by an index number – one for each year up to early 1980s. In a similar fashion, we construct an overall index of import liberalization for the period of 1978-1992. As shown in Table 6.5, two factors are taken into account in the construction of this index: the import liberalization ratio (for QRs) and the average tariff rate in each year. We observe that the degree of import liberalization in Korea has consistently improved from 1978. This is shown by higher index numbers over time (see the fifth column in Table 6.5). No fluctuations in the index are shown. In addition, the trade system is expected to progress towards a regime of almost free trade by 1993.15

Other Measures of Protection

Although tariffs and QRs, which are major instruments for protection, have been reduced substantially through these reform programs, there are other measures for trade

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15In Volume 2 of Papageorgiou, et. al., Kim [1991] provides the trade liberalization index for Korea. Our index number is based on his estimation for the period of 1978-1984. But for 1985-1992 we estimated by ourselves. Also, we do not consider an export liberalization index in the calculation of overall trade liberalization index since exports were nearly 100% liberalized after 1984.
protection. These consists of import source diversification notices (especially on imports from Japan), anti-dumping provisions, subsidy-countervailing duty provision, and tariff adjustment provisions. The discretionary tariff adjustment system provides the government with the flexibility to vary tariff rates under certain circumstances. It can allow for retaliation for unfair discrimination abroad, most-favored nation treatment of non-GATT signatory countries, and tariff adjustment for stabilization of the domestic prices of specific commodities. Another instrument of contingency protection is the so-called import surveillance. Import surveillance products are periodically announced and the government monitors the import of these items for possible restrictions whenever they appear to have disruptive effects on the domestic market. Also, emergency tariffs are supposed to be the Korean version of safeguards. Considering these other measures, one may well argue that trade liberalization index constructed above overestimates the overall degree of trade liberalization in Korea.

**TABLE 6.5 IMPORT LIBERALIZATION INDEX: KOREA, 1979-1993, SELECTIVE YEARS**

<table>
<thead>
<tr>
<th>Year</th>
<th>Average tariff(t)</th>
<th>$1/(1+t)$</th>
<th>ILR</th>
<th>Weight$^1$</th>
<th>Index$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>34.4</td>
<td>74.4</td>
<td>69.1</td>
<td>71.8</td>
<td>7.2</td>
</tr>
<tr>
<td>1983</td>
<td>23.7</td>
<td>80.8</td>
<td>80.3</td>
<td>80.6</td>
<td>8.1</td>
</tr>
<tr>
<td>1984</td>
<td>21.9</td>
<td>82.0</td>
<td>84.8</td>
<td>83.4</td>
<td>8.3</td>
</tr>
<tr>
<td>1988</td>
<td>18.1</td>
<td>84.7</td>
<td>95.2</td>
<td>90.0</td>
<td>9.0</td>
</tr>
<tr>
<td>1990</td>
<td>11.4</td>
<td>87.7</td>
<td>96.4</td>
<td>92.1</td>
<td>9.2</td>
</tr>
<tr>
<td>1993$^3$</td>
<td>7.9</td>
<td>92.7</td>
<td>98.9</td>
<td>95.8</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Notes: (1) $[\text{ILR} + 1/(1+t)]/2$.
(2) Weight multiplied by 0.1, so that the index of 10.0 conceptually represents free trade.
(3) Expected figures as announced.

### 6.4 Changing Industrial Patterns With Reform

Theoretical studies suggest that trade reform has impact and long-run effects on several variables. As mentioned, without rigorous analytic tools it is very hard to capture
to what extent and through which channels these effects operate. Also, econometric evaluation of the recent reform can only be conducted after sufficient data accumulation. In this section, we focus on describing short-run changes in sectoral production, exports and imports, investments, wages, etc. following the trade reform implemented during 1984-1988. Since the second pre-announced tariff reform is still in effect, the overall changes for the second episode cannot be investigated in this study. Where data is available, we include some short-run consequences of the earlier part of the second reform episode commenced from 1989.16

**Sectoral Production Structure**

Table 6.6 presents the constant price values of domestic production by major sector for selective years during the trade reform period. During the period 1980-1988, when the first episode of trade reform was carried out, the sectors that recorded especially rapid increases in production were manufacturing industries (31.8% to 33.2%). A notable pattern is that the heavy industry products increased their production share from 17.3% in 1984 to 19.7% in 1988 whereas the light industry products share declined from 13.5% to 12.8%.17 This trend continued during 1989-1990 when the overall manufacturing sector even declined.

Detailed examination reveals that production increases in colour TV, VCR, music instruments, and in automobiles, contributed to the increasing production in the heavy industries. The fall in the share of light industry production throughout the 1980s was accounted by falls in the production of meat and meat-processed goods and a relatively smaller rise in fabricated textile products and pulp and paper. On the other hand, the nontradeable sector including construction has steadily increased its production share since 1986. The table also shows that the agricultural production share decreases over time. No consistent trend was seen in the service sector share, but since 1988 it has increased.

16 The long-run consequences of the tariff reform announced in 1988 will be predicted by a dynamic simulation model in the following chapter.
17 The heavy industry products here are chemical products, electrical machinery, iron and steel, transport equipment, and petroleum and coal products.
TABLE 6.6 CHANGES IN SECTORAL PRODUCTION STRUCTURE: KOREA, 1980-1990, SELECTIVE YEARS (%)

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>14.7</td>
<td>12.9</td>
<td>11.5</td>
<td>10.5</td>
<td>10.2</td>
<td>9.1</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>30.9</td>
<td>31.8</td>
<td>32.6</td>
<td>33.2</td>
<td>31.9</td>
<td>29.6</td>
</tr>
<tr>
<td>Light-</td>
<td>14.5</td>
<td>13.5</td>
<td>13.4</td>
<td>12.8</td>
<td>11.1</td>
<td>8.9</td>
</tr>
<tr>
<td>Heavy-</td>
<td>15.2</td>
<td>17.3</td>
<td>18.3</td>
<td>19.7</td>
<td>20.2</td>
<td>20.3</td>
</tr>
<tr>
<td>Service</td>
<td>34.5</td>
<td>35.1</td>
<td>36.2</td>
<td>36.3</td>
<td>35.9</td>
<td>37.1</td>
</tr>
<tr>
<td>Nontradeable</td>
<td>19.9</td>
<td>20.2</td>
<td>19.7</td>
<td>19.9</td>
<td>22.0</td>
<td>24.1</td>
</tr>
</tbody>
</table>

Notes: Agriculture includes forestry and fishing and manufacturing includes mining. Nontradeable is other than services.

Imports and Exports

The volume of imports increased by around 130% during 1985-1991. This can be readily explained by observing the import penetration ratio which is defined as the ratio of the value of imports to total production of a particular good [Young, 1986]. This is shown in Table 6.7.

TABLE 6.7 IMPORT PENETRATION RATIO: KOREA, 1980-1989, SELECTIVE YEARS (%)

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>19.0</td>
<td>14.5</td>
<td>13.4</td>
<td>14.2</td>
<td>14.4</td>
<td>14.1</td>
</tr>
<tr>
<td>Mining</td>
<td>84.5</td>
<td>83.2</td>
<td>77.4</td>
<td>78.3</td>
<td>79.6</td>
<td>79.5</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>16.6</td>
<td>15.9</td>
<td>17.4</td>
<td>18.0</td>
<td>18.9</td>
<td>19.2</td>
</tr>
<tr>
<td>Heavy-</td>
<td>23.7</td>
<td>21.6</td>
<td>23.4</td>
<td>23.8</td>
<td>24.8</td>
<td>25.0</td>
</tr>
<tr>
<td>Light-</td>
<td>7.3</td>
<td>7.0</td>
<td>7.8</td>
<td>8.3</td>
<td>9.4</td>
<td>9.8</td>
</tr>
<tr>
<td>Service</td>
<td>3.2</td>
<td>3.1</td>
<td>2.6</td>
<td>3.4</td>
<td>3.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Average (all)</td>
<td>14.8</td>
<td>13.2</td>
<td>13.3</td>
<td>13.7</td>
<td>14.5</td>
<td>14.8</td>
</tr>
</tbody>
</table>

The average import penetration ratio increased from 13.2% in 1985 to 14.8% in 1989. Again, the manufacturing industry played a leading role in the increase in this ratio. Estimates show that the import penetration ratio grew in nearly all sectors during 1985-1989. This may provide evidence that trade liberalization has been effective.\textsuperscript{18} In terms of imports by use, raw materials steadily accounted for nearly 54% of total imports regardless of reform. This suggests that raw materials were already under low tariffs. The ratio of investment goods has increased steadily although it fell temporarily in 1989. Table 6.8 presents imports by use during 1984-1990.

Table 6.8 also shows that consumer goods (except grains) have accounted for a relatively small proportion in total imports, indicating that import restrictions have been most tight on consumer goods despite trade liberalization programs. However, their share has increased consistently from 4.7% in 1985 to 7% by 1990 as trade reform matured.

\begin{table}
\centering
\caption{Trend in Imports by Use: Korea, 1984-1990, Selective Years (\%)}
\begin{tabular}{lcccccc}
\hline
\hline
Raw materials & 57.4 & 55.9 & 54.4 & 53.8 & 53.6 & 53.8 \\
Investment goods & 33.0 & 35.5 & 35.9 & 36.8 & 36.4 & 36.5 \\
Consumer goods & 5.3 & 4.7 & 6.1 & 6.2 & 6.6 & 7.0 \\
Grains & 4.3 & 3.8 & 3.6 & 3.2 & 3.4 & 2.7 \\
\hline
\end{tabular}
\end{table}


How have exports changed during the reform periods? Tables 6.9 and 6.10 show the changing patterns of exports during the 1980s. They also confirm the role that exports have played in the industrialization process in the 1980s. Table 6.9 indicates a declining share of agricultural goods in the composition of exports and an increasing share of manufactured exports since 1985.

\textsuperscript{18}Young [1986, p. 41, Table 16] reports that the import penetration ratio (IPR) in most manufacturing industries (imports demand/total demand) in the 1980s increased, indicating that trade reform in the 1980s was substantial. He also shows that the IPR decreased during the 1970s despite the reform programs which were implemented.
### TABLE 6.9 COMPOSITION OF EXPORTS: KOREA, 1980-1989, SELECTIVE YEARS (%)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>3.5</td>
<td>2.0</td>
<td>2.1</td>
<td>1.9</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Mining</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>73.5</td>
<td>77.5</td>
<td>78.7</td>
<td>79.5</td>
<td>81.6</td>
<td>81.4</td>
</tr>
<tr>
<td>Heavy</td>
<td>38.3</td>
<td>47.5</td>
<td>48.2</td>
<td>48.2</td>
<td>48.9</td>
<td>49.4</td>
</tr>
<tr>
<td>Light</td>
<td>35.2</td>
<td>30.0</td>
<td>30.5</td>
<td>31.3</td>
<td>32.7</td>
<td>31.0</td>
</tr>
<tr>
<td>Service</td>
<td>22.7</td>
<td>20.3</td>
<td>19.1</td>
<td>18.5</td>
<td>16.6</td>
<td>16.9</td>
</tr>
<tr>
<td>All Average</td>
<td>10.2</td>
<td>13.2</td>
<td>13.3</td>
<td>13.7</td>
<td>14.7</td>
<td>14.5</td>
</tr>
</tbody>
</table>


The share of manufacturing products (heavy and light) generally increased during 1980-1989. Table 6.10 presents the export ratio by sector, defined as the ratio of the value of exports to total output. The manufacturing export rate showed an increasing trend during 1985-1989. The overall export-output ratio, on average, increased until 1988. Thus, the two tables indicate that both the share and the exports-output ratio of manufacturing exports grew during the trade reform period.

**Real Exchange Rates**

It has generally been argued that if trade reform can bring about a real depreciation, then all tradeable activities will be enhanced. It will thus lead to the expansion of exports and to the discouragement of other import-substituting sectors. The opposite exchange rate movement may worsen the current account position, and hence act to induce reversal of trade reform. Figure 6.2 represents the time series of the real exchange rate movement faced by the manufacturing industries in Korea during the reform period. It generally shows an upward trend (depreciation) during the 1980s, which is generally compatible

---

*19* Here the real exchange rate is defined as \( e_p^* / p \) where \( p^* \) is U.S. CPI index, \( p \) is Korea's CPI, and \( e \) is nominal exchange rate in terms of U.S. dollars.
with Korea's export performance during the short-run adjustment following reform (except 1989).

TABLE 6.10 SECTORAL EXPORT-OUTPUT RATIO: KOREA, 1980-1989, SELECTIVE YEARS (%)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>5.6</td>
<td>3.8</td>
<td>4.7</td>
<td>5.2</td>
<td>4.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Mining</td>
<td>5.6</td>
<td>2.8</td>
<td>3.1</td>
<td>3.7</td>
<td>3.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>19.2</td>
<td>22.5</td>
<td>24.7</td>
<td>26.6</td>
<td>27.9</td>
<td>29.5</td>
</tr>
<tr>
<td>Heavy</td>
<td>19.3</td>
<td>24.5</td>
<td>26.6</td>
<td>27.9</td>
<td>28.8</td>
<td>30.2</td>
</tr>
<tr>
<td>Light</td>
<td>19.0</td>
<td>20.0</td>
<td>22.2</td>
<td>24.9</td>
<td>25.3</td>
<td>25.1</td>
</tr>
<tr>
<td>Service</td>
<td>10.4</td>
<td>10.1</td>
<td>10.5</td>
<td>11.1</td>
<td>11.6</td>
<td>11.9</td>
</tr>
<tr>
<td>All Average</td>
<td>13.3</td>
<td>14.5</td>
<td>16.2</td>
<td>17.6</td>
<td>19.2</td>
<td>18.9</td>
</tr>
</tbody>
</table>


FIGURE 6.2 EXCHANGE RATES IN MANUFACTURING: KOREA, 1980-1990

-20  -10   0    10    20
80-82 83-85 86  87  88  89  90

real effective
nominal average

20Papageorgiou, et. al. [Volume 7, 1991] infer from the 19-country experiences that a sustained real depreciation is associated with a long survival of that reform. This inference is consistent with theoretical work of Calvo [1985], in which short-lived reform is related to the overvaluation of the real exchange rate.
Real Wages

Figure 6.3 shows percentage changes in the monthly wages of regular employees in mining and manufacturing industries during the 1980s.

![Graph showing percentage changes in wages](image)

It can be seen that the level of wages received by each sector’s employees increased continuously during the liberalization period (after 1986), amounting to an average annual rate of wage increase of around 15-20% (in terms of constant 1980 prices). Experts have argued that this hike in wages (real and nominal) in the late 1980s became one of the reasons for Korea losing export competitiveness after 1989, contributing to current account deficits during the period of 1990-1991.

Investments by Sector

In Table 6.11 the investment ratio by major sector for selected years during the reform period is represented. In most sectors, investment increased in terms of its ratio to GNP (also in absolute amount). Table 6.11 shows that the ratio for the exportable sector remained significantly high, ranging from 11-26% during 1985-1988. Within the
exportable sector, practically all manufacturing industries experienced relatively high investment rates during this period, with only a few exceptions.  

**TABLE 6.11 RATE OF INCREASE IN SECTORAL INVESTMENT RATIO: KOREA, 1984-1988 (%)**

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exportable</td>
<td>20.2</td>
<td>10.8</td>
<td>18.8</td>
<td>23.8</td>
<td>25.9</td>
</tr>
<tr>
<td>Importable</td>
<td>3.9</td>
<td>-3.8</td>
<td>10.6</td>
<td>10.1</td>
<td>10.1</td>
</tr>
<tr>
<td>Nontradeable</td>
<td>5.9</td>
<td>4.6</td>
<td>-6.7</td>
<td>9.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Average</td>
<td>10.9</td>
<td>5.0</td>
<td>12.0</td>
<td>16.5</td>
<td>13.4</td>
</tr>
</tbody>
</table>


Note: Three sectors are reclassified according to Korea’s 1987 I-O 20-sector Table. Exportables are sectors in which exports are more than imports, importables are sectors in which imports are more than exports, and nontradeables are sectors with almost no trade.

In contrast, import-competing sectors such as agriculture, forestry, fishery, processed food, and all services showed lower rates of increase in their investment (and hence capital stock) than the average of all sectors. The investment rate in the agriculture industries, on the other hand, declined during the same period, although the investment ratio in the import-competing manufacturing industries increased slightly. This is why the ratio in the overall importable sector appears steady from 1986-1988.

**Tariff Revenues**

There are also fiscal implications of tariff reform. As anticipated, the Korean experience in the 1980s indicates that as tariff rates have been reduced the share of tariff revenues in total government revenues has in general been reduced. Figure 6.4 shows that the ratio fell from 16.5% in 1987 to 10% in 1990, which implies that the second tariff reduction episode in particular has been intensive. However, as indicated in Table 1, the government budget remained in surplus during 1983-1990, indicating indirectly that there was an effective tax system reform as well. Korea’s trade reform implemented

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21 A detailed examination of data shows that the sectors that recorded especially rapid growth of investment were nonmetallic products, petroleum and coal products, iron and steel, and miscellaneous manufacturing.
during 1984-1988 did not generate any fiscal difficulties, unlike reforms in the Southern Cone countries.\footnote{For reforms in the Southern Cone countries, see the Volume 1 of Papageorgiou et al.}

![Graph showing the ratio of tariff revenue in total revenues: Korea, 1980-1990](image)

**FIGURE 6.4 RATIO OF TARIFF REVENUE IN TOTAL REVENUES: KOREA, 1980-1990**

### 6.5 Capital Account Liberalization

The capital account transactions were tightly controlled by the government until the mid-1980s. Alongside trade reform in the 1980s, Korea began to lift capital controls at a rapid pace. Controls on capital inflows such as foreign loans and foreign direct investment have been substantially relaxed, and restrictions on foreign exchange transactions, investment abroad, and purchasing foreign assets have also been reduced. The cost of foreign capital has also fallen during that period.

**Liberalization of Capital Inflows**

Until the early 1980s all inflows of foreign capital to Korea had to be approved by the Korean government. Also, foreign investment in Korea was restricted until that time. Since the mid 1980s, there has been a relaxation of controls on foreign borrowing. At the same time, there has been continuous efforts to encourage foreign investment. Foreigners have become able to invest 100\% of their own fund from 1984. As part of a substantial
revision of the Foreign Capital Inducement Act, Korea introduced a negative list system for foreign investment approvals in 1984 and has annually reduced the number of industries on the negative list since then.

As a result of these policies, 79% of all production sectors were open to foreign investment, 16% were conditionally open (restricted), and only the remaining 5% were prohibited as of 1989. Consequently, the investment liberalization ratio for all industries reached 80% in 1990 from 66% in 1984, and the ratio, in manufacturing industries, increased to 98%. The lowest is the agricultural sector which showed only a 20% investment liberalization ratio in 1990. Estimates show that the value of foreign investment increased from 122 million U.S. dollars in 1983 to 895 million U.S. dollars in 1990. By the end of 1992, the current foreign investment approval system will be converted to a notification system to further induce more foreign investment. There are, however, still various kinds of restrictions on foreign borrowing in terms of its maturity terms and the interest rate conditions of foreign loans.

**Liberalization of Capital Outflows**

In the 1960s and 1970s Korean residents' (both firms and households) holdings of foreign exchange and foreign securities were severely restricted. Any short-term capital outflow could not be made without the approval of the Central Bank or the Ministry of Finance. However, as the country's current account balance increased in the mid 1980s, the government took a series of measures to ease foreign exchange regulations. As of 1988, Korean residents had virtually no limitations on the purchasing foreign currency. Accordingly, the government has encouraged investment abroad by converting from an approval system to a notification system. Hence, Korean residents were, in principle, allowed to invest in real estate overseas in 1989. Consequently, the total value of investment abroad was increased from 37 million U.S. $ in 1984 to 183 million U.S. $

---

23 The definition of the investment liberalization ratio is analogous to ILR. It is the ratio of the number of industries under automatic approval for foreign investment to total number of industries (at a certain classification).

24 Investing in domestic bonds by foreigners has also steadily been allowed with the establishment of the Korea Fund and the Korea-Europe Fund. Detailed descriptions for the Korean security market can be found in MOF [1990].
in 1988. Along with this, investment by domestic investors in foreign bonds have steadily increased over the same period.\textsuperscript{25} As most foreign exchange transactions have been liberalized, Korea acceded to IMF Article 8 in November 1989, removing essentially all foreign exchange restrictions.\textsuperscript{26}

As most regulations on foreign exchange holdings were relaxed, the spread between the official exchange rate and the parallel market exchange rate, which was large during the period of 1970s, nearly disappeared by 1987. According to MOF [1990], this spread was reduced from 14.5\% in 1980 to 1.2\% in 1989. However, as the country's current account deficit has increased from 1990, the government reintroduced some measures of controls on foreign exchange transactions.\textsuperscript{27}

\textit{Full Scale Capital Account Liberalization: The Next Task?}

Table 6.12 shows that the interest rate differential between domestic and offshore markets turned positive with the appreciation of the Korean currency since 1987. By the same token, the real private cost of foreign capital was reduced from 1984-1988, and became negative in 1987, indicating that foreign capital was more attractive than domestic capital during 1987-1988. However, this cost has risen again since then.

Has foreign capital flowed in with the Korean currency's appreciation? No. The data shows that foreign commercial and public loans were in fact reduced at annual average rate of 21\% between 1986-1989. A cross check of Table 6.1 and 6.12 indicates that the appreciation of the Korean currency was positively related to the economy's current account surplus rather than to increases in foreign borrowing. Estimates also indicate that there was a negative correlation between the real interest rate differential and the real effective exchange rate during 1986-1988, and the relation oscillates since then [Park, 1989]. This could imply indirectly that capital inflows were still under government

\textsuperscript{25}Foreign securities firms have been allowed to establish their branches in Korea and joint securities enterprises were also allowed since 1991. Foreign firms will also be allowed to invest directly in the Korean capital market from 1993.
\textsuperscript{26}IMF Section 8 Country is a country which satisfies the following conditions on foreign exchange transactions: (i) no restrictions on foreign exchange for the current account transactions, (ii) no adoption of a multiple exchange rate system and no differential treatment on exchange, holdings, and use in foreign currencies, and (iii) purchase of SDR from non-IMF Section 8 Country.
\textsuperscript{27}Korea also adopted the exchange rate regime of a market average system in March 1990. On Korea's exchange rates policy, see Koo [1979] and Oum [1989].
control in a significant way during the mid- to late 1980s, and liberalization was not extensive.

**TABLE 6.12 REAL COST OF FOREIGN CAPITAL: KOREA, 1981-1990, SELECTIVE YEARS (%)**

<table>
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</thead>
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<tr>
<td>r(^1)</td>
<td>12.5</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>11.0</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>r*(^2)</td>
<td>13.3</td>
<td>9.7</td>
<td>6.4</td>
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<td>9.4</td>
<td>8.4</td>
<td>8.6</td>
</tr>
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<td>(\hat{e})(^3)</td>
<td>10.0</td>
<td>14.8</td>
<td>1.3</td>
<td>-6.7</td>
<td>-11.2</td>
<td>-1.1</td>
<td>5.4</td>
</tr>
<tr>
<td>(\hat{p})(^4)</td>
<td>9.8</td>
<td>3.9</td>
<td>2.7</td>
<td>3.5</td>
<td>4.2</td>
<td>5.2</td>
<td>8.9</td>
</tr>
<tr>
<td>(r - r^* - \hat{e})</td>
<td>-10.8</td>
<td>-14.5</td>
<td>2.3</td>
<td>9.3</td>
<td>12.8</td>
<td>3.7</td>
<td>-3.0</td>
</tr>
<tr>
<td>(r^* + \hat{e} - \hat{p})</td>
<td>13.5</td>
<td>20.6</td>
<td>5.0</td>
<td>-2.8</td>
<td>-6.0</td>
<td>2.1</td>
<td>5.1</td>
</tr>
<tr>
<td>RER(^5)</td>
<td>-3.2</td>
<td>4.3</td>
<td>14.6</td>
<td>0.9</td>
<td>-8.9</td>
<td>-10.3</td>
<td>3.6</td>
</tr>
<tr>
<td>Foreign loans(^6)</td>
<td>2729</td>
<td>2135</td>
<td>2500</td>
<td>2667</td>
<td>1879</td>
<td>1332</td>
<td>448</td>
</tr>
</tbody>
</table>

(1) Domestic bank lending rate, based on discounts on bills of deposit at money banks.  
(2) Foreign interest rate: ninety-day London Interbank Offered Rates (LIBOR).  
(3) Nominal exchange rate depreciation rate: annual average rate of U.S.$/won, minus figures indicates an appreciation of won.  
(4) Inflation rate: GNP deflator.  
(5) Real exchange rate: \(\hat{e}^*\) is U.S. CPI index and \(\hat{p}\) is Korea's CPI, figures for 1990 is unofficial.  
(6) Foreign loans (commercial and public loans), million U.S dollars, annual average.

### 6.6 Implications on Timing, Sequencing, and Credibility

We now summarize and draw some implications of the Korean trade reform (and capital account liberalization) implemented in the 1980s, for the issues of timing, sequencing, and credibility of reform.

(1) Unlike the earlier trade reform in the 1970s, the main focus of the two episodes of trade reform for the period of 1984-1988 and 1989-1993 has been to reorganize the tariff system and to reduce general tariff levels.

(2) The reform programs in the 1980s have been essentially based on mid- to long-term plans. There was a time lag between announcement and implementation to provide
industries with sufficient time to minimize their adjustment costs. The increase in investment ratios and the changing patterns in the composition of production in the manufacturing sector during the reform may indirectly indicate that serious adjustment costs did not arise.

(3) It is difficult to draw inferences on the sequencing of liberalization in the balance of payment accounts from Korea's experiences. In the 1970s, trade reform was conducted, but severe controls on capital and exchange transactions were maintained, especially to minimize any current account problems. In the 1980s, however, trade and the capital account were generally tackled at the same time.

(4) Korea's trade policy has evolved in a standard way that experts have urged, namely, (i) a reduction in QRs, (ii) a reduction in tariffs, and (iii) capital account liberalization. In terms of speed, Korea can be regarded as a standard example of gradual reform.

(5) The real exchange has depreciated during the liberalization period, and hence contributed to the expansion of the exportable sector.

(6) The current account deficit in 1990 and 1991 has basically stemmed from less exports and more imports. Why have imports increased so rapidly in the early stages of the second liberalization episode? One may argue that there is a credibility problem for the Korean government, although we cannot quantify this here. In particular, since the consumer import goods were restricted until the mid 1980s despite several trade reform measures, import liberalization in consumption goods may not be so credible and hence people anticipate that it will end soon. This expectation may have prompted consumers to purchase more imports, causing a worsening the current account deficit during 1990-1991. Indeed, there are growing concerns in Korea that the government will have to restrict imports and foreign exchange to defend the current account.
APPENDIX TO CHAPTER 6


<table>
<thead>
<tr>
<th>Dates</th>
<th>Policy Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 1978</td>
<td>The Import Liberalization Committees established</td>
</tr>
<tr>
<td>May 1978</td>
<td>QRs liberalized and tariffs selectively reduced</td>
</tr>
<tr>
<td>Sep 1978</td>
<td>QRs further liberalized</td>
</tr>
<tr>
<td>Jan 1979</td>
<td>QRs further reduced and average tariffs were reduced</td>
</tr>
<tr>
<td>June 1983</td>
<td>QRs and tariffs liberalization plan announced</td>
</tr>
<tr>
<td>Jan 1984</td>
<td>Tariffs (and QRs) reduced as announced</td>
</tr>
<tr>
<td>Jan 1985</td>
<td>Tariffs (and QRs) reduced as announced</td>
</tr>
<tr>
<td>June 1985</td>
<td>Further import liberalization announced</td>
</tr>
<tr>
<td>Jan 1986</td>
<td>Tariffs (and QRs) reduced as announced</td>
</tr>
<tr>
<td>Jan 1987</td>
<td>Tariffs (and QRs) reduced as announced</td>
</tr>
<tr>
<td>Jan 1989</td>
<td>Tariffs reduced as announced</td>
</tr>
<tr>
<td>Jan 1990</td>
<td>Tariffs reduced as announced</td>
</tr>
<tr>
<td>Jan 1991</td>
<td>Tariffs reduced as announced</td>
</tr>
<tr>
<td>Jan 1992-</td>
<td>Tariff reform is on going</td>
</tr>
</tbody>
</table>

MTI, *Trade Liberalization Policy in the 1980s* [1990].
CHAPTER 7

A SIMULATION ANALYSIS FOR KOREA'S TRADE REFORM USING AN INTERTEMPORAL COMPUTABLE GENERAL EQUILIBRIUM MODEL

7.1 Introduction

The analytical models in Chapters 3, 4, and 5 have discussed important issues in trade liberalization: timing and duration, sequencing, speed and credibility of reform. Some analytical analyses produced definitive results, other results were ambiguous. Moreover, even the definitive results have been based on some restrictive assumptions and caution in interpretations and policy recommendations is required. Several empirical studies suggest that the short- and long-run effects of trade reform would in practice vary from country to country, largely depending on the country's overall economic structure. Hence, in this chapter we attempt to synthesize our theoretical analyses into a numerical simulation model, and reexamine our issues in the context of the Korean trade liberalization.

A number of numerical simulation studies have been shown to be useful in producing more precise estimates of the policy shocks. In particular, a computable general equilibrium (CGE) approach has been used extensively to investigate trade policy and development issues. For example, an early CGE analysis by Boadway and Treddenick [1978] examined the effects of changes in the Canadian tariff structure. The ORANI model by Dixon, Paramenter, Sutton, and Vincent (DSVP) [1982] was developed to examine Australia's industrial policy. The Michigan CGE model by Deardorff and Stern [1986] discusses trade policy in the case of a large country whereas Clarete and Roumasset [1987] deal with trade reform in the Philippines. These CGE models are

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1See De Melo and Robinson [1982] and De Melo [1988], among others. See also Ginzburgh and Mercenier [1988] for a reconciliation between macro models and micro theory in the general equilibrium context.
essentially real and static, leaving dynamic issues out. Feltenstein [1980] introduced a monetary CGE model to examine Argentina's trade policy reform in the 1970s. Dynamic issues are also neglected in his analysis. Khan and Zahler [1983] developed a pioneering dynamic simulation model to examine the issue of sequencing and speed of external liberalization in the context of a representative Latin American economy, although the timing and duration of reform were not their main concern.

Most of these models, however, are somewhat arbitrary in that they are not based on optimizing frameworks. Recent works by Goulder and Eichen green [1989] and Eichen green and Goulder [1990] are new initiatives in the area of intertemporal computable general equilibrium models (ICGE) which incorporate optimizing characteristics. Their numerical models are basically large-country models and examine both the intertemporal (especially timing issue) and inter-industry effects of U.S. trade policy. Also, Mercenier and Sampaio De Souza [1990] develop an ICGE optimizing model to investigate the role of trade liberalization on structural adjustment in the case of Brazil.

Several studies of Korea's trade liberalization policy have also accumulated. Young [1986, 1987] investigates the patterns of industrial development and the firm-level adjustment following import liberalization programs from the late 1970s to the early 1980s. Oh and Kim [1986] and Dongkuk University [1987] also illustrate the patterns of changes in the industry production and profitability after import liberalization. A study by Lee, Kim, and Park [1988] is also in a similar line. Kim's [1991] country study as part of the World Bank project examines the impacts of trade liberalization programs in Korea during the 1960 and 1970s. It also tries to provide inferences on the timing and sequencing of the two episodes of Korea's trade liberalization programs which were conducted in 1965-67 and 1978-1979. Lee and Ahn's [1989] work seems to be the only

---

2See also Clements [1980].
3See also Goulder and Summers [1989] for an application of an ICGE model to U.S. tax policy.
4The Dongkuk University study also surveys 207 firms in terms of 311 liberalized manufacturing goods (CCCN 8-digit level) during 1983-1984. The survey results suggest that there are positive relationships between import liberalization and firm's competitiveness, technology, and quality of products.
5Recent problems and tasks of Korea's trade liberalization policy are well illustrated in Young [1990].
micro-founded controlled numerical study. It sets up a 31-sector CGE model, examining the employment and output effects of Korea's tariff reduction policy in the late 1980s. Their model is the usual static CGE model, and therefore neither intertemporal aspects nor the issues of timing, sequencing, and speed could be raised and examined.

The simulation model we establish here is a fully optimizing intertemporal, disaggregated computable general equilibrium model of Korea's trade. It is shown to be especially useful for examining the dynamic effects of tariffs in the transition and the long-run. The model disaggregates Korea's production into three broad sectors, allowing us to analyze the intersectoral effects of different policy initiatives over time. Furthermore, in contrast with other simulation models, our model here is essentially micro-founded and can capture the dynamic connections between tariff reform, saving, investment, and hence the current account. It also demonstrates how capital controls interact with the current account. By applying several realistic parameters to the model, the simulation results produce estimates of the effects of tariff reform, and allow policy suggestions to be made in a definitive way.

A number of results emerge. For a selected range of parameter values, both permanent and temporary tariff cuts are shown to generate trade deficits. The trade deficit is reduced over time as a permanent tariff reduction causes the real exchange rate for commercial transactions to rise over time, contributing to the expansion of the exportable industry in the longer-term. In a temporary tariff cut, intertemporal consumption substitution and wealth effects are reinforcing although wealth effects are small, whereas in the permanent tariff cut wealth effects are prominent and intertemporal substitution is smaller since tariff cuts are made in every period. Both types of reform generate intertemporal welfare gains, but a permanent reform produces a greater improvement in welfare. As predicted in the theoretical chapters, a shorter duration of temporary reform induces more consumption substitution towards the initial period, but wealth effects are correspondingly smaller as the reform ends shortly. Also, the timing of reform is crucial to determining both the

---

6 The model is based on an earlier paper which deals with a two-period CGE framework [Kim, 1991a].
degree of any jump and the subsequent adjustment paths in the forward-looking variables at the time of implementation.

The simulation findings for the speed of reform are mostly as expected. We observe that the initial response is much more pronounced in the case of a one-shot tariff reduction, and therefore the transitional adjustment paths are less smooth. By contrast, when the tariff reduction is gradually implemented over several periods, the initial movement is relatively less sharp. This implies that the shocked variables return to their original level more smoothly over time. A large trade deficit is observed following the abrupt tariff cut. Interestingly, the cumulative effect on the current account does not differ much for the two policy initiatives. It is also shown that the importable industry experiences a serious output loss (and loss of employment) in the short-run following an abrupt reform.

Trade reform under a free capital regime is also simulated. Under a dual rate, a trade deficit occurs with the appreciation of the financial exchange rate, while it is the quantity of foreign asset that adjusts in a free capital regime. We observe that the loss of foreign reserves is larger when trade reform occurs after the capital account has been liberalized. The responses in relative prices, consumption, investment and output are larger under a capital control regime. Also, the welfare gain is shown to be larger under the capital control regime, although the trade balance is lower. Our analysis of Korea's trade reform thus supports the standard sequencing of the external sector reform – current account first. Finally, Korea's actual pre-announced five-year tariff cut plan is projected with the assumption of two scenarios: credible or incredible. The dynamics of critical variables are essentially analogous with those of a permanent versus a temporary reform. Korea's welfare gain will be substantial if the announced tariff cut plan is implemented without cancellation, and conversely.

The rest of this chapter is organized as follows: Section 2 provides the simulation model structure in a nontechnical manner, and then Section 3 presents the solution of the model. Section 4 describes the sources of data, parameterization, and the calibration procedure. Sections 5 conducts a set of hypothetical simulation experiments and offers
their results. The short- and long-run effects of Korea's actual tariff reform during 1989-1993 are predicted in Section 6. Sensitivity analyses are carried out in Section 7. Finally, Section 8 concludes. Mathematical derivations for the model equations, a summary of model equations, model variables, model parameters and coefficients are all contained in the Appendix.

7.2 The Simulation Model

Overview

In this section we present an illustrative overview of the simulation model. The model considered is an integration of the theoretical models in the previous chapters. It is a fully optimizing monetary model of an intertemporal general equilibrium. It disaggregates the production sector into three sectors: exportable, importable, and nontradeable industries. We assume that the domestically produced and imported goods used in the tradeable sectors are not perfectly substitutable. Thus, there are five goods in each period: domestically-produced good in each tradeable sector, imported good in each tradeable sector, and the nontradeable good.

Several features of the model are worth mentioning. First, it integrates the forward-looking consumer's saving and consumption decision. Both goods consumption and asset demands are specified as an outcome of the explicit intertemporal optimization problem, and thus the consumption plan takes account of not only the present, but also the future with perfect foresight. Second, the model provides a minimal framework that is capable of representing capital controls. As adopted in Chapter 3, a dual exchange rate regime is specified to formulate a capital control regime, and this control generates a wedge between the exchange rates applied for current and capital account transactions.

Appendix 7.1 provides technical derivations of the model in detail. Kim (1991a) also differentiates domestic production from the production of exports.
Trade reform under this dual rate regime will be compared with reform under a single unified regime where the quantity of foreign asset is allowed to adjust over time.9

Third, firms are also assumed to be intertemporally optimizing agents which are not only concerned with current profits but future profitability as well. The firm's investment decision balances the costs of new capital against the higher future output made possible by the accumulated capital stock. In a free capital regime, firms can also borrow internationally. Hence, in the case of free capital mobility the economy's net holdings of foreign assets change over time through changes in the private sector's asset demand, and this is reflected in changes in the capital account. In the capital control regime, on the other hand, changes in foreign reserves just reflects the current account. We now examine each sector in detail.

**Households**

A representative household is assumed to be infinitely lived which is the entire period of the model. The household is forward-looking with perfect foresight. Given the nature of preferences, the consumer's optimization problem can be considered as solving a multi-level decision problem. First, given the intertemporal budget constraint, the consumers decide how to allocate their wealth by choosing paths of consumption and real money holdings in order to maximize lifetime utility. The intertemporal utility function we adopt is in constant elasticity of substitution form. The consumer's objective is to maximize

\[
\text{(1a)} \quad \int_0^\infty \frac{1}{1 - \sigma} \left[ c_t^{\sigma h_t^{1 - \sigma}} \right] e^{-\theta t} dt
\]

subject to the flow and stock constraints:

\[
\text{(1b)} \quad a_t = \sum_{j=1}^n (W_i L_{ij} + Q_{ij}) + r^* B_t + \gamma b_t - \pi h_t - c_t
\]

9 If the authorities impose a tax on capital flows, allowing quantities to be market determined, then the capital account is endogenously determined by the optimizing agent, and the tax rate is an exogenous policy instrument. Note that if there is certainty, the two cases are theoretically equivalent like the equivalence of tariffs and quota in the context of a commercial policy.
where $j$ is an industry notation. $WL$ is wage income and $Q$ is profit income (distributed), and other notations are the same as in Chapter 3. The numeraire is the commercial exchange rate. The initial and transversality conditions can be imposed in the same way as in Chapter 3.

Second, consumers decide how to distribute each period's optimal expenditure across the three composite goods. We assume that the overall consumption ($c_t$) in each period is a Cobb-Douglas aggregate of three composite consumption goods ($c_j$), implying that consumption spending is allocated across consumption goods in fixed expenditure shares. Each composite traded good is then a CES composite of domestically produced and imported goods. Households choose the optimal mix of domestic and imported goods to minimize the unit expenditure of traded composite of type $j$. The consumption of imported good $j$ is subject to a tariff rate $\tau_j$. Table 7.1 illustrates the structure of the household's consumption decision.

\begin{table}[h]
\centering
\begin{tabular}{l l}
\hline
Consumption Structure & Functional Form \\
\hline
$u = u(u_1, u_2, \ldots, u_k)$ & CES \\
$u_t = u_t(c_t, h_t)$ & Cobb-Douglas \\
$c_t = c_t(c_{i1}, c_{i2}, \ldots, c_{in})$ & Cobb-Douglas \\
$c_{ij} = c_{ij}(c_{ij}^{M}, c_{ij}^{M})$ & CES \\
\hline
\end{tabular}
\caption{Household Consumption Structure}
\end{table}

**Producer**

For each industry, a multi-level production technology governs the production of each industry's output. Firms choose the quantity of labour that maximizes current profits, for a given stock of fixed capital. Labour and capital combine to produce the value-added composite. This composite is then combined with intermediate inputs in fixed proportions.
to generate a single output. Tradeable intermediate inputs can be purchased both at home and abroad, and firms choose the mix of domestically produced and imported inputs of the traded goods in accordance with their cost minimization.

Both value-added and intermediate input functions take the CES form. By imposing this particular functional form, we can effectively exclude the substitutability between value-added and intermediate inputs. Capital and labour in the value-added function, and domestic and foreign inputs in the intermediates function, respectively, however, are assumed to be substitutable with each other. This production structure is summarized in Table 7.2.

Industry outputs are also used as investment goods in creating industry capital stocks. The technology for creating the capital stock is analogous to the usual firm's cost minimization problem. That is, at a given level of investment in each industry, each industry chooses a cost-minimizing mix of domestically produced and imported inputs of the traded goods for capital creation.

### TABLE 7.2 INDUSTRY PRODUCTION STRUCTURE

<table>
<thead>
<tr>
<th>Production Structure</th>
<th>Functional Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_t = Y_t(V_t, Z_{11}, Z_{12}, \ldots, Z_{tn})$</td>
<td>Leontief</td>
</tr>
<tr>
<td>$V_t = V_t(L_t, K_t)$</td>
<td>CES</td>
</tr>
<tr>
<td>$z_{ij} = z_{ij}(z_{i1}, z_{ij})$</td>
<td>CES</td>
</tr>
</tbody>
</table>

The representative firm's problem is to maximize the present value of net lifetime profit (or cash flows) by choosing levels of employment, intermediate inputs in each period, and investment level independently in the current period. That is,

---

10Ahn [1991] calculates the Allen's partial elasticity of substitution between labour and aggregated imported intermediate input, and capital and aggregated imported intermediate inputs, on the basis of nonlinear three stage least square estimates using quarterly average data from 1972-1987. They are 0.06 and 0.09, respectively, implying that they are nearly not substitutable with each other.
where $\Pi_{jt}$ is profit, $\chi_{jt}$ is gross investment expenditure, $I_{jt}$ is quantity of investment, $K_{jt}$ is capital stock, and $\delta_{j}$ is the rate of depreciation, all in industry $j$ at time $t$. Dividends in each period are related through the cash-flow identity equating sources and uses of funds:

$$\Pi_{jt} + D_{jt} = Q_{jt} + \chi_{jt} + rD_{jt}$$

where $D_{jt}$ is foreign borrowing, $rD_{jt}$ is interest payments, and $Q_{jt}$ is profit distributed to the households in industry $j$. We assume that $Q_{jt}$ is paid out at a fixed ratio of total earnings at $t$. Firm $j$'s $\Pi$ in each period is given by

$$\Pi_{jt} = p_{jt}Y_{jt} - W_{jt}L_{jt} - \sum_{i=1}^{n} (p_{it}Z_{ijt}^{II} + p_{it}^{M}Z_{ijt}^{M})$$

where $Y_{jt} = f_{t}[V_{jt}(K_{jt}, L_{jt}), Z_{ijt}(Z_{ijt}^{II}, Z_{ijt}^{M})]$, $V_{jt}$ is the value-added function, $K_{jt}$ and $L_{jt}$ are inputs of capital and labour used in industry $j$, $Z_{ijt}^{II}$ and $Z_{ijt}^{M}$ are home-produced and imported intermediate input $t$ used in industry $j$, respectively, $Z_{ijt}$ is their composite, $p_{jt}$ is the price of output $j$, $W_{jt}$ is the wage rate, $p_{it}^{II}$ and $p_{it}^{M}$ are the prices of intermediate inputs $t$ by sources.

Investment expenditure is the sum of the direct costs of the new capital plus adjustment costs associated with its installation:\[11\]

$$\chi_{jt} = p_{kjt}I_{jt} + p_{jt}\phi_{jt}(I_{jt}/K_{jt})I_{jt}$$

where $p_{kjt}$ is the price of investment good $j$ and $\phi_{jt}(I_{jt})$ is the adjustment cost function.

The adjustment cost function is adopted from Goulder and Eichengreen [1989, p. 14]:

\[11\] The unit adjustment cost function follows from from $\phi_{jt} = \phi_{jt}(I_{jt}, K_{jt})$, where $\phi_{jt}$ is assumed to exhibit constant returns to scale.
(6) \[ \phi_{jt}(I_{jt}/K_{jt}) = \frac{\beta/2[(I_{jt}/K_{jt}) - \zeta]}{I_{jt}/K_{jt}} \]

where \( \beta \) is the adjustment cost parameter and \( \zeta \) is a scalar. As shown in Appendix 7.1, solving the firm's optimization problem generates the optimal investment function:

(7) \[ \frac{I_{jt}}{K_{jt}} = \frac{\lambda_{jt} - p_{jit}}{p_{jt}} + \zeta \]

where \( \lambda_{jt} \) is the shadow price of capital in industry \( j \). Equation (4) produces the optimal \( L_{jt}(\cdot) \), \( Z_{jt}^{M}(\cdot) \), \( Z_{jt}^{M}(\cdot) \) at given \( K_{jt} \), and from which the optimal \( \Pi_{jt}(\cdot) \) can be obtained. Also, we can derive the optimal \( X_{jt}(\cdot) \) from (5)-(7). Given the fixed ratio of dividend paid-out, (3) will generate the expression for the optimal borrowing.

**Government**

The government is assumed to consume domestically-produced goods. It receives various taxes (including import duties) from the private sector, and also provides a lump-sum transfer to households. Hence, the lump-sum payments adjust to balance the government budget when tariff revenues fall following trade reform.

The government's budget constraint in period \( t \) can be written as

(8) \[ \sum_{i=1}^{n} (p_{it}^G G_{it}^{H}) + T_{t} = \sum_{i=1}^{n-1} \tau_{it} p_{it}^M D_{it}^M + O_{t} \]

where \( \sum_{i=1}^{n-1} \tau_{it} p_{it}^M D_{it}^M \) is tariff revenue, with \( D_{it}^M = c_{it}^M + Z_{it}^M + I_{it}^M \), \( O_{t} \) is other taxes, and \( T_{t} \) is lump-sum transfers. The trade balance is just the change in foreign reserves under the capital control regime:

(9a) \[ \dot{R}_{t} = \sum_{i=1}^{n-1} (p_{it}^G D_{it}^X - p_{it}^M D_{it}^M) \]

12According to the I-O table, the Korean government does not consume imports.
However, in a free capital-mobility regime, changes in foreign reserves represent the overall balance of payments position:

\[
\hat{R}_t = \sum_{i=1}^{n-1} (p^X_i D^X_i - p^M_i D^M_i) + \hat{D}_t - \hat{B}_t
\]

The integration of the three agents' budget constraints provides the fundamental economy-wide intertemporal budget constraint which equates the net present value of private plus public consumption with the net present value of income.

**Exports**

Foreign demand for Korea's export $j$ is specified as a simple function:

\[
D^X_{jt} = (p^X_{jt})^{-\eta_j}
\]

where $D^X_{jt}$ is the demand for export $j$, $p^X_{jt}$ is the world price of export $j$, and $\eta_j$ is the price elasticity of foreign demand for $j$. The world price of import $j$ is assumed to be fixed and tariff rates determines the domestic price of imports (given the commercial exchange rate).

**Welfare**

Our welfare measure is an intertemporal version of equivalent variation (EV). The EV measures utility levels in monetary units (referred to as a money metric of utility, see Cornes [1988]) by associating utility level with an amount of income required to attain that utility level at new prices. Intra-temporal equivalent variation is measured by

\[
EV_t = (-1/2) \sum_{j=1}^{n-1} S_{jj} \bar{t}_{ij} \bar{r}_{ij}
\]

where $S_{jj}$ is the compensated elasticity of demand $j$ evaluated at the original utility and price levels, and it is assumed that the cross price elasticity of demand between good $t$ and $j$ is zero. To obtain this approximation equation, see Boadway and Bruce [1984, pp.

We can not observe $S_{jj}$, but it is possible to utilize estimated demand functions to infer the properties of the Hicksian demand function, and therefore to obtain approximate measures of EV. See Hausman [1981] for more exact measures of EV. For the simulation, in addition to observed prices and quantities, we need to know $S_{jj}$. This can be approximated using the Slutsky decomposition equation where the Marshallian price and income elasticities can be obtained by econometric estimation. Intertemporal welfare measures can be obtained by calculating each period’s EV and discounting future EVs to the present at the consumer’s discount rate. That is,

$$LEV = \sum_{t=1}^{k} (d^t EV_t)$$

where LEV is a lifetime equivalent variation and $d$ is the nominal discount rate $(1/(1+p))$. 

7.3 Solving the Model

Atemporal and Intertemporal Equilibrium

Equilibrium must satisfy two sets of conditions. First, atemporal equilibrium requires that, given expectations of future variables, current supplies and demands balance in each period. That is, at each period, (i) the demand for labour equals supply, (ii) the demand for output of the nontradeable industry equals its supply, (iii) domestic saving plus foreign borrowing must equal investment expenditure, (iv) money supply equals money demand, and (v) government revenues equal government spending (government consumption plus transfers). These requirements imply a total of 5 equilibrium conditions: one labour market, one nontraded goods market, one money market, one

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13 Basically, our expenditure function will be in the form of $E(p, r, u)$ where $r$ is the nominal interest rate and $u$ is utility, and $\partial E/\partial r$ yields the Hicksian money demand function by Shepard’s Lemma. We start from the definition of EV by using our expenditure function, and using a Taylor series expansion (second-order approximation) to obtain (11a). On expenditure functions which incorporate real balances, see Dixit and Norman [pp. 197-204, 1980] and Fane [1987].

14 Note that this condition is only applied to a free capital mobility regime. In the capital control regime, there are no capital flows internationally, so that the current account balance is just the change in foreign reserves.
foreign bond market (only in the free capital mobility case), and one government budget balance. Hence, it will be sufficient to solve for 4 equilibrium conditions as the remaining one will then be satisfied by Walras's Law.

Second, intertemporal equilibrium requires that expectations conform to the values realized in later periods. Since we adopt the assumption of "perfect foresight" the private agents can predict any course of the economy without errors.15

**Numerical Solution**16

To solve the model numerically, we need to obtain explicit numerical paths for the dynamic variables. The dynamic variables in our model are $\lambda_j$, $K_j$, $A$, $\gamma$, $H$, and $R$, i.e., the variables which constitute differential equations ($\lambda_j$ are the shadow price of capital in sector $j$ and $A$ is the shadow price of wealth). Once these are solved, the paths of other variables can be calculated readily by applying relevant equations from the model. This implies that finding a numerical solution to the model boils down to solving the model's systems of equations of motion. These are represented by a set of simultaneous differential equations, so solving them requires some form of numerical integration. As long as the initial values of these dynamic variables are known, the solution is equivalent to solving an "initial value problem". If the initial values are not known (e.g., $\lambda_j$ and $A$), then the steady-state requirements (transversality condition) can be imposed in the terminal period, and hence the system is uniquely determined.17 However, when the boundary conditions are scattered among several points in time, the system is called a "multiple-point boundary value problem", and to solve it requires special numerical methods.18

---

15 Other assumptions about expectations formation can be used. One compelling reason for assuming "perfect foresight" is that forming expectations any other way means agents would be systematically and repeatedly wrong about the future.

16 This sub-section partly draws on Wilcoxen [1989].

17 For a wide range of numerical solution methods for the dynamic system, see Press, Flannery, Teukolsky and Vetterling [1986].

18 A number of methods of solving two-point boundary problems are illustrated in Press, et al. [1986], Lipton, Poterba, Sachs and Summers [1982], and Fair and Taylor [1983]. For an excellent summary, see Wilcoxen [1989].
In our simulation model, we adopt a "finite difference method". This is a natural choice for use with general equilibrium models that employ Johansen's linearization method. The method is well documented in Wilcoxen [1989], Codsi, Pearson, and Wilcoxen [1991], and Pearson [1991]. Here, we describe the method by taking a simple example. Consider the capital accumulation condition, \( \dot{K} = 1 - \delta K \). First, we expand this function, \( \dot{K} \), using Taylor series expansion around a particular time \( t \) for an adjacent time \( t+h \), and dropping higher order terms, which yields \( \dot{K} = \frac{K(t+h) - K(t)}{h} \), and hence we have

\[
(12) \quad \frac{K(t+h) - K(t)}{h} = 1 - \delta K
\]

This would not be an accurate approximation of the original equation unless \( h \) is fairly small. Therefore, secondly, we use a series of expressions like (12), each holding over successive intervals of time. If the total period were 100 years, for example, \( h \) could be broken up into two intervals of fifty years each, and hence one equation like (12) could link years 0 to 50, while another connected years 50 to 100. In this fashion, the solution can be made arbitrarily accurate by using a sufficiently small step size \( h \). Eventually, the original differential equation will have been replaced by a system of difference equations which link values of \( K(\cdot) \) at different points in time. Solving this system simultaneously yields the entire path of the capital stock. Hence, our whole model is linearized about an equilibrium dynamic trajectory, not about a single equilibrium point.

Overall, this finite difference method is versatile, robust to numerical instability, fairly easy to implement and extremely fast to solve. We employ a GEMPACK program which has recently been redesigned for the elimination of the static linearization errors by

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19 Note that \( h \) can be a variable, depending on the grid spacing. In Appendix 7.4, dyr(t) stands for \( h(t) \), i.e., step sizes can vary over time.

20 The dates at which these points are placed are often called a "grid".

21 Wilcoxen [1989] shows that either increasing the total number of grid point or moving grid points from the regions where the dynamic variables will be changing very slowly to periods where the variables are changing rapidly, reduces the truncation error.
conducting a multi-step (Euler) simulation through extrapolation method. In the simulation, we adopt 21 variable grid points for a period of over 80 years. Thus, it would not be appropriate to read \( K_t \) as a value of variable \( K \) at time \( t \). Instead, \( K_t \) is the value of \( K \) at grid point number \( t \), and the actual time of grid point \( t \) is determined by the step size between grid points. If the step size between grid points is always one then \( K_t \) may be read as the value of variable \( K \) at date \( t \).

7.4 Data and Parameters: Calibration

**Baseline Data**

Unlike a static model, an intertemporal model requires complete intertemporal base case values for the entire period of concern. Construction of this base case from observable historic data is problematic, since most of the years in the dynamic simulation lie in the future, and there will always be some that are not observable. Normally the only one that could possibly be observed is the first period's data. Thus, if we assume that the economy is in a steady-state equilibrium in the initial period, then the entire baseline can be inferred by replication of the initial period's data. Then, along this steady-state baseline, the economy's relative price structure would remain unchanged. The systems of differential equations are all set to zero to obtain the steady-state solution values. If we do not make the assumption of steady-state in the initial period, then a full nonlinear solution of the system is necessary.

We adopt this steady-state approach. However, in general historically observable data does not perfectly coincide with the steady-state requirements. Therefore, we construct the first period's data to possess steady-state properties and then the entire base case is obtained by replicating this initial period's values. A large part of data is drawn

\[ \text{22 On the solution procedure for multi-step simulation, see Pearson [1991] and Codsi, Pearson, and Wilcoxen [1991], and for Richardson's extrapolation see Birkhoff and Rota [1977].} \]

\[ \text{23 Most intertemporal simulation models have taken the steady-state approach. For a revised baseline approach, see Eichengreen and Goulder [1990], and for a calibration variable approach see Horridge [1990] and Malakellis [1991].} \]

\[ \text{24 Growth rate can either be taken as some exogenous labour force growth rate (scalar) or simply as zero. In either case, the relative price structure is not changed along the steady-state path.} \]
from the Bank of Korea's 1986 input-output table. Its 402-sector industry classification is aggregated into our three sector model, exportable, importable, and nontraded goods industries. Table 7.3 shows an industry classification, while Table 7.4 presents industry characteristics.

**TABLE 7.3 INDUSTRY CLASSIFICATION**

<table>
<thead>
<tr>
<th>Industry</th>
<th>I-O 402-Sector Classification Number</th>
</tr>
</thead>
</table>

We then combine information from different sources to form a 1986 benchmark data set. The depreciation rate of each industry's capital stock is obtained from Financial Statements Analysis, and this rate is used to calculate the capital stock by using \( K = 0 \) and the marginal value for capital by setting \( \lambda = 0 \).

**TABLE 7.4 INDUSTRY CHARACTERISTICS**

<table>
<thead>
<tr>
<th></th>
<th>Exportables</th>
<th>Importables</th>
<th>Nontradeables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export intensity</td>
<td>0.238</td>
<td>0.031</td>
<td>0.000</td>
</tr>
<tr>
<td>Import substitution</td>
<td>0.106</td>
<td>0.256</td>
<td>0.000</td>
</tr>
<tr>
<td>Imported intermediate demand ratio</td>
<td>0.172</td>
<td>0.259</td>
<td>0.000</td>
</tr>
<tr>
<td>Imported investment good ratio</td>
<td>0.150</td>
<td>0.505</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note. Export intensity: exports \( j / \text{total output } j \)
Import substitution: imports \( j / \text{total demand } j \)
Imported intermediate ratio: imported intermediate \( j / \text{total intermediate } j \)
Imported investment ratio: imported investment good \( j / \text{total investment good } j \)

25 Note that the classification of a three-sector industry is subjective and there is no universal way to do so. Also the problem of reclassification arises since today's importable sector could be an exportable sector tomorrow. Our criterion is represented in Table 7.4.
The Korean I-O table does not distinguish the adjustment costs part in total investment expenditure, and so it is calculated by adopting Goulder and Eichengreen's [1989] adjustment costs parameters. Also, the I-O table does not provide the input-output matrices for investment goods (both domestic and imported). We thus construct this by assuming that the input-output ratios for investment goods are the same as the ones for intermediate goods. Selective benchmark values for the industries are presented in Table 7.5. Other baseline values such as the money stock and foreign reserve holding are obtained from National Accounts [1990]. Table 7.6 presents these values. Although a few adjustments have been made to maintain the consistency between sources of data, we consider that our constructed baseline values are a reasonably close approximation to the actual 1986 data set. The entire baseline is then obtained by replication of this set. It is this steady-state baseline which serves as a reference path for measuring the effects of subsequent policy shocks. With perfect foresight the private sector would behave optimally from the moment of policy shocks, and hence the economic outcomes subsequent to a policy change will deviate from this baseline path. These deviations are what we will investigate in the simulations.

<table>
<thead>
<tr>
<th>TABLE 7.5 BASECASE VALUES FOR INDUSTRY BEHAVIOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depletion rate</td>
</tr>
<tr>
<td>Capital stock</td>
</tr>
<tr>
<td>Investment expenditure</td>
</tr>
<tr>
<td>Replacement costs</td>
</tr>
<tr>
<td>Adjustment costs</td>
</tr>
<tr>
<td>Tobin's q</td>
</tr>
<tr>
<td>Debt</td>
</tr>
</tbody>
</table>

Note. Values other than percentages are expressed in billion Korean won [1986].
Parameters

The percentage change form of the linearized model equations allows us to obtain most of the model parameters from the benchmark input-output tables. Certain parameters, however, are selected from outside sources. As mentioned, some parameter values are calculated to satisfy the steady-state properties of the basecase. Korean estimates of the elasticity of substitution between domestic and import goods, elasticity of substitution between primary factors, and the foreign price elasticity of demand for exports, are utilized. Where Korean estimates are not available, foreign estimates are employed. What follows are the parameters we employ in the simulations (see Table 7.7).

(1) A lower value for the Armington elasticity of substitution is chosen in the case of the importable industry, whereas for the exportable industry we take a relatively higher value. Both the extreme deficiency of Korea's agricultural and mineral endowment and the relatively high trade barriers in the import-competing industries justify these lower elasticities of substitution.26

(2) Substantial evidence from time-series estimation of the elasticity of substitution between capital and labour suggests that the elasticity of substitution between primary

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26 Existing estimates on the Armington elasticity of substitution ($\sigma$) vary. In ORANI (DSVP, 1982), $\sigma$ for the exportable sector ranges from 0.5-6.8 (from 2-12 industry classification) and $\sigma$ for the importable sector ranges from 0.0-5.0 in 21-sector classification. Also, in Deardorff and Stern (1986), its range varies from 1.0-4.0 in 11-sector classification (exportable) and varies from 0.1 to 3.5 in 15-sector classification (importable). Lee and Ahn (1989) uses 1.0-4.0 for their 11-sector exportable industry and 0.1-3.5 for 15-sector importable industry. Because of practical difficulties, we do not distinguish the elasticity estimates by end-use, intermediate use, and use for capital creation.
factors in most of the industries is around 0.5, whereas the estimate obtained from the cross section data is around unity. Our value is chosen at 0.5.

(3) Although the model employs a small country assumption, it doesn't seem to be reasonable to assume that the elasticity of foreign demand for Korea's exports is infinitely elastic if we consider the weighted shares of Korean exports in the world market. Nam (1988) estimated the foreign price elasticity of exports using time-series data from 1970 through 1986. This estimate is 3.5, which is applied in the simulation for all tradeable industry goods.

(4) The Slutsky decomposed price and income effects are obtained from Wang (1986) and Kim and Byron (1988).

(5) Existing studies indicate that a lower estimate of the intertemporal elasticity of substitution is obtained from cross section data, and higher values from time-series data. In this simulation, the intertemporal elasticity of substitution is taken as 0.5.

<table>
<thead>
<tr>
<th>TABLE 7.7 BASIC PARAMETERS AND ELASTICITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters and Elastisities</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Subjective discount rate</td>
</tr>
<tr>
<td>Intertemporal elasticity of substitution</td>
</tr>
<tr>
<td>Armington elasticity of substitution</td>
</tr>
<tr>
<td>Price elasticity of exports</td>
</tr>
<tr>
<td>Elasticity of substitution between capital and labour</td>
</tr>
<tr>
<td>World interest rate</td>
</tr>
<tr>
<td>Marginal budget share</td>
</tr>
<tr>
<td>Slutsky Price Effect</td>
</tr>
</tbody>
</table>

Note. ex, im, and non stand for exportables, importables, and nontradeables.

27 Kim (1984)'s estimates for the Korean manufacturing industry are also around unity. Ahn (1991)'s aggregated estimates using quarterly time series data during 1972-1987 show a very low elasticity figure between primary factors, 0.125. In ORANI, a 0.5 of elasticity is utilized in the simulation, whereas in the Michigan model the values are much larger, varying from 1.33 in the 9-sector exportable industry to 1.8 in the 16-sector importable industry, and 1.62 is chosen for 5-sector nontraded goods industry.

(6) The subjective rate of discount (\( \varphi \)) is chosen such that \( \varphi < \rho \), and therefore the shadow price of wealth declines over time (see (A3) in Appendix). A discrepancy between the subjective discount rate and the real interest rate determines whether the consumption profile is steeper or smooth.\(^{29}\)

Finally, all these elasticities and parameters are summarized in Table 7.7, and a sensitivity analysis will be conducted on them in a later section.

7.5 Simulation Results\(^{30}\)

Three broad categories of simulation experiments are carried out: (1) permanent vs temporary tariff reduction, (2) gradual vs abrupt tariff reduction, and (3) tariff reduction with and without capital controls. Timing and duration issues are examined in the first set of simulations and speed and sequencing issues are inferred from the second and third sets of simulations, respectively.

Timing of Tariff Reduction: Permanent vs Temporary

**Permanent Tariff Reduction:** We impose a permanent reduction of 10% tariffs uniformly in all tradeable sectors in the first period of the base line. Note that capital controls in the form of a dual exchange rate system is in effect.

As examined in the theoretical chapters, a reduction of tariffs generates the following effects through which domestic consumption, saving, investment, output, trade balance and welfare are influenced over time: (i) intratemporal substitution between foreign and domestic goods responding to the (tariff-induced) change in their relative prices, (ii) intertemporal expenditure substitution via changes in the consumption rate of real interest, and (iii) wealth effect. The magnitude of the intratemporal substitution effect depends largely upon the Armington elasticities of substitution between imports and domestic

---

\(^{29}\)Note that a higher value of \( \rho \) at a given \( \varphi \) implies that \( \Lambda \) declines at a faster rate, which represents a higher saving (a steeper consumption schedule) over time.

\(^{30}\)The result reported here have been obtained using the general-purpose economic modelling software GEMPACK which calls the Harwell sparse matrix routines MA28. See Pearson [1988], Codsi and Pearson [1988], and Duff [1977].
goods, whereas the degree of expenditure switching over time is dependent upon the intertemporal elasticity of substitution parameter.

Table 7.8 presents the main results for these experiments. For a given intertemporal elasticity parameter value \(0 < \sigma < 1\), a permanent tariff reduction has little impact on the intertemporal allocation of resources (through intertemporal substitution effects) since it would not alter the consumption-based time preference substantially, except in the period that tariffs are unexpectedly reduced. On the other hand, intratemporal expenditure substitution towards both foreign goods in the tradeable industries and towards the nontradeable industry goods occurs since the relative price of imports has fallen. Also, changes in this relative price leads to a transfer of resources towards the production of both exportable and nontradeable goods. Consequently, an excess supply of home goods is created, which causes a decline in the price of home goods and the overall price index.

Significant changes occur over time. The real exchange rate, defined as the world price of imports relative to the price index for the domestic goods, rises. The nation's exports rise, but imports rise more in the short-run, and therefore a trade deficit occurs following trade reform. In this capital control regime, this deficit is manifested in a reduction of consumer's money balances, which is equal to the loss of foreign reserves. The private sector's portfolio composition between domestic money and foreign assets cannot be quantitatively adjusted and so no change occurs in the capital account. Consequently, the financial exchange rate must fall to regain the asset composition equilibrium. The real interest rate, which is defined as the sum of the world interest rate and the rate of change in the financial rate, rises, and this is consistent with a contraction of real balances. However, the trade deficit decreases over time as the rate of increase in exports exceeds that in imports, caused by the expansion of the exportable industry. This suggests that permanent trade liberalization does not necessarily generate a permanent trade deficit if it can improve the export performance.

31 No intertemporal substitution would occur if the expenditure share of each good in overall expenditure and the expenditure share of import good \(j\) in composite expenditure on \(j\) are both constant over time.

32 Other definitions of the real exchange rate can also be calculated in a straightforward way.

33 Other simulation studies provide qualitatively similar result. See, for example, Eichengreen and Goulder [1990].
### TABLE 7.8 PERMANENT VS TEMPORARY TARIFF REDUCTION

<table>
<thead>
<tr>
<th></th>
<th>Permanent</th>
<th></th>
<th></th>
<th>Temporary</th>
<th></th>
<th></th>
</tr>
</thead>
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<tr>
<td></td>
<td>1 (shock)</td>
<td>6</td>
<td>20</td>
<td>1 (shock)</td>
<td>6</td>
<td>20</td>
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<tr>
<td><strong>Aggregate Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Price index</td>
<td>-0.075</td>
<td>-0.095</td>
<td>-0.192</td>
<td>-0.089</td>
<td>0.053</td>
<td>-0.002</td>
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<tr>
<td>Consumption</td>
<td>0.502</td>
<td>0.470</td>
<td>0.146</td>
<td>0.466</td>
<td>0.182</td>
<td>-0.002</td>
</tr>
<tr>
<td>Consumption rate of real interest</td>
<td>0.075</td>
<td>0.003</td>
<td>0.004</td>
<td>0.089</td>
<td>-0.161</td>
<td>-0.000</td>
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<tr>
<td>Commercial real exchange rate</td>
<td>0.045</td>
<td>0.065</td>
<td>0.186</td>
<td>0.059</td>
<td>-0.057</td>
<td>0.002</td>
</tr>
<tr>
<td>Financial exchange rate</td>
<td>-0.041</td>
<td>-0.058</td>
<td>1.190</td>
<td>-0.061</td>
<td>2.260</td>
<td>-0.023</td>
</tr>
<tr>
<td>Wage rate</td>
<td>0.392</td>
<td>0.301</td>
<td>0.173</td>
<td>0.353</td>
<td>0.188</td>
<td>0.004</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>0.721</td>
<td>0.759</td>
<td>-0.641</td>
<td>0.670</td>
<td>-2.905</td>
<td>0.031</td>
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<tr>
<td>Trade balance</td>
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<td>-321.476</td>
<td>-205.857</td>
<td>-318.902</td>
<td>-7.890</td>
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<tr>
<td></td>
<td>0.131</td>
<td>0.173</td>
<td>0.032</td>
<td>0.162</td>
<td>-0.125</td>
<td>0.005</td>
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<tr>
<td></td>
<td>1.144</td>
<td>1.143</td>
<td>1.047</td>
<td>1.122</td>
<td>0.099</td>
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<td>Welfare</td>
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<td></td>
<td></td>
<td>0.465</td>
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<td><strong>Industry Effects</strong></td>
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<td>Output</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
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<td>0.033</td>
<td>0.358</td>
<td>0.029</td>
<td>-0.056</td>
<td>0.007</td>
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<tr>
<td>Importable</td>
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<td>-0.048</td>
<td>-0.309</td>
<td>-0.070</td>
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<td>0.001</td>
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<td>Nontradeable</td>
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<td>0.265</td>
<td>0.160</td>
<td>0.226</td>
<td>0.074</td>
<td>0.006</td>
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<tr>
<td>GROSS</td>
<td>0.007</td>
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<td>0.074</td>
<td>0.001</td>
<td>0.013</td>
<td>0.005</td>
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<td>Profit</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
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<td>0.272</td>
<td>0.024</td>
<td>-0.067</td>
<td>0.001</td>
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<tr>
<td>Importable</td>
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<td>-0.076</td>
<td>-0.389</td>
<td>-0.082</td>
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<td>Nontradeable</td>
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<td>0.179</td>
<td>0.093</td>
<td>0.155</td>
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</tr>
<tr>
<td>GROSS</td>
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<td>-0.018</td>
<td>-0.022</td>
<td>-0.017</td>
<td>-0.001</td>
<td>-0.000</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
<td>0.095</td>
<td>0.159</td>
<td>0.507</td>
<td>0.088</td>
<td>0.034</td>
<td>0.013</td>
</tr>
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<td>0.192</td>
<td>0.102</td>
<td>0.017</td>
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<td>0.094</td>
<td>0.243</td>
<td>0.043</td>
<td>0.019</td>
<td>0.007</td>
</tr>
<tr>
<td>GROSS</td>
<td>0.162</td>
<td>0.232</td>
<td>0.442</td>
<td>0.132</td>
<td>0.063</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Note. 1. All figures express percentage changes from the base case value, except the trade balance which is in changes from the base line path in 1986 Korean billion won.
2. Real commercial exchange rate: world price index of imports / price index for domestic goods.
The expansion of the exportable industry is noticeable in the lower part of Table 7.8. A relatively higher price of exports to imports leads to increased switching of resources towards the production of exportable goods (and nontraded goods) over time. More labour is demanded in the exportable industry, which causes the wage rate to increase. The profitability of the exportable sector increases over time. However, the overall profitability in the economy is shown to fall as profits in the importable industry decrease over time substantially. Investment rises via two channels. First, a higher (lower) profitability in the exportable (importable) industry raise (reduces) the marginal value for capital in that industry, and second, lower tariffs on imported investment goods directly contribute to the increase in investment in all industries. In the simulation, we observe that investment in all industries has increased, indicating that the direct effect of lower import prices offsets the indirect effects on industry earnings. This is an interesting result since it reveals a high dependency on imported investment goods in Korean industry, including in the import-competitive industry. In sum, a permanent tariff reduction contributes to the expansion of the exportable industry over time, whereas the importable industry shrinks over time. The nontraded sector also benefits as the demand for these goods is stimulated by a rise in income. The trade balance deteriorates in the short-run, but improves in the long-run.

The welfare effects are approximated by the intertemporal equivalent variation measures (IEV) [Boadway and Bruce, 1984]. It is shown that the permanent tariff reduction increases a representative Korean's lifetime welfare by 1.2%. What this means is that the individual's discounted lifetime utility improves by an amount equivalent to a net income return to consumers which is equal to 1.2% of its total discounted lifetime income, evaluated at 1986 pre-reform prices.

Temporary Tariff Reduction: In the second experiment, we employ a temporary 10% uniform tariff cut. This is done by assuming that tariffs are reduced immediately in the

---

34 Hence, theoretically, the overall effect on investment in the importable industry is ambiguous. This point was examined in Chapter 4.
current period, but raised again in the sixth period. This temporary shock is unanticipated, but agents are perfectly aware of the temporary nature of the reform. Atemporal behaviours of critical variables can be explained analogously with the permanent cut case, but the time paths of the two cases are distinguishable. Our interpretations are first focus on the initial responses, and then we explain the adjustment paths in the period when temporary reform ends. We refer again to Table 7.8.

During the periods when both types of tariff reform are in effect, the initial magnitude of the responses largely depends on the intertemporal substitution effect and wealth effects. The intertemporal substitution effect is larger in the case of a temporary tariff reduction as is revealed by a larger rise in the consumption rate of real interest in the initial period. This induces the temporary tariff cut experiment to produce a larger initial response in consumption, as we analyzed in Chapter 3. However, wealth effects are relatively larger in the case of a permanent tariff reduction where income rises in every period, and therefore a higher income must be allocated to consumption across periods. Hence, the wealth effects of a permanent tariff reduction on current consumption are greater than those of a temporary cut. This is because the increase in income only occurs in the early period in temporary reform, but consumers will spread this extra income over their lifetimes, so that the current saving must increase. Consumption rises much less at the margin than the rise in income in the temporary cut case. When we consider both effects, the overall result is ambiguous analytically.

In our simulation experiment, most price variables initially respond more in the temporary reform case whereas a large initial consumption gain is observed in the permanent reform case, indicating greater wealth effects. On the industry side, output responses are larger initially when the reform is temporary whereas the investment responses are larger in the permanent reduction case. This partly refers to the adjustment costs. Although investment goods are relatively cheaper in the periods when the temporary reform is in effect, we must also consider the adjustment costs. The firm's investment is made according to the schedule that equates the marginal cost of investment with the shadow price of capital. Since the firms are assumed not to accumulate imported
investment goods as inventory, there is no intertemporal substitution in the industry side (see Chapter 4). This higher initial consumption and investment in the permanent reform case generates a larger initial trade deficit following the permanent tariff cut.

When tariffs return to their higher levels, reverse movement of variables are prominent. The consumption rate of real interest falls sharply, the real commercial exchange rate appreciates, the real interest rate falls, and the real financial rate starts to depreciate. Accordingly, individual's money demand rises, consumption falls sharply, and the rise in both exports and imports is moderated and exports even fall under the baseline. As a result the trade deficit almost vanishes in that period and switches to a surplus from then on. The individual's intertemporal welfare is much higher in the permanent reform case. For the intersectoral effects, output, profit and investment also show similar adjustment patterns when tariffs are reimposed. Only the capital stocks adjust smoothly over time towards their baseline values, reflecting the adjustment costs. All quantities ultimately approach their baseline levels around fifteen periods after temporary trade reform is abandoned. In this case, a temporary policy has no permanent effects.

**Degree of Temporariness:** One of the factors which determines the dynamic path under a temporary tariff reform is its duration and timing. To see this, we introduce an extreme temporary policy, i.e., a temporary tariff reduction in period 1 which is abandoned immediately in the next period. We then compare the time paths of variables from this experiment with the ones reported in the temporary policy above. Figure 7.1 shows a comparison of time paths for selective variables.

The essential nature of the comparison is very similar to that of the comparison of permanent reform with temporary reform in the sense that permanent reform may be regarded as the longest temporary reform. The behaviour of the crucial variables in response to reform can therefore be explained analogously. As the temporary policy becomes less temporary, the rise in the consumption rate of interest rate is relatively larger and the fall in the price index is also larger. For consumption, wealth effects dominate over the intertemporal substitution effects, and hence the consumption gain is larger as the duration of temporary reform becomes longer. Also, the investment increase
is shown to be larger initially when the reform is expected to survive relatively longer. Consequently, the size of the trade deficit is relatively greater as the temporary tariff reduction policy is maintained relatively longer. Also, the reverse jump of these variables can similarly be explained as before.

The initial welfare gain appears to be smallest in the extreme temporary policy case which partly indicates the intertemporal distortion created by the temporariness of trade liberalization. The lifetime welfare gain is larger the later the temporary reform ends. As the duration of temporary reform grows longer, and approaches a permanent reform, the intertemporal welfare gain is maximized. On the industry side, when the trade reform is maintained longest, the exportable industry gains most while the import-competing sector loses most in terms of output. The initial investment level in the importable industry is highest when the duration of the temporary policy is shortened. This is a sort of resource-dampening effect of temporary trade liberalization. These results are as predicted in the theoretical chapters.

**Altered Timing:** We also perform an experiment which introduces a permanent tariff reduction later, i.e., a tariff cut in the third period with the announcement in the current period. This experiment reveals the different dynamic responses between an immediate implementation of reform and implementation after announcement.

As we have emphasized in the theoretical analyses, the crucial difference between these two timing assumptions lies in the adjustment paths of the forward-looking variables, particularly between the announcement and implementation dates. When the tariff reduction is implemented immediately, a forward-looking variable, such as the shadow price of wealth, jumps down immediately to a new saddle path in that period (first period), and then approaches over time its new steady-state equilibrium value. The consumption change also occurs in this manner but in an opposite direction. However, if the tariff reduction is implemented after the announcement, the response of the shadow price of wealth in the present period is in the same direction, but the jump is quantitatively less simply because actual tariffs still remain high at the time of announcement.
Between announcement and implementation, the marginal value for wealth (and other forward-looking variables) evolves with the original differential equations. Consequently, at the time of implementation, the shadow price of wealth falls more and
then starts to rise towards the new steady-state equilibrium. There is no jump (discontinuity) in these forward-looking variables when tariffs are actually reduced.\textsuperscript{35} These comparisons are shown in Figure 7.2. The behaviour of the shadow price of capital and investment (and capital stock) can be interpreted analogously. Investment follows the path of the marginal value for capital, jumping upward at the announcement and then rising steadily toward the new stationary equilibrium. The capital stock is also shown to rise with the higher investment, and steadily increase even at the instant of implementation. There is no jump in the capital stock. After implementation, it continues to grow at a slower rate toward the new steady-state.

\textit{Gradual vs One-Shot Reform: Speed}

We now turn to the issue of the speed of reform: gradual vs one-shot reform. A one-shot tariff reduction in our simulation means a 10\% reduction of all tariffs permanently from the first period. A gradual tariff reduction, on the other hand, is assumed to be a permanent reduction of tariffs which takes place gradually over five periods, at a rate of 2\% in each period starting from period 1 and continuing to period 5. The comparison of the two experiments is given in Table 7.9.

Since there is essentially no qualitative difference in the behaviour of the critical variables following the tariff cut, we again focus on the principle difference which lies in the intensity of their responses at different dates. The adjustment paths during the transition are distinguishable under the two experiments. What we expect is that the effects of a "shock" type policy will result in more pronounced movements of variables in the initial periods with less smooth transitional paths. This pattern of adjustment is evident in our experiments.

For example, the fall in the price index is greater and the rise in consumption and trade deficits are both greater in the initial period following the abrupt tariff cut.\textsuperscript{36} Also, investment and output are observed to respond sharply in the initial period.

\textsuperscript{35}See Chapter 4.

\textsuperscript{36}Note that the results show that the cumulative current account deficit is virtually the same regardless of the speed of reform.
At the same time, it appears that these variables start to return toward their original value earlier, rendering the adjustment steeper. On the other hand, when the tariff reduction is conducted in a gradual way, the initial responses are smaller, and for some variables are negligible. It is shown that exports even slightly fall initially (by $-0.06\%$).
although they gradually rise later. Following the one-shot reform, a contraction of the importable industry is also evident in the earlier period as resources move to the other sectors, particularly to the exportable sector, prominently and immediately. Labour demand falls sharply in the importable industry. Although the overall employment level is not altered due to the assumption of the model, the importable sector initially experiences a costly adjustment following a one-shot reform. This is evidence that the abrupt reform can bring about substantial adjustment costs in the short-run [Mussa, 1986].

However, the one-shot reform produces a large welfare gain in the initial period, although in subsequent periods the gain is smaller, unlike the case of gradual reform where a relatively smaller welfare gain is spread over several periods. It is interesting to see that intertemporal welfare gain is greater when tariffs are reduced in an abrupt fashion.

This may be because in the case of one-shot reform, the benefit in the current period (period 1) offsets a loss in subsequent periods, resulting in a relatively larger improvement in the lifetime welfare. This presents obvious trade-offs between welfare and the trade balance. Our experiments suggest that gradualism may be preferred since it spreads a deterioration in the trade account over several periods, but at the same time it does delay the welfare gain into the future. The later the welfare gain occurs, the smaller its discounted present value, making the lifetime welfare gain relatively smaller. Therefore, in terms of its welfare-improving effects, a one-shot tariff cut is shown to be preferable. As an indication, Figure 7.3 shows the adjustment paths of trade balance between these two experiments.

**Tariff Reduction with and without Capital Controls: Sequencing**

The above sets of tariff cut experiments have been conducted under the assumption of capital controls in the form of a dual exchange rate.

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37 Since our model assumes a Ricardo-Viner type of industry-specific capital, capital does not move across the sectors. A useful extension of the present analysis is to assume that capital is quasi-fixed (in Mussa's [1978] term), i.e., it is locked to the original sector in the short-run but can freely shift between industries in the long-run.
TABLE 7.9 ONE-SHOT VS GRADUAL TARIFF REDUCTION

<table>
<thead>
<tr>
<th></th>
<th>One-Shot 1 (shock)</th>
<th>One-Shot 10</th>
<th>One-Shot 20</th>
<th>Gradual 1 (shock)</th>
<th>Gradual 10</th>
<th>Gradual 20</th>
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</thead>
<tbody>
<tr>
<td><strong>Aggregate Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price index</td>
<td>-0.075</td>
<td>-0.104</td>
<td>-0.192</td>
<td>-0.017</td>
<td>-0.100</td>
<td>-0.191</td>
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<tr>
<td>Consumption</td>
<td>0.502</td>
<td>0.456</td>
<td>0.145</td>
<td>0.204</td>
<td>0.459</td>
<td>0.146</td>
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<tr>
<td>Consumption rate of real interest</td>
<td>0.075</td>
<td>0.002</td>
<td>0.004</td>
<td>0.017</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
<td>Commercial real exchange rate</td>
<td>0.045</td>
<td>0.071</td>
<td>0.170</td>
<td>0.004</td>
<td>0.070</td>
<td>0.186</td>
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<td>Financial exchange rate</td>
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<td>0.186</td>
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<td>0.171</td>
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<tr>
<td>Real interest rate</td>
<td>0.721</td>
<td>0.750</td>
<td>-0.641</td>
<td>0.293</td>
<td>0.813</td>
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<td>Exports</td>
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<td>0.284</td>
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<td>1.047</td>
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</tbody>
</table>

**Industry Effects**

<table>
<thead>
<tr>
<th></th>
<th>Exportable</th>
<th>Importable</th>
<th>Nontradeable</th>
<th>GROSS</th>
<th>Exportable</th>
<th>Importable</th>
<th>Nontradeable</th>
<th>GROSS</th>
<th>Exportable</th>
<th>Importable</th>
<th>Nontradeable</th>
<th>GROSS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Profit</strong></td>
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<td></td>
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<tr>
<td>Exportable</td>
<td>0.001</td>
<td>0.026</td>
<td>0.272</td>
<td></td>
<td>-0.049</td>
<td>0.021</td>
<td>0.147</td>
<td></td>
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</tr>
<tr>
<td>Importable</td>
<td>-0.056</td>
<td>-0.092</td>
<td>-0.389</td>
<td></td>
<td>0.047</td>
<td>0.035</td>
<td>-0.240</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nontradeable</td>
<td>0.170</td>
<td>0.186</td>
<td>0.093</td>
<td></td>
<td>0.083</td>
<td>0.270</td>
<td>0.241</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROSS</td>
<td>-0.016</td>
<td>-0.019</td>
<td>-0.022</td>
<td></td>
<td>-0.003</td>
<td>-0.019</td>
<td>-0.021</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
<td>0.095</td>
<td>0.196</td>
<td>0.507</td>
<td></td>
<td>0.033</td>
<td>0.181</td>
<td>0.501</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importable</td>
<td>0.222</td>
<td>0.385</td>
<td>0.428</td>
<td></td>
<td>0.090</td>
<td>0.355</td>
<td>0.421</td>
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<tr>
<td>Nontradeable</td>
<td>0.057</td>
<td>0.116</td>
<td>0.243</td>
<td></td>
<td>0.034</td>
<td>0.108</td>
<td>0.240</td>
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<tr>
<td>GROSS</td>
<td>0.149</td>
<td>0.275</td>
<td>0.463</td>
<td></td>
<td>0.058</td>
<td>0.254</td>
<td>0.457</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note. One-shot cut: 10% removal of tariffs uniformly and permanently in period 1. Gradual cut: 2% reduction of tariffs (uniform and permanent) from period 1 to period 5.
We now experiment with the case where tariff reform occurs after capital controls have been lifted, i.e., a dual exchange rate regime has already been collapsed to a single fixed exchange regime through a capital account liberalization. We assume that tariff reform (by 10%) is permanent and uniformly applied to all industries, and it occurs in the first period.

The new explanation we require in this experiment concerns the response of the capital account. From the industry side, foreign borrowing may take place to meet the increased investment expenditure. From the consumer's side, the asset portfolio can now be diversified internationally. Any portfolio disequilibrium is corrected by means of a swap of domestic money balances for foreign bonds. Thus, the current account is no longer identified as the change in money balances. Instead, the current account is equal to the net accumulation of foreign claims (net private assets plus foreign reserves). We report the simulation results with a particular emphasis on these new features.

Table 7.10 presents the results. As tariff rates fall, the overall price index falls and the money demand falls, which is qualitatively the same response under both capital-mobility regimes. However, the price index is shown to fall less in a single unified exchange rate regime. In the unified regime, instead of no adjustment in the price of foreign bonds, the quantity demand for foreign bonds rises at the given wealth stock. The central bank

---

38 This implies that consumers can borrow internationally to finance their consumption whereas firms can purchase foreign bonds.
experiences a greater reserve loss which stems from the increased demand for foreign bonds. Thus, the fall in the money supply (and demand) is larger in the free capital mobility case than in the case of capital controls. Also, the consumption gain is larger in the free mobility case. Since the lower price of imported investment goods (as well as domestic investment goods) reduces total investment expenditure, firms (except those in nontradeable goods industry) are shown to save rather than to borrow, which contributes to capital outflows.

As examined in Chapter 3, in the dual exchange regime the instantaneous appreciation of the financial exchange rate substitutes partially for the needed quantity adjustment achieved via the current account, whereas in the unified regime the quantity adjustment is manifested in the capital account. Figure 7.4 compares the loss of reserves (and the price index) in both regimes.

Thus, we have found that a loss in foreign reserves occurs in both regimes following the permanent tariff liberalization, but this loss is shown to be larger in the free capital mobility case and correspondingly smaller in the controlled case.

On the industry side, the effects on output, earnings, and investment are shown to be relatively smaller in a unified exchange rate regime, corresponding to a weak response in price variables in that system. The welfare improvement is shown to be slightly larger in the capital control case. This is mainly because the consumption gain is relatively higher and real balances are relatively higher in a dual exchange rate regime. Therefore, based on our model specification and the Korean data, trade liberalization before the capital account has been liberalized generates relatively less foreign reserve losses with a higher welfare improvement, vindicating the conventional arguments for the sequencing of external reform—i.e., trade account first.\(^{39}\) This more or less conforms to our analytical analysis in the earlier chapters.

\(^{39}\)Note, however, if capital account liberalization generates welfare gain, this gain may be larger with trade controls than without trade controls. To analyze this, we need a different framework which is able to examine the timing of capital account liberalization.
<table>
<thead>
<tr>
<th></th>
<th>With Capital Control</th>
<th>Without Capital Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 (shock) 10 20</td>
<td>0 (shock) 10 20</td>
</tr>
<tr>
<td><strong>Aggregate Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price index</td>
<td>-0.075 -0.104 -0.192</td>
<td>-0.059 -0.102 -0.096</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.502 0.456 0.146</td>
<td>0.110 0.097 0.086</td>
</tr>
<tr>
<td>Consumption rate of real interest</td>
<td>0.075 0.002 0.004</td>
<td>0.069 0.001 0.000</td>
</tr>
<tr>
<td>Commercial real exchange rate</td>
<td>0.045 0.070 0.179</td>
<td>0.034 0.067 0.132</td>
</tr>
<tr>
<td>Financial exchange rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital account</td>
<td>-0.041 -0.066 1.190</td>
<td>0.000 0.000 0.000</td>
</tr>
<tr>
<td>Exports</td>
<td>0.131 0.193 0.432</td>
<td>0.098 0.146 0.354</td>
</tr>
<tr>
<td>Imports</td>
<td>1.144 1.144 1.047</td>
<td>1.107 1.156 1.007</td>
</tr>
<tr>
<td>Welfare</td>
<td>1.210</td>
<td>1.006</td>
</tr>
<tr>
<td><strong>Industry Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
<td>0.007 0.054 0.358</td>
<td>0.005 0.045</td>
</tr>
<tr>
<td>Importable</td>
<td>-0.044 -0.050 -0.309</td>
<td>-0.034 -0.040 -0.165</td>
</tr>
<tr>
<td>Nontradable</td>
<td>0.248 0.278 0.160</td>
<td>0.252 0.298 0.186</td>
</tr>
<tr>
<td>GROSS</td>
<td>0.007 0.033 0.074</td>
<td>0.005 0.028 0.069</td>
</tr>
<tr>
<td>Profit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
<td>0.001 0.026 0.272</td>
<td>0.000 0.021 0.147</td>
</tr>
<tr>
<td>Importable</td>
<td>-0.056 -0.092 -0.389</td>
<td>-0.036 -0.075 -0.240</td>
</tr>
<tr>
<td>Nontradable</td>
<td>0.170 0.186 0.093</td>
<td>0.193 0.213 0.143</td>
</tr>
<tr>
<td>GROSS</td>
<td>-0.016 -0.019 -0.022</td>
<td>-0.011 -0.013 -0.015</td>
</tr>
<tr>
<td>Investment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exportable</td>
<td>0.095 0.196 0.507</td>
<td>0.081 0.181 0.501</td>
</tr>
<tr>
<td>Importable</td>
<td>0.222 0.385 0.428</td>
<td>0.161 0.305 0.391</td>
</tr>
<tr>
<td>Nontradable</td>
<td>0.057 0.116 0.243</td>
<td>0.034 0.108 0.240</td>
</tr>
<tr>
<td>GROSS</td>
<td>0.162 0.275 0.442</td>
<td>0.142 0.254 0.429</td>
</tr>
</tbody>
</table>

Note. 1. Both shocks are permanent from period 1.
2. Capital account and foreign reserves are expressed as 1986 Korean billion won.
Other Experiments

Our model is also useful for examining the dynamics of trade reform when other supplementary policies are conducted simultaneously. Changes in fiscal policy, devaluation, monetary policy, and movement to a unified floating exchange rate can be investigated. Also, changes in the external terms of trade caused by changes in imported input prices or the world interest rate can also be examined. For example, trade reform with a lower world interest rate produces an additional welfare gain of 0.31% compared with reform under the baseline world interest rate. Also, it is shown that trade reform with a government spending increase creates larger trade deficits, suggesting that stabilization may be important prior to liberalization. These are not reported here.

7.6 Predictions of Korea's Tariff Reform, 1989-1993

As illustrated in Chapter 6, Korea has been implementing a substantial tariff reform program from 1989. In this section, we predict the transitional and long-run effects of that program under two assumptions: (i) if it is believed to be implemented as announced, and (ii) if it is not believed to be implemented as announced. We call the former scenario "credible" reform whereas the latter is considered as "incredible" reform.
The first task is to calculate the tariff reduction schedule according to our 3-sector input-output data since the announced schedule (presented in Chapter 6) is based on the HS classification.\textsuperscript{40} We adopt the calculation procedure of Lee and Ahn [1989] for the I-O classified legal tariff rates.\textsuperscript{41} The I-O based tariff reduction schedule for our 2 tradeable-industry case is presented in Table 7.11, and the percentage change of these nonuniform tariffs (as pre-announced by the government) is employed as a shock in the simulations of this section.\textsuperscript{42}

\textbf{If Credible or If Not Credible}

We assume that Korea's five-year tariff reduction schedule is implemented precisely (and permanently) as announced for the credible case while for the incredible case we assume that the plan is implemented as announced for the first two periods but after that tariffs are raised again to their original levels.\textsuperscript{43}

\begin{table}
\centering
\begin{tabular}{lcccccc}
\hline
\hline
Exportables & 15.82 & 10.90 & 9.72 & 8.35 & 6.88 & 5.81 \\
Importables & 12.60 & 9.76 & 8.33 & 6.81 & 5.32 & 3.60 \\
\hline
\end{tabular}
\caption{Tariff Reduction Schedule: Korea, 1988-1993}
\end{table}

We report and compare selective results from both experiments in Table 7.12. As expected, and as reflected historically, the credible reform generates a substantial current account deficit in the short-run, although it is predicted that this deficit is reduced over

\textsuperscript{40} See footnote (10) in Chapter 6 for the classification of goods.

\textsuperscript{41} The basic calculation procedure is: (i) match HS with I-O tables, (ii) use a connection table of CCCN-HS, (iii) cross match CCCN-I0 and HS-I0, (iv) calculate an average tariff rate by industry (of our concern), by weighting the tariff rates of sub-goods within the industry by their import volume in 1986.

\textsuperscript{42} Note, however, we observe that the I-O based tariff rates calculated in general underestimate the true actual rates since tariff revenues (in I-O table) are the net of tariff revenue return to the industry whose imports were used for the production of exports. Since our shock is based on the percentage reduction of tariff rates, we employ these lower rates for the basecase tariff rates.

\textsuperscript{43} The "incredible" reform case is only a scenario, but it may be interesting to predict the effects of this experiment since the current account deficit in 1991 (third year of 1989-1993 reform) reached more than U.S. $10 billion, and as of March 1992, the current account deficit has already exceeded U.S. $3.1 billion (unofficial). There have been increasing debates in Korea between protectionists and liberalizers.
time as exports start to exceed imports partly caused by a relatively higher increase in investment and the capital stock in the exportable industry.

TABLE 7.12 PREDICTIONS OF KOREA'S TARIFF REFORM, 1989-1993
(TWO SCENARIOS: CREDIBLE AND INCREDIBLE CASES)

<table>
<thead>
<tr>
<th>period</th>
<th>If Credible</th>
<th>If Not Credible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Price index</td>
<td>-0.283</td>
<td>-0.223</td>
</tr>
<tr>
<td>Consumption</td>
<td>1.121</td>
<td>1.202</td>
</tr>
<tr>
<td>Investment</td>
<td>0.351</td>
<td>0.712</td>
</tr>
<tr>
<td>Trade Balance</td>
<td>-894.879</td>
<td>-645.539</td>
</tr>
<tr>
<td>Exports</td>
<td>0.591</td>
<td>0.304</td>
</tr>
<tr>
<td>Imports</td>
<td>3.313</td>
<td>2.267</td>
</tr>
<tr>
<td>Wage rate</td>
<td>0.787</td>
<td>1.079</td>
</tr>
<tr>
<td>Output</td>
<td>0.002</td>
<td>0.081</td>
</tr>
<tr>
<td>Welfare</td>
<td>2.875</td>
<td></td>
</tr>
</tbody>
</table>

Note. Both scenarios are permanent reform.

The table also shows the sources of the increase in imports following the tariff cut, and indicates that the share of imported intermediate inputs for production as well as for capital creation is large. The increase in consumption of imports is relatively smaller. Nevertheless, the nation's intertemporal welfare improves substantially due to a rise in lifetime income.

On the other hand, if the reform schedule is not implemented according to the announcement, the trade deficit caused by the tariff cut appears to be relatively smaller after the cancellation date. The welfare gain is also relatively smaller in this incredible policy scenario. Overall, the effects of these nonuniform tariff cut cases (credible vs incredible) are qualitatively analogous those in the permanent vs temporary tariff cut experiment.

7.7 Sensitivity Exercise
The above simulation exercises, based on particular assumptions on the parameters of the model, have offered a number of interesting and plausible responses. Selecting certain other combinations of parameter values might have produced counterintuitive results within the same model. Since the values of these chosen parameters are not known with precision, one should be very cautious in interpreting the results. Here, we present some sensitivity tests of the parametrization assumptions.

We have simulated the dual exchange rate model for the case of a permanent tariff cut by employing alternative parameter values. We have taken three sets of alternative assumptions on parametrization: lower and higher intertemporal elasticities of substitution, lower and higher elasticities of substitution between domestic and foreign goods, and lower and higher adjustment cost parameters. For the lower cases, the central values are halved and for the higher cases the values are doubled.

The higher intertemporal elasticity of substitution implies that the consumers put more weight on the future consumption (current savings), and hence put less weight on the current consumption. This is borne out by Table 7.13.44

<table>
<thead>
<tr>
<th>TABLE 7.13 SENSITIVITY ANALYSIS: PERMANENT TARIFF CASE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Central case</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>High</td>
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<tr>
<td>Low</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>High</td>
</tr>
</tbody>
</table>

Note. Central Case: $\sigma = 0.6$, $s = 3.5$ for exportable and 0.5 for importable, and $\beta = 19.6$. The values for a central case are doubled for a higher case, and halved for a lower case simulation.

44In Table 7.13, period 1 may represent the short-run and period 20 for the long-run, although the new steady-state is achieved some periods later.
The overall consumption in the earlier periods is smaller at higher intertemporal elasticities of substitution, and so is the demand for money. Exports are higher, imports are smaller, and hence the trade balance is higher (smaller deficit) in the present period. Current investment is also shown to be higher with higher intertemporal substitution.

Larger Armington elasticities imply that demands are more price elastic intratemporarily, which in turn indicates larger intratemporal relative price effects. This can cause larger responses in output, income and the trade balance. As expected, the intratemporal relative price of imports to domestic goods is higher when the Armington elasticity of substitution is higher. This implies that the expenditure switching effect of the relative price change is greater when the elasticity is high. It is obvious that the trade deficit worsens as this elasticity becomes larger. If the elasticities of substitution between domestic and foreign goods are very low, the trade balance turns into surplus in the current period. This is because the lower price of intermediate imports enhances the production of exports by the increase in the relative price of export to domestic goods, which is greater than the smaller increase of imports associated with the lower values of elasticities.

Higher adjustment costs are associated with a relatively lower rate of increase in investment. The marginal value for capital rises less when the adjustment costs are high, and the profitability of the exportable (and nontraded) industry increases less. Hence, the overall revenue rises less. As a consequence, the consumer's lifetime income rises at a much slower pace. At the same time, the rise in overall investment is smaller relative to the rise in saving, resulting in smaller deficits in the trade account.

7.8 Conclusion

Three broad issues are reexamined in this simulation study using the Korean data: timing, sequencing, and speed and credibility of trade liberalization. The model used was
an intertemporal optimizing general equilibrium model of the Korean economy. We can summarize the simulation results as follows.

(1) Both temporary and permanent tariff reductions worsen the trade balance, particularly in the short-run. A temporary tariff reform has a larger short-run impact on the consumption-based real interest rate, while a permanent tariff reform has both larger initial and long-run welfare effects. Both policy initiatives increase output in the exportable and nontraded goods industries and contract the import-competing industry. The Tobin's q in all industries initially increases following the tariff reduction, generating a higher rate of capital accumulation for the economy. Also, a higher rate of capital accumulation is correspondingly accompanied by a deterioration of trade balance, at least in the short-run.

(2) The timing and duration of reform are shown to be crucial to determining the economy's dynamic responses at different dates. The longer the temporary policy is maintained, the higher the welfare gain generated, although the trade balance is initially lowered. The consumption rate of real interest responds more as the temporary reform is shorter, although consumption and welfare improvements are higher in the initial period when the reform policy survives longer, indicating a larger wealth effect. The announcement effects are also shown. The forward-looking variables are shown to jump in the current period by the announcement but by less than the jump in the immediate implementation case. The result also shows a smooth movement of variables at the actual implementation date, suggesting the desirability of the announced reform for a more smooth adjustment over time.

(3) The effects of gradual and abrupt tariff reductions are qualitatively similar, except for the adjustments in the short-run transition. An abrupt reduction is shown to reap the full benefits of opening-up in the current period. However, a deterioration in the trade account balance is also prominent in this period. Hence, the transition is less smooth in a one-shot type policy since the variables return to their original levels sharply. We have observed that the importable industry generates substantial output losses. Gradualism
may be preferred as it can spread the negative trade balance effects over several periods, whereas a one-shot policy may be preferable in terms of its welfare-improving aspects.

(4) Two scenarios for Korea's announced trade reform were predicted. If it is credible, and hence implemented as announced, then the nation's welfare will be improved substantially. At the same time, large short-run trade deficits are anticipated. In the long-run, however, these trade deficits will be switched into surpluses as the exportable industry expands. Conversely, if the plan is cancelled and is not carried out as announced, an intertemporal consumption distortion is evident. Therefore, our scenarios suggest that reform must be credible. If not, and if the intertemporal substitution effects offset the income effects, there is nothing to gain from an incredible reform, and it may be worse than no-reform at all, as indicated in the theoretical chapters.
7.1 Derivation of Model Equations

Consumers

maximize \( \frac{1}{\delta} \frac{1}{1 - \sigma} \left[ c_t^\eta h_t^{1-\alpha} \right]^{1-\sigma} e^{\gamma_t} \) \( dt \)

subject to \( \dot{a}_t = p_t y_t + r^* B_t + \gamma_t b_t - \pi h_t - p_t c_t \)

\( a_t = h_t + b_t \)

The Hamiltonian is given by

\( H = \frac{1}{1 - \sigma} \left[ c_t^\eta h_t^{1-\alpha} \right]^{1-\sigma} + \Lambda_t (y_t + r^* B_t + \gamma_t b_t - \pi h_t - c_t) + \Lambda_t (a_t - h_t - b_t) \)

The first order conditions are

(A1) \( \frac{\alpha}{c_t} (c_t^\eta h_t^{1-\alpha})^{1-\sigma} = \Lambda_t p_t \)

(A2) \( \frac{1 - \alpha}{h_t} (c_t^\eta h_t^{1-\alpha})^{1-\sigma} = \Lambda_t r_t \)

(A3) \( \dot{\Lambda}_t = \Lambda_t (\phi - \rho_t) \)

where \( p_t = \frac{(\dot{y}_t + r^*)}{\gamma_t} \) which yield (A4), and \( r_t = \pi + \rho_t \). In the steady state, \( \Lambda_t = \tilde{\Lambda} e^{(\phi - \rho)!} \)

where \( \tilde{\Lambda} \) and \( \tilde{\rho} \) represent corresponding steady-state values. Next, the two budget constraints generate (A5):

(A4) \( \dot{\gamma}_t = \gamma_t \rho_t - r^* \)
where \( t = 1, 2, \ldots, k; \quad t = 1, 2, \ldots, n-1 \) (traded goods), \( t = n \) (nontraded good), and \( u_t(\cdot) \), \( c_t(\cdot) \) and \( c_m(\cdot) \) may be regarded as subutilities. In order to obtain five demand functions in each period, we may set up a 2-stage maximization problem:

Stage 1: 

\[
\min \{ p_t c_t^{II} + p_t c_t^{IM} \} \quad \text{subject to} \quad c_t(c_t^{II}, c_t^{IM}) \geq 1
\]

where \( c_t = (c_t^{II} + c_t^{IM})^{\frac{1}{2}} \), then from the usual optimization process we can obtain the demand function for home and imported traded good \( t \):

(A6) \[
c_t^{II} = \frac{p_t c_t}{p_t^{II} s_t + p_t^{IM} s_t}
\]

(A7) \[
c_t^{IM} = \frac{p_t c_t}{p_t^{IM} s_t + p_t^{II} s_t}
\]

where \( s_t \) is the elasticity of substitution between the traded good \( t \) of two sources, and \( v_t = \frac{1}{1 - s_t} \).

Stage 2: 

\[
\min \sum_{t=1}^{n} p_t c_t \quad \text{subject to} \quad c_t(c_t^{II}, c_t^{IM}) \geq 1
\]

where \( c_t(\cdot) = \prod_{t=1}^{n} c_t^{\gamma_t}(c_t^{II})^{\gamma_t} \) with \( \sum_{t=1}^{n} \gamma_t = 1 \). Then we obtain the composite demand function for the traded good and nontraded good \( t \) in period \( t \):
(A8) \[ c_t = \frac{\gamma_t p_t c_t}{p_{tt}}, \quad (t = 1, 2, ..., n-1) \]

(A9) \[ c_t^n = \frac{\gamma_t p_t c_t}{p_{tn}^n}, \quad (t = n) \]

Now we can derive these equations in a percentage change form, with some manipulation:

(A10a) \[ c_t^I = \hat{p}_t + \hat{c}_t + s_u[\gamma_t \theta_t^{M} \hat{p}_t^M + (\nu_t \theta_t^{M} - 1) \hat{p}_t^M], \quad (t = 1, 2, ..., n-1) \]

(A10b) \[ c_t^n = \hat{c}_t - \hat{p}_t^n, \quad (t = n) \]

(A11) \[ c_t^M = \hat{p}_t + \hat{c}_t + s_u[\nu_t \gamma_t \theta_t^{M} \hat{p}_t^M + (\nu_t \theta_t^M - 1) \hat{p}_t^M], \quad (t = 1, 2, ..., n-1) \]

(A12) \[ \hat{p}_t = \sum_{t=1}^{n} \gamma_t \theta_t^M \hat{p}_t^M + \theta_t^M \hat{p}_t^M + \gamma_t \theta_t^M \hat{p}_t^M \]

(A13) \[ [\alpha(1 - \sigma) - 1)] \hat{c}_t + (1 - \alpha)(1 - \sigma) \hat{h}_t = \Lambda_t \]

(A14) \[ \alpha(1 - \sigma) \hat{c}_t + [(1 - \alpha)(1 - \sigma) - 1] \hat{h}_t = \Lambda_t + \hat{p}_t \]

(A15a) \[ \Lambda_{t+1} = (1 + \varphi - \rho) \Lambda_t - \rho \hat{p}_t, \quad (t = 1, 2, ..., k-1) \]

(A15b) \[ \Lambda_t = 0, \quad (t = k) \]

(A16a) \[ \gamma_{t+1} = \hat{\gamma}_t + r^s(\hat{\gamma}_t + \hat{\rho}_t), \quad (t = 1, 2, ..., k-1) \]

(A16b) \[ \hat{\gamma}_t = - \hat{\rho}_t, \quad (t = k) \]

(A17) \[ \hat{r}_t = (p/r) \hat{\rho}_t, \quad (t = 1, 2, ..., k) \]

where all the coefficients and parameters are summarized in the Appendix 7.4.
Production

A representative firm's objective is to maximize the present value of lifetime dividends subject to the capital accumulation condition:

\[
\text{(A18)} \quad \max \int [\Pi_{ij} - \chi_{ij}] e^{pt} \, dt
\]

subject to \( \dot{K}_{ij} = I_{ij} - \delta_j K_{ij} \)

The Hamiltonian function for firm \( j \) is:

\[
H_{ij} = [\Pi_{ij}(-) - \chi_{ij}(-)] + \lambda_{ij}(I_{ij} - \delta_j K_{ij})
\]

The first order condition is

\[
(A19) \quad \frac{\partial \chi_{ij}(-)}{\partial I_{ij}} = p^K_{ij} + p^H_{ij} \phi_{ij}(-) + I_{ij} \phi_{ij}(I_{ij}/K_{ij})
\]

where \( \phi_{ij} = \frac{\beta/2[(I_{ij}/K_{ij})^2 - \zeta^2]}{(I_{ij}/K_{ij})} \). Since \( \frac{\partial \chi_{ij}(-)}{\partial I_{ij}} = \lambda_{ij} \), we can obtain, with some manipulations, the following function for the shadow price of capital:

\[
(A20) \quad \lambda_{ij} = p^K_{ij} + \beta p^H_{ij}(I_{ij}/K_{ij}) - \beta \zeta p^H_{ij}
\]

which yields the optimal investment function as a function of \( \lambda_{ij} \) and price terms:

\[
(A21) \quad \frac{I_{ij}}{K_{ij}} = \zeta + \frac{\lambda_{ij} - \Gamma_{ij}^K}{\beta p^H_{ij}}
\]

The evolution of the marginal value for capital is determined by

\[
(A22) \quad \dot{\lambda}_{ij} = (\rho + \delta_j) \lambda_{ij} - \frac{\partial \Pi_{ij}}{\partial K_{ij}}
\]
where \( \partial \Pi_j / \partial K_{ij} = \Gamma_{ij} \), which is unit profit per capital stock. In the form of a percentage change,

\[
(A23a) \quad \lambda_{ij}^\hat{t} = (1 + \rho + \delta_j) \lambda_{ij}^t + (\rho + \delta_j) \Gamma_{ij}, \quad (t = 1, 2, \ldots, k-1)
\]

\[
(A23b) \quad \lambda_{ij}^k = \lambda_{ij}^{k-1} \quad (t = k)
\]

\[
(A24) \quad \Gamma_{ij} = \Pi_{ij} - \hat{K}_{ij} - \hat{p}_{ij}^k
\]

\[
(A25) \quad \hat{I}_{ij} = (\Phi_{ij} - 1)\hat{p}_{ij}^t + \Phi_{ij} \lambda_{ij}^t - \Phi_{ij} \hat{p}_{ij}^k
\]

\[
(A26) \quad K_{ij}^{t+1} = (1 - \delta_j) \hat{K}_{ij} + \delta_j \hat{I}_{ij}
\]

\[
(A27a) \quad \dot{x}_{ij} = \psi_{ij} (\hat{p}_{ij}^t + \hat{I}_{ij}) + (1 - \psi_{ij}) (\hat{p}_{ij}^t + \dot{\phi}_{ij} + \hat{I}_{ij})
\]

\[
(A27b) \quad \dot{\phi}_{ij} = (1 - \psi_{ij}) (\hat{K}_{ij} - \hat{I}_{ij})
\]

\[
(A28) \quad \hat{p}_{ij}^k = \sum_{j=1}^{n-1} \kappa_{ij}^0 \kappa_{ij}^k \hat{p}_{ij}^t + \kappa_{ij}^k \hat{p}_{ij}^t + \kappa_{ij}^k \hat{p}_{ij}^k + \kappa_{ij}^k \hat{p}_{ij}^k
\]

Let \( \Pi_{ij} \) be a firm \( j \)'s profit in period \( t \):

\[
\Pi_{ij} = p_{ij}^t Y_{ij} - W_i L_{ij} - \sum_{t=1}^{n-1} (p_{ij}^t Z_{ij}^t + p_{ij}^t Z_{ij}^M) - p_{ij}^t Z_{ij}^H
\]

Now in each period the firm \( j \) chooses the quantity of labour and intermediate inputs, at given capital stocks to maximize profit, according to production technology in that period. That is,

\[
\text{max} \quad p_{ij}^t Y_{ij} - W_i L_{ij} - \sum_{t=1}^{n-1} (p_{ij}^t Z_{ij}^t + p_{ij}^t Z_{ij}^M) - p_{ij}^t Z_{ij}^H
\]

subject to \( Y_{ij} = \min \left( \frac{1}{a_{ij}^t} V_{ij} (K_{ij}^t, \cdot \cdot \cdot K_{ij}^t) \right) \)
Note that for a notational simplification the subscript \( j \) which stands for industry will be dropped such that \( Y_{ij} \rightarrow Y_i \), \( L_{ij} \rightarrow L_i \), \( I_{ij} \rightarrow I_i \), and \( Z_{it}^{II} \rightarrow Z_{it}^I \), etc. Henceforward, \( Y_i \) represents period-\( t \) output of industry \( j \), and \( Z_{it} \) is the amount of intermediate good \( t \) used in the production in industry \( j \) in period \( t \), and so on. The Lagrangean function is

\[
L = p_t^I Y_i - W_t L_t - \sum_{u=1}^{n-1} \left( p_u^{II} Z_{it}^{II} + p_u^{N} Z_{it}^{N} \right) - p_t^H Z_{it}^H \\
+ \mu_t \left[ V_t(K_t, L_t) - a_{iv} Y_i \right] + \sum_{u=1}^{n} \mu_u \left[ Z_{it}^H, Z_{it}^{N} \right] - a_{it} Y_i
\]

The first order conditions are:

(A29) \( p_t^H = \mu_t v_t + \sum_{u=1}^{n} \mu_u a_{it} \)

(A30) \( W_t = \lambda_t, V_t^L \)

(A31) \( p_u^H = \lambda_u Z_{it}^H \)

(A32) \( p_u^M = \lambda_u Z_{it}^M \)

where \( Z_{it}^H = \partial Z_{it} / \partial Z_{it}^H \) and \( Z_{it}^M = \partial Z_{it} / \partial Z_{it}^M \). To derive output supply and input demand functions in percentage change form, we use the elasticity of substitution formula and the Euler equations. The elasticity of substitution between labour and capital in period \( t \), \( \sigma_{iv} \), is

(A33) \( \sigma_{iv} = \frac{\% \text{ change in } L_i/K_i}{\% \text{ change in } \text{MRTS}_{L_i,K_i}} = \frac{\text{dlog}(L_i/K_i)}{\text{dlog}(V_t^L/V_t^K)} \)

In our notation of proportional-differentiation form,

(A34) \( \sigma_{iv} = \frac{\dot{K}_t - \dot{L}_t}{\dot{V}_t^L - \dot{V}_t^K} \)
Similarly, the elasticity of substitution between imported intermediate and domestically-produced inputs can be specified as

\[(A35) \quad \sigma_{tr} = \frac{\hat{Z}_{tr} - \hat{Z}_{tr}^M}{Z_{tr}^n - Z_{tr}^h} \]

Since \(V_t(.)\) and \(Z_t(.)\) are assumed to be linearly homogeneous, their partial derivatives are homogeneous of degree zero. Then, the Euler theorem tells us the following relationships:

\[(A36) \quad \zeta_t^L \hat{V}_t^L + \zeta_t^K \hat{V}_t^K = 0 \]

\[(A37) \quad \zeta_t^H \hat{Z}_{tr}^H + \zeta_t^M \hat{Z}_{tr}^M = 0 \]

where \(\zeta_t^L + \zeta_t^K = 1, \zeta_t^H + \zeta_t^M = 1\), for all \(t\).

With these relationships in mind, we proportionally differentiate the FOCs (A29)-(A32) and production technology in period \(t\):

\[(A38) \quad \hat{p}_t^L = \frac{\mu_{tv} \Psi_{tv}}{p_t^L} \mu_{tv} + \sum_{i=1}^{n} \frac{\mu_{tU} \Psi_{tu}}{p_t^L} \mu_{tu} \]

\[(A39) \quad \hat{W}_t = \hat{\mu}_{tv} + \hat{\mu}_{i} \]

\[(A40) \quad \hat{p}_t^H = \mu_{tu} + \hat{Z}_{tr}^h \]

\[(A41) \quad \hat{p}_t^M = \mu_{tu} + \hat{Z}_{tr}^M \]

\[(A42) \quad \hat{Y}_t = \zeta_t^L \hat{L}_t + \zeta_t^K \hat{K}_t \]

\[(A43) \quad \hat{Y}_t = \zeta_t^H \hat{Z}_{tr}^H + \zeta_t^M \hat{Z}_{tr}^M \]

From (A40), (A41), and (A35), we obtain
(A44) \[ \hat{p}_H^t - \hat{p}_n^t = \frac{1}{\sigma_u} (\hat{Z}_n^t - \hat{Z}_H^t) \]

Since \( V_t \) is a function of a single variable, \( L_t \), and the firm has no choice about how to produce, so that (A42) defines \( L_t \) as an implicit function of \( Y_t \) and \( \bar{K}_t \). Hence the restricted demand for labour in period \( t \) can be obtained directly from (A42):

(A45) \[ \hat{L}_t = \frac{1}{\theta^L_t} \hat{Y}_t - \frac{\theta^K_t}{\theta^L_t} \hat{K}_t \]

From (A43) and (A44), we obtain the cost-minimizing demands for home-produced and imported intermediate input \( t \) in period \( t \) used in the production in the traded industry \( j \):

(A46) \[ \hat{Z}_u^t = \hat{Y}_t + \xi^M_{u} \sigma_u (\hat{
abla}_H^t - \hat{
abla}_n^t) \]

(A47) \[ \hat{Z}_n^t = \hat{Y}_t - \xi^H_{u} \sigma_u (\hat{
abla}_H^t - \hat{
abla}_n^t) \]

Next, we assume that the technology for creating capital stock does not require primary factor costs [DSVP, 1980]. Firms only demand good \( t \) for production of capital which will augment the capital stock of the next period in industry \( j \). The usual cost minimization problem is involved:

\[
\text{minimize} \quad \sum_{u=1}^{n-1} (p_H^u I_H^u + p_n^u I_n^u) \\
\text{subject to} \quad b_u I_t = I_u(I_H^u, I_n^u), \text{with } I_u(\cdot) \text{ is CES and linearly homogeneous}
\]

where \( I_t \) is a given level of investment in the traded industry \( j \). Again, using the homogeneity property and the elasticity formula we can derive demand functions of good \( t \) used for creating capital in industry \( j \) in period \( t \) in a percentage change form:

(A48a) \[ \hat{I}_u^t = \hat{I}_t + \theta^M_u \sigma_u (\hat{p}_H^t - \hat{p}_n^t), \quad (t = 1, 2, ..., n-1) \]
Next we derive the firm's profit-maximizing (restricted) output supply function in period \( t \). From (A34) and (A36), we derive

\[
\hat{L}_t = \frac{\sigma_{x_t}}{A_{t,4}} \hat{p}^1_t - \frac{\sigma_{y_t}}{A_{t,4}} \hat{V}_t - \frac{\sigma_{x_t}}{A_{t,4}} \sum_{i=1}^{n} A_{t,i} (\hat{r}_{1}^1 \hat{p}^1_t + \hat{r}_{M}^1 \hat{p}^M_t) + \hat{K}_t
\]

where

\[
A_{t,4} = \frac{\mu_{y_t} \sigma_{x_t}}{\hat{p}^1_t} - \sum_{i=1}^{n} A_{t,i} \left( \hat{r}_{1}^1 \hat{p}^1_t + \hat{r}_{M}^1 \hat{p}^M_t \right) - \hat{V}_t
\]

Substituting (A51) into (A42) generates restricted output supply function in period 1,

\[
\hat{Y}_t = \frac{\sigma_{x_t}}{A_{t,4}} \hat{p}^1_t - \sum_{i=1}^{n} A_{t,i} \left( \hat{r}_{1}^1 \hat{p}^1_t + \hat{r}_{M}^1 \hat{p}^M_t \right) - \hat{V}_t + \hat{K}_t
\]

Note that \( \hat{r}_{1}^1 = 1 \) and \( \hat{r}_{M}^1 = 0 \) in the case that \( t = n \). Substituting (A52) into equations (A46) and (A47) respectively yields the profit-maximizing restricted intermediate input demand function for period \( t \):
Substituting input demands and output supply functions into the linearized profit identity generates the optimal profit function in period $t$ in a linearized form:

$$\hat{\Pi}_t = \frac{1}{A_{lp}} \left[ 1 - \frac{\sigma_{tv}}{\zeta_t^M} + \left( 1 - \sum_{i=1}^{n} A_{n} \frac{\lambda_{tv}}{\zeta_t^M} \right) \frac{\sigma_{tv}}{A_{tv} \zeta_t^M} \right] \hat{P}_t$$

$$- \frac{1}{A_{lp}} \left[ \frac{\sigma_{tv}}{A_{tv} \zeta_t^M} \left( 1 - \sum_{i=1}^{n} A_{n} \frac{\lambda_{tv}}{\zeta_t^M} \right) A_{tv} \zeta_t^M + \sum_{i=1}^{n} \lambda_{tv} \zeta_t^M \sigma_{tv} + \sum_{i=1}^{n-1} \lambda_{tv} \zeta_t^M \sigma_{tv} \right] \hat{W}_t$$

$$- \frac{1}{A_{lp}} \left[ A_{tv} \frac{\sigma_{tv}}{\zeta_t^M} \left( 1 + \sum_{i=1}^{n} A_{n} \right) - \frac{A_{tv} \sigma_{tv}}{\zeta_t^M} \right] \hat{V}_t + \hat{K}_t$$

Finally, the firm's cash-flow identity is

$$\hat{D}_{ij} = (1/v_i^j) \left[ v_i^j \hat{X}_{ij} + v_i^j \hat{Q}_{ij} - \hat{\Pi}_{ij} \right]$$

where $\hat{D}_{ij}$ is zero in the capital control regime.

**Government and Foreign Sector**

The linearized form for changes in foreign reserve equation is given by
\[ \dot{R}_{t+1} = \dot{R}_t + \sum_{i=1}^{n-1} \omega_i (p_{it}^X + \dot{D}_{it}^X) - \sum_{i=1}^{n-1} \omega_i (p_{it}^{Y*} + \dot{D}_{it}^{Y*}) - \left[ \omega_r (B_{t+1} - \dot{B}_t) + \omega_d (D_{t+1} - \dot{D}_d) \right] \]

where the RHS of (A57) is the sum of the current and capital account. In a capital control regime the capital account is zero. Trade balance (foreign currency value) in change form (not a percentage change) is

\[ dTB_t = EX_t (p_{t}^X + \dot{D}_{t}^X) - EM_t \dot{D}_{t}^{Y*} \]

where \( EX_t \) and \( EM_t \) are the basecase values for exports and imports respectively. The price of export and import good \( t \) in period \( t \), in the percentage change form, are

\[ p_{it}^H = p_{it}^X + \dot{E}_{ct}, \quad (t = 1, 2, \ldots, n-1) \]

\[ p_{it}^{Y*} = (1 + \tau_{it}) + \dot{E}_{ct} + p_{it}^{Y*}, \quad (t = 1, 2, \ldots, n-1) \]

A linearized form of foreign demand for export good \( t \) is

\[ \dot{D}_{it}^X = -\eta_i p_{it}^X, \quad (t = 1, 2, \ldots, n-1) \]

Equation for export \( t \) is

\[ \dot{D}_{it}^X = (1/\sigma_i) [\dot{Y}_t - (1 - \sigma_i) \dot{D}_{it}^H]. \]

Equilibrium

\[ \dot{D}_{it}^H = \dot{Y}_t, \quad \text{nontraded goods market} \quad (t = n) \]

\[ \dot{L}_t = \Delta_l z \sum_{j=1}^{n} \dot{L}_{ij}, \quad \text{labour market} \]

\[ \dot{H}_{t+1} = \dot{H}_t + \Xi (\dot{R}_{t+1} - \dot{R}_t), \quad \text{money market} \]
7.2 Model Equations

<table>
<thead>
<tr>
<th>identifier</th>
<th>equation</th>
<th>eq. number</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1a)</td>
<td>$c^*<em>{it} = p_t + \hat{c}<em>t + s_t(v</em>{it}^\theta M\hat{p}^M</em>{it} + (v_{it}^\theta I_{it} - 1)\hat{p}^I_{it})$</td>
<td>(n-1)k</td>
<td>con of h'goods</td>
</tr>
<tr>
<td>(1b)</td>
<td>$\hat{c}^*_{it} = \hat{c}<em>t - \hat{p}^H</em>{it}$</td>
<td>k</td>
<td>con of nonr good</td>
</tr>
<tr>
<td>(2)</td>
<td>$\hat{c}^M_{it} = \hat{p}<em>t + \hat{c}<em>t + s_t(v</em>{it}^\theta M\hat{p}^M</em>{it} + (v_{it}^\theta M - 1)\hat{p}^M_{it})$</td>
<td>(n-1)k</td>
<td>con of imports</td>
</tr>
<tr>
<td>(3)</td>
<td>$\hat{p}<em>t = \sum</em>{i=1}^{n-1} \theta^M_{it}\hat{p}^M_{it} + \theta^H_{it}\hat{p}^H_{it} + e_{it}\hat{p}^I_{it}$</td>
<td>k</td>
<td>unit expenditure</td>
</tr>
<tr>
<td>(4)</td>
<td>$[\alpha(1 - \sigma) - 1]c_t + (1 - \sigma)(1 - \alpha)\hat{h}_t = \Lambda_t + \hat{p}_t$</td>
<td>k</td>
<td>consumption at t</td>
</tr>
<tr>
<td>(5)</td>
<td>$\alpha(1 - \sigma)c_t + [(1 - \sigma)(1 - \alpha) - 1]h_t = \Lambda_t + \hat{p}_t$</td>
<td>k</td>
<td>real money balances</td>
</tr>
<tr>
<td>(6a)</td>
<td>$\Lambda_{t+1} = [(1 + dyr(t)(\rho - \rho))]\Lambda_t - \rho \hat{p}_t$</td>
<td>n-1</td>
<td>shadow wealth</td>
</tr>
<tr>
<td>(6b)</td>
<td>$\Lambda_t = 0$</td>
<td>1</td>
<td>$\Lambda$ in end period</td>
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<tr>
<td>(7a)</td>
<td>$\gamma_{t+1} = \gamma_t + r^*dyr(t)(\gamma_t + \hat{p}_t)$</td>
<td>k-1</td>
<td>real financial rate</td>
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<td>(7b)</td>
<td>$\gamma_t = -\hat{p}_t$</td>
<td>1</td>
<td>end condition for $\gamma$</td>
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<td>(8)</td>
<td>$\hat{r}_t = (\rho/r)\hat{p}_t$</td>
<td>k</td>
<td>nominal interest rate</td>
</tr>
<tr>
<td>(9)</td>
<td>$h_{t+1} = (1 - h)\hat{h}_t + h^2(\hat{B}_t + h^2\hat{B}_t) + h\gamma_t - h\gamma_t + \hat{c}_t$</td>
<td>k</td>
<td>real balances change</td>
</tr>
<tr>
<td>(10a)</td>
<td>$\lambda_{t+j} = [1 + dyr(t)(\rho + \delta_2)]\lambda_{t+j} + dyr(t)(\rho_{ij} - \delta_{ij})$</td>
<td>n(k-1)</td>
<td>shadow price of K</td>
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<tr>
<td>(10b)</td>
<td>$\lambda_{t+j} = \lambda_{t+j}$</td>
<td>n</td>
<td>end condition for $\lambda$</td>
</tr>
<tr>
<td>(11)</td>
<td>$\hat{I}<em>{ij} = \hat{I}</em>{ij} - \hat{K}<em>{ij} - \hat{p}</em>{ij}$</td>
<td>nk</td>
<td>unit profit per capital</td>
</tr>
<tr>
<td>(12)</td>
<td>$\hat{I}<em>{ij} = (\Phi</em>{ij}^2 - 1)\hat{p}^H_{ij} + \Phi_{ij}^2\lambda_{ij} - \Phi_{ij}^2\hat{p}_{ij}$</td>
<td>nk</td>
<td>investment j</td>
</tr>
<tr>
<td>(13)</td>
<td>$K_{t+j} = (1 - \delta_j)K_{t+j} + \delta_j\hat{I}_{ij}$</td>
<td>n(k-1)</td>
<td>capital accumu.</td>
</tr>
<tr>
<td>Equation</td>
<td>Description</td>
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<tr>
<td>(14) $\hat{\chi}<em>{ij} = \psi^i (\hat{p}</em>{ij} + \hat{r}<em>{ij}) + (1 - \psi^i) (\hat{p}</em>{ij}^H + \hat{\phi}<em>{ij} + \hat{l}</em>{ij})$</td>
<td>nk inv expenditure</td>
<td></td>
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<tr>
<td>(15) $\hat{\phi}<em>{ij} = (1 - \psi^i) (K</em>{ij} - \hat{l}_{ij})$</td>
<td>nk unit inv cost</td>
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</tr>
<tr>
<td>(16a) $\hat{p}<em>{ij}^H = \sum</em>{j=1}^{n-1} [\kappa_{ij}^M \hat{p}<em>{ij}^{M} + (1 - \kappa</em>{ij}^M) \hat{p}<em>{ij}^{H} + \kappa</em>{ij} \hat{p}_{ij}^{H}]$</td>
<td>(n-1)k price of K in j</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(16b) $\hat{p}<em>{in}^H = \hat{p}</em>{in}$</td>
<td>k price of K in nontr</td>
<td></td>
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</tr>
<tr>
<td>(17a) $\hat{I}<em>{ij}^H = \hat{I}</em>{ij} + \zeta_{ij} M_{ij} \sigma_{ij} (\hat{p}<em>{ij}^M - \hat{p}</em>{ij}^H)$</td>
<td>(n-1)nk h inv good j in i</td>
<td></td>
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<tr>
<td>(17b) $\hat{I}<em>{ij}^N = \hat{I}</em>{ij}$</td>
<td>nk nontr inv good j in i</td>
<td></td>
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<tr>
<td>(18) $\hat{I}<em>{ij}^M = \hat{I}</em>{ij} + \zeta_{ij} \sigma_{ij} (\hat{p}<em>{ij}^M - \hat{p}</em>{ij}^H)$</td>
<td>(n-1)nk imp inv good j in i</td>
<td></td>
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</tr>
<tr>
<td>(19) $L_{ij}^* = \frac{\sigma_{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{p}<em>{ij}^H - \frac{\sigma</em>{ij}}{\zeta_{ij}} \hat{W}<em>i - \frac{\sigma</em>{ij}}{\zeta_{ij}} \hat{k}_{ij}$</td>
<td>nk labour demand</td>
<td></td>
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<tr>
<td>(20) $Y_{ij}^* = \frac{\sigma_{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{p}<em>{ij}^H - \frac{\sigma</em>{ij}}{\zeta_{ij}} \hat{W}<em>i + \hat{k}</em>{ij}$</td>
<td>nk supply of good j</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(21a) $Z_{ij}^H = \frac{\sigma_{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{p}<em>{ij}^H - \frac{\sigma</em>{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \sum_{j=1}^{n-1} A_{ij} \zeta_{ij} \hat{p}<em>{ij}^{M} - \frac{\sigma</em>{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{W}<em>i + \hat{k}</em>{ij}$</td>
<td>(n-1)nk h' good j in i</td>
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</tr>
<tr>
<td>(21b) $Z_{ij}^N = \hat{Y}_{ij}$</td>
<td>nk nontr input j in i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(22) $Z_{ij}^M = \frac{\sigma_{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{p}<em>{ij}^H - \frac{\sigma</em>{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \sum_{j=1}^{n-1} A_{ij} \zeta_{ij} \hat{p}<em>{ij}^{M} + \frac{\sigma</em>{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{W}<em>i - \frac{\sigma</em>{ij} \zeta_{ij}}{A_{ij} \zeta_{ij}} \hat{k}_{ij}$</td>
<td>(n-1)nk impo j in i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>identifier</td>
<td>equation</td>
<td>eq. number</td>
<td>description</td>
</tr>
<tr>
<td>------------</td>
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<td>------------</td>
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</tr>
<tr>
<td>(23)</td>
<td>$\hat{\Pi}<em>{ij} = \frac{1}{A</em>{ij}^{(l)}} (\hat{Y}<em>{ij} + \hat{p}</em>{ij}^{A} - A_{ij}(\hat{W}<em>{i} + \hat{L}</em>{ij})) - \sum_{u=1}^{n} A_{ij}^{(l)} (\hat{p}<em>{iu}^{A} + \hat{Z}</em>{iu}^{A})$</td>
<td>nk</td>
<td>firm $j$'s profit</td>
</tr>
<tr>
<td>(24a)</td>
<td>$\hat{D}<em>{ij} = (1/\nu</em>{ij}^{A})(\nu_{ij}^{A} \hat{X}<em>{ij} + \nu</em>{ij}^{A} \hat{Q}<em>{ij} - \hat{\Pi}</em>{ij})$</td>
<td>nk</td>
<td>firm $j$'s cash flow</td>
</tr>
<tr>
<td>(24b)</td>
<td>$\hat{Q}<em>{ij} = \hat{\Pi}</em>{ij}$</td>
<td>nk</td>
<td>firm $j$'s div paid-out</td>
</tr>
<tr>
<td>(25)</td>
<td>$\hat{D}<em>{r} = (1/\omega</em>{r})(\hat{Y}<em>{r} - (1 - \omega</em>{r})\hat{D}_{r}^{M})$</td>
<td>(n-1)k</td>
<td>exports</td>
</tr>
<tr>
<td>(26)</td>
<td>$\hat{D}<em>{q} = -\omega</em>{q} \hat{P}_{q}^{M}$</td>
<td>(n-1)k</td>
<td>price of export $j$</td>
</tr>
<tr>
<td>(27)</td>
<td>$\hat{p}<em>{ij}^{H} = (1 + \tau</em>{ij}) + \hat{E}<em>{q} + \hat{p}</em>{ij}^{M}$</td>
<td>(n-1)k</td>
<td>price of import $j$</td>
</tr>
<tr>
<td>(28)</td>
<td>$\hat{p}<em>{ij}^{M} = \hat{p}</em>{ij}^{M} + \hat{E}_{q}$</td>
<td>(n-1)k</td>
<td>$h'$ price of traded $j$</td>
</tr>
<tr>
<td>(29)</td>
<td>$\hat{T}<em>{t} = \sum</em>{i=1}^{n} \Delta_{i}^{A}(\hat{\tau}<em>{i} + \hat{d}</em>{i}^{M}) + \Delta_{i}^{H}(\hat{\Omega}<em>{i}) - \sum</em>{i=1}^{n} \Delta_{i}^{A}(\hat{p}<em>{i}^{M} + \hat{G}</em>{i}^{M})$</td>
<td>k</td>
<td>govt budget</td>
</tr>
<tr>
<td>(30)</td>
<td>$dTB_{t} = EX_{t} (\hat{p}<em>{X}^{H} + \hat{D}</em>{X}^{H}) - EM_{t} \hat{D}_{t}^{M}$</td>
<td>k</td>
<td>trade balance</td>
</tr>
<tr>
<td>(31)</td>
<td>$H_{t+1} = H_{t} + \Xi_{t}(R_{t+1} - R_{t})$</td>
<td>k</td>
<td>money market equi</td>
</tr>
<tr>
<td>(32)</td>
<td>$\hat{D}<em>{q}^{M} = \sum</em>{i=1}^{n} \hat{e}<em>{i}^{q} + \sum</em>{i=1}^{n} \hat{e}<em>{i}^{q} \hat{X}</em>{ij}^{M} + \sum_{i=1}^{n} \hat{e}<em>{i}^{q} \hat{Y}</em>{ij}^{M}$</td>
<td>(n-1)k</td>
<td>total import $j$</td>
</tr>
<tr>
<td>(33)</td>
<td>$\hat{D}<em>{l}^{H} = \sum</em>{i=1}^{n} \hat{e}<em>{i}^{H} \hat{D}</em>{ij}^{H} + \sum_{i=1}^{n} \hat{\Theta}<em>{i}^{H} \hat{D}</em>{ij}^{H} + \sum_{i=1}^{n} \hat{\Theta}<em>{i}^{H} \hat{I}</em>{ij}^{H}$</td>
<td>nk</td>
<td>$d$ for home good $j$</td>
</tr>
<tr>
<td>(34)</td>
<td>$\hat{Y}<em>{ij} = \hat{D}</em>{ij}^{H}$</td>
<td>k</td>
<td>nontraded good equi</td>
</tr>
<tr>
<td>(35)</td>
<td>$\hat{D}<em>{d}^{M} = \sum</em>{i=1}^{n} \hat{e}<em>{i}^{H} \hat{D}</em>{ij}^{M}$</td>
<td>k</td>
<td>total imports</td>
</tr>
<tr>
<td>(36)</td>
<td>$\hat{D}<em>{q}^{H} = \sum</em>{i=1}^{n} \hat{e}<em>{i}^{H} \hat{D}</em>{ij}^{H}$</td>
<td>k</td>
<td>total exports</td>
</tr>
<tr>
<td>Identifier</td>
<td>Equation</td>
<td>Eq. Number</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>(37)</td>
<td>( \hat{L}<em>t = \Delta</em>{ij} \sum_{i=1}^{n} \hat{L}_{ij} )</td>
<td>k</td>
<td>labour market clear</td>
</tr>
<tr>
<td>(38)</td>
<td>( \hat{Z}<em>{ij} = \sum</em>{i=1}^{n} \Delta_{ij} \hat{Z}_{ij} )</td>
<td>nk</td>
<td>int home j</td>
</tr>
<tr>
<td>(39)</td>
<td>( \hat{Z}<em>{ij} = \sum</em>{i=1}^{n} \Delta_{ij} \hat{Z}_{ij} )</td>
<td>nk</td>
<td>int import j</td>
</tr>
<tr>
<td>(40)</td>
<td>( \hat{I}<em>{ij} = \sum</em>{i=1}^{n} \Omega_{ij} \hat{I}_{ij} )</td>
<td>nk</td>
<td>h inv good j</td>
</tr>
<tr>
<td>(41)</td>
<td>( \hat{I}<em>{ij} = \sum</em>{i=1}^{n} \Omega_{ij} \hat{I}_{ij} )</td>
<td>nk</td>
<td>im inv good j</td>
</tr>
<tr>
<td>(42)</td>
<td>( \hat{I}<em>t = \sum</em>{j=1}^{n} \nu_{ij} \hat{I}_{ij} )</td>
<td>k</td>
<td>total investment</td>
</tr>
<tr>
<td>(43)</td>
<td>( \hat{N}<em>t = \sum</em>{j=1}^{n} \nu_{ij} \hat{N}_{ij} )</td>
<td>k</td>
<td>total profit</td>
</tr>
<tr>
<td>(44)</td>
<td>( \hat{Y}<em>t = \sum</em>{j=1}^{n} \mu_{ij} \hat{Y}_{ij} )</td>
<td>k</td>
<td>total output</td>
</tr>
<tr>
<td>(45)</td>
<td>( \hat{p}<em>{ij} = \sum</em>{i=1}^{n} \hat{g}<em>{ij} \hat{p}</em>{ij} )</td>
<td>k</td>
<td>home price index</td>
</tr>
<tr>
<td>(46)</td>
<td>( \hat{p}<em>{ij} = \sum</em>{i=1}^{n} \hat{g}<em>{ij} \hat{p}</em>{ij} )</td>
<td>k</td>
<td>import price index</td>
</tr>
<tr>
<td>(47)</td>
<td>( \hat{p}<em>{ij} = \sum</em>{i=1}^{n} \hat{g}<em>{ij} \hat{p}</em>{ij} )</td>
<td>k</td>
<td>export price index</td>
</tr>
<tr>
<td>(48)</td>
<td>( \hat{p}<em>{ij} = \sum</em>{i=1}^{n} \hat{g}<em>{ij} \hat{p}</em>{ij} )</td>
<td>k</td>
<td>cap good price index</td>
</tr>
<tr>
<td>(49)</td>
<td>( \text{dEV}<em>t/y_t = (-1/2) \sum</em>{j=1}^{n} (\hat{e}<em>{ij} \hat{e}</em>{ij} + \hat{e}<em>{ij} \hat{e}</em>{ij}) - (1/2)(\hat{e}<em>{ij} \hat{e}</em>{ij} + \hat{e}<em>{ij} \hat{e}</em>{ij}) )</td>
<td>k</td>
<td>equivalent variation</td>
</tr>
<tr>
<td>(50)</td>
<td>( \text{LEV} = \sum_{i=1}^{k} \text{dEV}_t )</td>
<td>l</td>
<td>intertemporal EV</td>
</tr>
</tbody>
</table>

Total number of equations is \(118K - 2\) if there are 3 industry goods.
### 7.3 Model Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
</table>
| $c_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | consumption of home good j |
| $c^M_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2$ | 2k | consumption of import j |
| $\hat{c}_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | overall consumption of goods |
| $p_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | consumer’s price index in t |
| $\Lambda_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | shadow price wealth |
| $\rho_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | real interest rate |
| $\hat{r}_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | nominal interest rate |
| $\hat{r}_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | real financial rate |
| $h_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | demand for real balances |
| $\hat{Y}_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | output of good j |
| $\hat{W}_t$ | $t = 0, 1, 2, \ldots, k-1$ | k | economy-wide real wage rate |
| $p^k_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | price of investment j |
| $\hat{L}_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | labour demand in industry j |
| $\hat{K}_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | capital stock in industry j |
| $Z^H_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 9k | int demand for home good j in industry i |
| $Z^M_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 6k | int demand for import j in industry i |
| $\lambda_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | marginal value of capital in firm j |
| $\chi_{ij}$ | $t = 0, 1, 2, \ldots, k-1$  
  $j = 1, 2, 3$ | 3k | total investment costs in firm j |
<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{\phi}_{ij} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>unit adjustment costs in firm j</td>
</tr>
<tr>
<td>( \hat{\Gamma}_{ij} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>unit profit per capital in industry j</td>
</tr>
<tr>
<td>( \hat{I}_{ij} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>investment demand function in firm j</td>
</tr>
<tr>
<td>( \hat{I}_{ij}^h )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>9k</td>
<td>demand for h capital good j in firm i</td>
</tr>
<tr>
<td>( \hat{I}_{ij}^{st} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>6k</td>
<td>demand for im capital good j in firm i</td>
</tr>
<tr>
<td>( \hat{\Pi}_{ij} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>profit in industry j</td>
</tr>
<tr>
<td>( \hat{Q}_{ij} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>dividend in industry j</td>
</tr>
<tr>
<td>( \hat{D}_{ij} )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>firm j's debt</td>
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<tr>
<td>( \hat{T}_t )</td>
<td>( t = 0, 1, 2, \ldots, k-1 )</td>
<td>k</td>
<td>lump-sum transfer</td>
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<tr>
<td>( \hat{R}_t )</td>
<td>( t = 0, 1, 2, \ldots, k-1 )</td>
<td>k</td>
<td>foreign reserve</td>
</tr>
<tr>
<td>( dB_T )</td>
<td>( t = 0, 1, 2, \ldots, k-1 )</td>
<td>k</td>
<td>trade balance</td>
</tr>
<tr>
<td>( \hat{D}_{ij}^M )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2 )</td>
<td>2k</td>
<td>demand for import j</td>
</tr>
<tr>
<td>( \hat{D}_t^M )</td>
<td>( t = 0, 1, 2, \ldots, k-1 )</td>
<td>k</td>
<td>total import j</td>
</tr>
<tr>
<td>( \hat{D}_{ij}^E )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2 )</td>
<td>2k</td>
<td>foreign demand for export j</td>
</tr>
<tr>
<td>( \hat{D}_t^E )</td>
<td>( t = 0, 1, 2, \ldots, k-1 )</td>
<td>k</td>
<td>total export j</td>
</tr>
<tr>
<td>( \hat{D}_{ij}^H )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
<td>3k</td>
<td>demand for home good j</td>
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<tr>
<td>( \hat{p}_{ij}^H )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
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<td>domestic price of good j</td>
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<tr>
<td>( \hat{p}_{ij}^M )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2 )</td>
<td>2k</td>
<td>price of import good j</td>
</tr>
<tr>
<td>Variable</td>
<td>Range</td>
<td>Number</td>
<td>Description</td>
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<tr>
<td>( \hat{p}_t )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2 )</td>
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<td>world price of good j</td>
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<tr>
<td>( \hat{Z}_t )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
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<td>int demand for home goods in firm j</td>
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<tr>
<td>( \hat{Z}_t^M )</td>
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<td>int demand for imports in firm j</td>
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<td>( \hat{I}_t^H )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
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<td>firm j's demand for capital home goods</td>
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<tr>
<td>( \hat{I}_t^M )</td>
<td>( t = 0, 1, 2, \ldots, k-1 ) ( j = 1, 2, 3 )</td>
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<td>( \hat{I}_t )</td>
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<td>( \hat{\Pi}_t )</td>
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<td>( \hat{Y}_t )</td>
<td>( t = 0, 1, 2, \ldots, k-1 )</td>
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<td>( \hat{p}_t^M )</td>
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<td>( \hat{p}_t^E )</td>
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<td>( \hat{r}_{ij} )</td>
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<td>( K_{ij} )</td>
<td>( t = 0 ) ( j = 1, 2, 3 )</td>
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<td>initial capital stock in industry j</td>
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<tr>
<td>Variable</td>
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<td>( \hat{O}_t )</td>
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<td>( k )</td>
<td>other taxes</td>
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</table>

Total number of exogenous variables: \( 11k + 3 \)

Total number of endogenous variables: \( 118k - 2 \)
7.4 Basic Model Parameters and Coefficients

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<td>elas. of subst. between primary factors</td>
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<td>2</td>
<td>foreign price elasticity of export t</td>
</tr>
<tr>
<td>ε_t</td>
<td>3k</td>
<td>budget share of consumption of good t</td>
</tr>
<tr>
<td>θ_{it}^M</td>
<td>2k</td>
<td>share of import good t in expenditure on t</td>
</tr>
<tr>
<td>θ_{it}^H</td>
<td>2k</td>
<td>share of home good t in expenditure on t</td>
</tr>
<tr>
<td>α</td>
<td>1</td>
<td>average propensity to consumption</td>
</tr>
<tr>
<td>ψ_{ij}^l</td>
<td>3k</td>
<td>ratio of replacement cost in total inv costs</td>
</tr>
<tr>
<td>ψ_{ij}^2</td>
<td>3k</td>
<td>β(δ_j - ζ)/δ_j</td>
</tr>
<tr>
<td>Parameter</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>$\kappa^M_{ij}$</td>
<td>2k</td>
<td>share of imports for capital creation of ind j</td>
</tr>
<tr>
<td>$\zeta^K_{ij}$</td>
<td>3k</td>
<td>capital share in value added</td>
</tr>
<tr>
<td>$\zeta^L_{ij}$</td>
<td>3k</td>
<td>labour share in value added</td>
</tr>
<tr>
<td>$A^v_{ij}$</td>
<td>3k</td>
<td>cost share of primary factors in output j</td>
</tr>
<tr>
<td>$A^h_{ij}$</td>
<td>9k</td>
<td>cost share good i used in j, in output j</td>
</tr>
<tr>
<td>$A^p_{ij}$</td>
<td>3k</td>
<td>share of profit of j in output j</td>
</tr>
<tr>
<td>$A^H_{ij}$</td>
<td>9k</td>
<td>cost share of home good i used in j in output j</td>
</tr>
<tr>
<td>$A^M_{ij}$</td>
<td>6k</td>
<td>cost share of import good i used in j in output j</td>
</tr>
<tr>
<td>$\Omega^H_{ij}$</td>
<td>9k</td>
<td>share of home inv good i used in j in output j</td>
</tr>
<tr>
<td>$\Omega^M_{ij}$</td>
<td>6k</td>
<td>share of import inv good i used in j in output j</td>
</tr>
<tr>
<td>$\xi^H_{ij}$</td>
<td>9k</td>
<td>share of home good i in j in expenditure on t in j</td>
</tr>
<tr>
<td>$\xi^M_{ij}$</td>
<td>6k</td>
<td>share of import good i in j in expenditure on t in j</td>
</tr>
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<td>$\nu^I_{ij}$</td>
<td>3n</td>
<td>share of inv j in total investment</td>
</tr>
<tr>
<td>$\nu^\pi_{ij}$</td>
<td>3k</td>
<td>share of profit j in total profits</td>
</tr>
<tr>
<td>$\omega_{ij}$</td>
<td>2k</td>
<td>ratio of export j in output j</td>
</tr>
<tr>
<td>$\xi^p_{ij}$</td>
<td>3</td>
<td>slutsky own price effect of j</td>
</tr>
<tr>
<td>$\xi^e_{ij}$</td>
<td>3</td>
<td>slutsky income effect of j</td>
</tr>
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<td>$\Theta^1_{ij}$</td>
<td>3k</td>
<td>consumer's demand/total home good demand j</td>
</tr>
<tr>
<td>$\Theta^2_{ij}$</td>
<td>9k</td>
<td>int demand j in ind i/total home good demand j</td>
</tr>
<tr>
<td>$\Theta^3_{ij}$</td>
<td>3k</td>
<td>govt's demand/total home good demand j</td>
</tr>
<tr>
<td>$\Theta^4_{ij}$</td>
<td>9k</td>
<td>int inv demand j in ind i/total home demand j</td>
</tr>
<tr>
<td>$\nu^I_{ij}$</td>
<td>3k</td>
<td>debt/profit j</td>
</tr>
<tr>
<td>Parameter</td>
<td>Number</td>
<td>Description</td>
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<td>--------</td>
<td>-------------</td>
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<tr>
<td>$\nu_{ij}^2$</td>
<td>3k</td>
<td>investment costs/profit</td>
</tr>
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<td>$\nu_{ij}^3$</td>
<td>3k</td>
<td>profit distribution ratio</td>
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<td>$\varepsilon_{ij}^1$</td>
<td>2k</td>
<td>consumer's demand/total import demand j</td>
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<td>$\varepsilon_{ij}^3$</td>
<td>3k</td>
<td>int demand j in ind i/total import demand j</td>
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<tr>
<td>$\varepsilon_{ij}^3$</td>
<td>3k</td>
<td>int inv demand j in ind i/total import demand j</td>
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<td>$\Phi_{ij}$</td>
<td>3k</td>
<td>$\zeta K_{ij}$/replacement cost j</td>
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<td>3k</td>
<td>$\lambda_{ij} K_{ij}/\beta I_{ij}$</td>
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<tr>
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<td>3k</td>
<td>$K_{ij}/\beta I_{ij}$</td>
</tr>
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<td>2k</td>
<td>tariff revenue j/trans</td>
</tr>
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<td>$\Delta_{ij}^T$</td>
<td>k</td>
<td>other revenues/transfer</td>
</tr>
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<td>$\Delta_{ij}^h$</td>
<td>3k</td>
<td>government consumption j/transfer</td>
</tr>
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<td>$\Xi_i$</td>
<td>k</td>
<td>base reserve/base money stock</td>
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<td>2k</td>
<td>imports value j/base reserve</td>
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<td>$\omega_{ij}^T$</td>
<td>2k</td>
<td>export value j/base reserve</td>
</tr>
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<td>$\omega_i^b$</td>
<td>k</td>
<td>foreign bond/base reserve</td>
</tr>
<tr>
<td>$\omega_i^d$</td>
<td>k</td>
<td>firm's debt/base reserve</td>
</tr>
<tr>
<td>$\mu_{ij}$</td>
<td>3k</td>
<td>output j/total outputs</td>
</tr>
<tr>
<td>$\Delta_{ij}$</td>
<td>3k</td>
<td>industry j's share in total employment</td>
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<tr>
<td>$g_{nn}^X$</td>
<td>2k</td>
<td>good t share in total demand for exports</td>
</tr>
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<td>$g_{nn}^M$</td>
<td>2k</td>
<td>good t share in total demand for imports</td>
</tr>
<tr>
<td>$g_{nn}^H$</td>
<td>3k</td>
<td>t share in consumer's expenditure on home goods</td>
</tr>
<tr>
<td>Parameter</td>
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<td>Description</td>
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<td>-----------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>$g_{it}^k$</td>
<td>3k</td>
<td>t share in firm's expenditure on capital goods</td>
</tr>
<tr>
<td>$h_{it}^1$</td>
<td>2k</td>
<td>ratio of inflation tax in base money</td>
</tr>
<tr>
<td>$h_{it}^2$</td>
<td>2k</td>
<td>ratio of interest earning in base money</td>
</tr>
<tr>
<td>$h_{it}^3$</td>
<td>3k</td>
<td>ratio of wage and dividends income in base money</td>
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<tr>
<td>$h_{it}^4$</td>
<td>3k</td>
<td>ratio of transfer income in base money</td>
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<td>$h_{it}^5$</td>
<td>3k</td>
<td>ratio of spending in base money</td>
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<tr>
<td>$\theta_{it}$</td>
<td>2k</td>
<td>$1/(1 - s_{it})$</td>
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CHAPTER 8

CONCLUSION

8.1 Main Issues Again

This thesis has examined important issues in trade liberalization in developing countries: timing and duration, sequencing, and speed and credibility of trade reform. Using intertemporal optimizing frameworks, we have analyzed the dynamics of permanent versus temporary reform, trade reform with and without capital controls, and the optimal speed of trade reform when the reform lacks credibility. In different theoretical models and in a simulation model, we have examined the following questions.

(1) What are the dynamic effects of the different timings of trade reform on welfare and the current account?

(2) What are the potential costs of temporary trade reform? Under what circumstances do these costs occur? How does the duration of temporary trade reform affect the transitional adjustment paths of the economy?

(3) How are the dynamic effects of trade liberalization with and without capital controls different? Under what circumstances is the standard "trade liberalization first" view vindicated?

(4) What are the costs, if any, of imperfectly credible trade liberalization, and what is the optimal speed of liberalization when the reform is incredible?

(5) What have been the industrial adjustment patterns following Korea's recent trade liberalization, and what are the implications of these episodes on the issues of timing, sequencing, and speed and credibility?

(6) Do the theoretical findings hold in an integrated simulation model for Korea? trade?
(7) What are the mid-to long-run predictions of the model for Korea's pre-announced trade reform over the period of 1989-1993 in terms of the nation's welfare and the current account?

8.2 Principal Findings

The results of each of the individual chapters were summarized in their concluding sections. Therefore, here we briefly summarize the main findings. Theoretically, we have shown that the dynamics of permanent and temporary trade reform are different not only in terms of the steady-state but also in the transitional adjustment. Unlike the permanent reform which is always welfare-improving, however, it has been shown that temporary reform can clearly generate intertemporal costs in terms of welfare. Both may generate a deficit in the current account in the short-run. The short-run (initial) effects of temporary reform on the current account have, however, been demonstrated to be ambiguous. The effects of non-credible reform were shown to be equivalent to those of a temporary reform. Brief summaries of each chapter now follow.

We have demonstrated that trade reform under capital controls (with a dual exchange rate regime) appreciates the real financial rate under plausible conditions, and hence can produce smaller deficits in the current account than reform under a unified exchange rate regime. Thus, capital controls may work in terms of reducing the current account deficit in this case. In this regard, the order of "trade account first" may be favoured. If the reform is permanent, the sequencing issue has a second-order importance. Also, the real (commercial) exchange rate movements were demonstrated to be an important factor to determine the responses of consumption and real balances in the new steady-state. It is also shown that temporary trade reform brings about smaller wealth effects but larger intertemporal consumption substitution than the permanent reform case. Whether the initial current account deficits are larger in the temporary reform therefore depends on the relative strength of these two effects (Chapter 3).
Chapter 4 focused on the issue of timing and duration of trade reform in the context of the firm's investment and the economy's resource allocation. We have shown that investment in both the importable and exportable industries might increase as a result of trade reform. The initial current account deficits are also ambiguous here because the two sectors operate in an opposite way in determining the initial current account response, as manifested by the jumps in their marginal values for capital. However, the resource allocation objective of trade liberalization can be dampened due to the temporariness of trade reform, which identifies another source of costs of temporary policy.

The sub-optimality of imperfectly credible trade reform is demonstrated in Chapter 5. Noncredible reform was shown to be functionally equivalent to temporary reform in the sense that both create an intertemporal distortion. Thus, under plausible circumstances, noncredibility itself makes a reform suboptimal, when it would have been optimal if credible. Enhancing credibility is important. We showed that the gradual implementation of trade reform is optimal if there is a credibility problem. Also, capital account liberalization may possibly be immiserizing if the government faces a serious credibility problem, again vindicating the view that capital account transactions should be controlled if the government's trade reform is perceived to be incredible to the public. Hence, we argued that under some circumstances maintaining capital controls would mitigate any intertemporal distortion in consumption, and hence could reduce any intertemporal costs caused by a noncredible nature of trade reform.

Korea's trade liberalization policy in the 1980s was examined. We observed that by and large the exportable industries, which have been the nation's "engine of growth," expanded during the reform period, and conversely the import-competing industries contracted. In terms of the sequencing of trade liberalization, we have seen that Korea's trade reform policy has been evolved according to standard recommendations.1 Throughout the reform stages, and especially in Phase II, neither the Latin American style

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of abrupt liberalization was adopted, nor were the reform temporarily ended, and as a result the government's credibility has been strengthened. One may say that Korea is a standard example of gradual, non-temporary, and credible trade policy reform.

The theoretical analyses of our issues were reexamined using a large multi-sector simulation model for Korea. Various assumptions on timings, sequencing, and speed and credibility of trade reform were specified and subject to run hypothetical simulations. The simulation results suggested that the theoretical predictions are in most cases robust in regard to sub-optimality of temporary (or incredible) trade reform. Our findings also confirm that the wealth effects of permanent trade reform are substantial, and at the same time, that the intertemporal consumption substitution resulting from a temporary reform is not negligible. The dynamic time paths of gradual versus abrupt permanent reform also support the theoretical arguments. In the second part of the simulation work, mid- to long-run predictions of Korea's most recent trade reform announced in 1988 for 1989-1993 were made. Two hypothetical scenarios were run: a credible and an incredible reform scenario. Trade-offs between welfare and the trade balance were observed. If the reform program is implemented according to the government's announcement, then the nation's welfare will be substantially improved although accompanied by a deficit in the current account in the short-run. However, our results also suggested that if the program is not implemented as announced, welfare costs would be incurred, with their magnitude depending upon when tariffs are raised again.

8.3 Agenda for Further Study

There are limitations to this study. First, we have examined the timing issue as if the credibility level is exogenously given. However, it would be reasonable to assume that the credibility is not exogenous, but is rather determined by economic events when the reform is in effect. There may include the ex post current account deficit, real exchange rates, investment levels, unemployment, and real wages, etc. For example, if the current account deficit is excessive during the transition of reform, the private sector may expect
that the government will reimpose tariffs to reduce deficits. Thus, the level of credibility and ex post current account deficits can be determined simultaneously.

Second, we have assumed that industry is perfectly competitive. This may not be a reasonable assumption, especially from the viewpoint of the Korean industries. Imperfect competition may be more common in reality. The welfare gains and the effects of trade reform on the current account can be reexamined under this assumption.

Third, although we have conducted some sensitivity experiments in the simulation analyses, other parameters imposed in the simulation analysis are not estimates obtained from recent Korean data, and hence the validity of the simulation results would be diminished if the adopted parameters and elasticities deviate far from their true values. Although this is a common problem for computable general equilibrium analysis, rigorous econometric estimation may be required to obtain more reliable results.

Finally, interactions between domestic financial repression, trade liberalization, and capital account liberalization were abstracted from. This would be one of the most important extensions of this thesis, especially considering the Korean financial structure. Incorporating some characteristics of financial repression (such as the curb market activities) into our framework may alter some of our results (at least qualitatively) in the sense that financial repression is essential to the saving-investment decision, and hence the current account. Ultimately, we could have more broad and general sequencing recommendations including domestic financial liberalization.

These are possible future extensions of this thesis.
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