AN ANALYSIS OF THEORETICAL AND APPLIED ISSUES IN FISCAL FEDERALISM AND LOCAL PUBLIC ECONOMICS

by

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In compliance with the requirements relating to Examination and Submission of the Thesis for the Degree of Doctor of Philosophy of the Australian National University, it is affirmed that, unless otherwise stated, the work that follows is my own.
I am indebted to Richard Cornes, Cliff Walsh and Graeme Wells for their willingness to provide encouragement, ideas, constructive criticism and make available their time during the course of research for this Thesis.

Thanks are also due to Perry Shapiro for the many sessions spent in discussion on federalism issues and for the opportunity to undertake the joint work in Chapters 5 and 6.

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This Thesis is a study of theoretical and applied issues in fiscal federalism and local public economics. The main theoretical issues to be examined include: (i) the welfare and provision implications of local public good externalities; (ii) the break-down of neutrality of lump-sum transfers when regions generate externalities and have different populations and marginal costs; (iii) the fly-paper effect; (iv) the inducement for independent political entities to federate; (v) the rationale for redistributitional transfers and the importance of certain federal institutions; (vi) tax competition and tax exporting; and (vii) the implications of considering the interaction between free internal migration and public good externalities in federal economies.

The applied issues relate to Australian fiscal federalism where two questions are analysed. They are: (i) why has Australia developed distinctive equalising procedures and institutional mechanisms for transferring income between states? and (ii) why has there been a relatively extreme degree of centralisation of taxation powers?

Although there are many ideas to emerge from the Thesis, three of the main conclusions are: (i) there may be benefits for independent political entities to cooperate in the provision of public goods and taxation of citizen-voters; (ii) diversity of preferences constrains the degree to which such cooperation may occur by imposing 'uniformity' costs on some of the participants in cooperative behaviour; and (iii) an important role for income transfers and institutional mechanisms in federal systems is to redistribute these costs and benefits to make cooperative behaviour more attractive.
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INTRODUCTION

1.1 Aims

The primary aim in this Thesis is to examine a number of issues in the theories of fiscal federalism and local public economics - fields of study within the overall subject of public economics, broadly defined. Some of the existing results to be found in these literatures are generalised and extended, and a number of new results are presented. The second aim is to analyse some issues specific to Australia's federal system. The following discussion expands on these aims, suggests why they are of interest and outlines how they are pursued in the work to follow.

1.2 Theoretical Issues

Public economics addresses three questions:

(i) What areas of economic activity should government be involved in (rationale for intervention)?

(ii) What decision rules should government follow once the rationale has been resolved?

(iii) How should government finance expenditure (taxation theory)?

The rationale issue is analysed using as a departure point the two fundamental theorems of welfare economics which state that: (i) a competitive equilibrium, if it exists, is Pareto optimal; and (ii) any Pareto optimum can be supported as a competitive equilibrium with appropriate lump-sum transfers [see Laffont (1988)]. If a competitive
equilibrium exists, and the underlying technical assumptions are met, then this implies that the only role for government is to implement lump-sum transfers, since markets will ensure that a Pareto optimum is achieved.

However, the assumptions underlying the notion of a competitive equilibrium typically fail to apply. Among other things, the simple competitive model ignores market failures, including externalities, public goods and non-convexities, the presence of which imply that a competitive equilibrium may not exist, and if it does, that the two theorems might not hold. There is then potential for government intervention through allocational and distributional policies to correct for these market failures and achieve a social optimum (the rationale for intervention). This raises the question of what decision rules government should follow in intervening in the economy. For example, optimal Pigovian taxes and subsidies and assignment of property rights are often discussed as corrective measures for the distortions caused by externalities. Similarly, the failure of markets or voting mechanisms to solve the problem of preference revelation with respect to public goods has created an extensive literature on incentive mechanisms for preference revelation, including the well-known mechanism of Groves and Ledyard (1977). Finally, given the rationale for intervention, and analyses of optimal decision rules, public economics addresses the issue of how intervention should be financed so as to minimise the welfare costs of taxation (taxation theory).

The bulk of public economics, in effect, assumes a unitary structure of government. However, several somewhat disparate strands of it attempt to address issues arising in economies with multi-tiered levels of government. For example, the literatures on fiscal federalism and local public economics consider, among other things, the rationale for, and the consequences of, having at least two 'levels' of government. These literatures add considerable depth and richness to the theory of public economics.
Arguably, the most important question of all raised in these literatures is why have multi-tiered government, or federalist-type structures, at all? Why should a single national government not undertake all the allocational and distributional tasks called for by the failure of markets?

Many other interesting issues arise by recognizing that a key feature of federal systems of government is the openness of localities to one another. Openness has a number of important implications. First, it implies that people can migrate relatively freely between localities, at least compared with international migration. Mobility, therefore, influences the size of regional populations for which local public goods must be produced, and the preferences and incomes of that population, thus having an impact on the mix and level of public good provision in a particular region. Also, mobility raises efficiency questions, such as: (i) what is the optimal population of a jurisdiction? (ii) what is the optimal distribution of a given national population between regions; and (iii) will freely migrating residents establish a population distribution which replicates this optimal distribution, and if not, what corrective policies are called for on efficiency grounds?

Second, openness implies that goods, services and capital are relatively freely mobile across regional borders. There are fewer impediments to free trade, such as tariffs or quotas, than between countries. Local public expenditure and tax policies will influence these flows with implications for welfare. Indeed, regions may have an incentive to use their tax and expenditure policies to distort trade in order to secure some local advantage for themselves, even if doing so has wider national welfare costs. For example, regions may be able to export their regional taxes to other regions, and engage in tax competition, both of which may distort the flow of trade within a federal system with consequent welfare costs. On the other hand, the free flow of goods and services will influence the determination of local tax and expenditure policies.
Finally, openness of regional economies may mean that public goods provided in one region generate benefits or costs for residents in neighbouring regions. These public good externalities also have implications for welfare.

Another important feature of federal economies is that not only will a particular locality be open to others at the same level, but it will also have to interact with at least one other level of government (and probably more) which also has some jurisdiction over its citizens. This leads to other forms of government interaction in federal economies, in addition to interaction between governments of the same level. First, the central government may need to intervene, on efficiency or distributional grounds, in the affairs of other level governments. For example, there may be positive local public good externalities between localities which are not taken into account by those localities, leading to a loss of social welfare. In this case, the central government could provide corrective matching grants to localities. Alternatively, the central government may need to provide fiscal equalisation grants to lower level governments to correct for distortions associated with the free migration process, or it may wish to provide such grants on equity grounds.

Second, governments at different levels may compete with one another (just as governments within the same level may) if, for example, they are attempting to tax the same tax base. An Australian example of this is the taxation of coal mining rents by both the State and Commonwealth Governments in the State of Queensland. It has been argued that this form of rivalry has created welfare losses.

Other forms of interaction between governments at a different level may also arise when there are conflicting distributional goals, or governments place different weights on the welfare of individuals, or groups of individuals.

Finally, the need, or wish, of central governments to intervene in other governments' affairs on either distributional or allocational
grounds, implies that grants from the central government to regional governments are required in federal economies (although other instruments may also be available). These grants introduce a range of interactions between governments, and raise issues such as: (i) what are the real effects of income redistribution between regions (undertaken by a central government)? and (ii) how do recipient and donor governments respond in terms of expenditure and taxation decisions to such redistribution?

In summary, while fiscal federalism and local public economics address the allocational and distributional questions of interest in public economics generally (but at the local level), they also concentrate attention on those issues which arise because of the presence of more than one level of government. The primary aim in this Thesis is to offer some additional analytical insights into a selection of these theoretical issues, in particular, local public good externalities, neutrality, the real effects of lump-sum transfers, the fly-paper effect, the inducement to federate and form federal-type structures, tax competition and tax exporting, and the implications for welfare and efficiency of considering the interaction between public good externalities and population mobility in one model of a federation.

1.3 Australia’s Federal System

In common with other federations, Australia’s federal system embodies the features outlined above and hence the issues discussed are also important in an Australian context. However, Australia’s form of federalism also has a number of distinguishing features which raise somewhat different, though important, theoretical questions.

This, together with the fact that very little analytical work has been done on Australian federalism, was recognised by Gramlich (1984) in his survey of Australia’s fiscal federalism arrangements when he concluded that:
'As an outsider from the United States, a country that worries perhaps excessively about its federalist institutions, I could not help but be struck by how little most public servants and economists in Australia appear to care about fiscal federalism. With few notable exceptions, very little economic research is done on federalism. The Australian federal system has its strong points, it could be improved, and there is no shortage of interesting analytical issues. Somebody ought to take it seriously.'

One significant feature of Australian fiscal federalism, which turns out to have considerable economic implications, is the high degree of centralisation of revenue collection responsibilities, coupled with decentralisation of expenditure responsibilities. Both at, and following, federation in 1901, the Australian States relinquished many of their taxing powers to the Commonwealth Government. For instance, at federation, the States lost not only their powers over customs duties (through Section 90 of the Constitution), but also their capacity to impose excise taxes (also through Section 90). Because of subsequent High Court of Australia interpretation of the meaning of excise, this has effectively excluded the States from the indirect tax base, with the exception of some franchise fees. Centralisation of taxes continued in later years, when, during WWII, the Commonwealth obtained responsibility for income tax. Though not constitutionally excluded from this base, as they are with indirect taxes, the States have not had access to the income tax base since then. Centralisation of indirect and income tax bases has meant that the States now rely on a relatively narrow, and some would argue, inefficient range of taxes, including payroll, property, financial transactions and resource taxes.

Together with the fact that the States have retained considerable expenditure responsibilities (for example, in areas such as health, education, law and order, transport and social welfare), centralisation of taxation responsibilities has contributed to a second distinguishing feature of Australian federalism: a relatively high degree of vertical fiscal imbalance.

As Walsh (1990) notes:

'Arguably the distinguishing feature of the Australian federal fiscal system is its extreme degree of vertical fiscal imbalance.'{(2)

He goes on to compare the Australian situation with that in other federations, concluding that

'Australia's federal fiscal arrangements are the most vertically unbalanced among the major advanced federations with which we are most appropriately compared (that is, those of Europe and North America).'{(3)

The degree of vertical fiscal imbalance in Australia has spawned a large literature on its economic costs, in particular, the problems it creates for accountability and responsibility, and proposals for redressing these problems, including the States' sharing the indirect and income tax bases with the Commonwealth [for example, see Mathews (1983, 1987), Freebairn, Porter and Walsh (1989), and Walsh (1990)].

Excessive vertical fiscal imbalance also necessitates that large Commonwealth general revenue grants be made to the States. This leads to a third distinguishing feature of Australian federalism: the way in which these grants are determined. Responsibility for recommending State shares of the pool of funds available to the States is held by the Commonwealth Grants Commission (CGC). It uses a principle known as 'fiscal equalisation' in determining these State shares. The principle of fiscal equalisation, as implemented by the CGC is as follows:

'Each state is entitled to receive a level of general revenue funding from the Commonwealth which would enable it to provide, without having to impose taxes and charges at levels appreciably higher than the levels imposed by the other States, government services at standards that are not appreciably different from the standards provided in the other states.'{(4)

2. Walsh (1990), p 55.
3. Walsh (1990), p 56.
As with the concerns over fiscal imbalance, the procedure adopted by the CGC for recommending State shares of general revenue funds has been criticised on the grounds that: (i) the grants themselves have become political rent-seeking variables, generating economic costs; (ii) the CGC tries to eliminate cost differentials in the provision of public services between States in its equalisation formula (that is, it tries to equalise tax prices across regions) which may generate efficiency costs; (iii) the procedure is not really an equalising scheme at all since it neither equalises true fiscal capacity nor expected public expenditures [see Gramlich (1984) and Walsh (1989) for discussion].

Indeed, Gramlich (1984) notes, with respect to the CGC and equalisation in Australia, that:

'This attempt to equalise public spending capacity across states is the most explicit and comprehensive in the world, .... Moreover, while CGC members and economists often are frustrated by the slowness of changes, the fact is the CGC is powerful, is listened to, and even makes fairly significant changes in the equalising provisions that are eventually adopted.'

Moreover, Gramlich (1984) offers the view that this emphasis on equalising is based on an Australian concern with 'equality' as the following comment indicates:

'The Australian belief in equality and apparent fear of market outcomes are evident in the system of fiscal relations between the Commonwealth and the State Governments. From the standpoint of equality Australia has the most equalising federalist system in the world.... But from the standpoint of protection from market outcomes there are many inefficiencies in the Australian system,...',

In summary, three of the distinguishing features of Australian fiscal federalism are; (i) the relatively extreme degree of centralisation of taxes; (ii) a high degree of vertical fiscal imbalance; and (iii) the way in which general revenue grants are allocated to the

States, and in particular, the emphasis given to equity and the central role of a single institution, the CGC.

A number of interesting issues in Australian federalism relate in one way or another to these distinguishing features, and, indeed, one can think of many worthwhile questions to address, including: (i) what were the underlying motives behind the centralisation of taxes (for example, the indirect tax base and Section 90 of the Constitution); (ii) why was the CGC, which has such a central role in federal arrangements, formed; (iii) what were the motives behind the development of the fiscal equalisation principle; and (iv) is the apparent concern with equality of outcomes, as highlighted by Gramlich (1984), the only, or the most important, motive behind equalisation or does equalisation serve some other economic purpose?

The second purpose of this Thesis is to accept Gramlich's challenge that the analytical issues in Australian fiscal federalism should be taken seriously, by analysing a number of these issues. An overview of the way in which the analysis proceeds can be obtained from a brief review of each Chapter.

1.4 Outline of Chapters

Chapter 2 is a selected review of the fiscal federalism and local public economics literatures. The discussion is highly selective, referring only to those parts of the literature relevant to the issues to be analysed.

One implication of openness, noted above, is that there may be local public good externalities generated by regions. The welfare and provision implications of such externalities are examined in Chapter 3. The specific aim is to show that, since externalities in a federation introduce a form of regional interdependence, they can be modelled in terms of a static Nash equilibrium between regions making voluntary contributions to local public goods, implying under-provision of local public goods and Pareto sub-optimality.
The Nash equilibrium can be characterised in terms of voluntary contributions to local public goods, or in terms of total taxes collected in each region, implying a direct correspondence between Lindahl equilibria and Nash equilibria. Therefore, the traditional Pigovian remedy for regional externalities, explained, for example, in Oates (1972), can take the form of either matching expenditure grants or tax subsidies.

It is also shown in Chapter 3 that when modelled under the Nash behavioural assumption, regional externalities introduce competition between regions analogous to the notion of competition adopted in much of the tax competition literature (which often adopts the Nash framework). The analysis also gives a modern interpretation of some of the basic ideas of fiscal federalism theory, including a number of those to be found in Oates (1972). Indeed, many of the results here are linked with those of Oates (1972), especially his notion of perfect correspondence. A final aim in Chapter 3 is to develop a basic model for use in later Chapters.

In Chapter 4, the model of Chapter 3 is adopted in order to contribute to three related literatures, which effectively examine interactions between regions arising from openness to one another, and interactions with the central government. These are the literatures on: (i) neutrality of lump-sum transfers; (ii) the potential for lump-sum transfers to be Pareto improving; and (iii) the 'fly-paper' effect.

With respect to (i), it has been shown [see Boadway, Pestieau and Wildasin (1989b)] that under certain conditions lump-sum transfers between regions undertaken by a central government may be neutral in their impact on per-capita welfare and levels of consumption of pure public and private goods, holding out the prospect of one hundred percent crowding out of central government redistribution by offsetting local actions. Chapter 4 aims to show, first, how neutrality breaks down once certain complexities of fiscal federalism are allowed for; in particular, local public goods and externalities, different regional populations and different marginal costs of producing local public goods. The discussion
goes on to emphasise the role that local public goods play in the process of breaking down neutrality, and in determining the real effects of lump-sum redistributions.

In relation to (ii), there is a literature which examines the possibility that lump-sum redistributions may be Pareto improving when the donor and recipient are linked via philanthropy [see for example, Hochman and Rodgers (1969)]. Chapter 4 argues that analogous Pareto improving lump-sum transfers can be made by a central government between regions in a federation, but without any need for donor and recipient to be linked by philanthropy. All that is required instead, is that there be interdependence through local public good externalities of a particular type.

Finally, the analysis in Chapter 4 shows that regional interdependence through local public good externalities also creates a 'fly-paper' effect; that is, a one dollar lump-sum redistribution leads to a greater provision response by the recipient region than a one dollar increase in its endowment. This has been a puzzle in the fiscal federalism literature for some time, and the model in Chapter 4 offers a further theoretical explanation for it.

Chapter 5 addresses two questions, one of general theoretical interest and the other of applied interest. The questions, which turn out to be closely related, are: (i) why have federal-type structures? and (ii) why the CGC and the principle of fiscal equalisation may be of such central importance in Australian fiscal federalism.

The first question is relevant in present times. In Canada, interest has developed because of internal tensions within an existing federation. In other cases, the interest is the other way; that is, in setting up a federation from independent nations or regions. The most striking example here is the European Community's recent moves toward a form of federalism. An example of both disintegration and federation is provided by the break-up of the former Soviet Union and the formation of the Commonwealth of Independent States. Even Australia, which has long
accepted its basic federal arrangements, is experimenting with new ideas about how to organise its federal system.

In addressing this question, a model of three independent regions is developed whereby each provides the level of public goods demanded by the median voter. It is shown that federation between the regions may yield a benefit or welfare gain: a tax price benefit associated with provision of the public good. On the other hand, federation may also bring with it a welfare loss: the regions which do not have the median demand within the federation will be forced to contribute to and consume the median’s preferred level of consumption, leading to a welfare loss for these participants in federation.

It is then argued that if regions are sufficiently similar in terms of preferences, there may be a social surplus from union, or excess of gain over loss. However, if parties are sufficiently different, union may lead to a social loss for some regions, even though there is a net social gain or positive surplus overall. In this case, federation will only proceed if there are compensating payments made to the losers, and if there is sufficient surplus to enable such payments to be made while securing a Pareto improvement.

Hence, income transfers, and the institutional mechanisms needed to facilitate them, can be thought of as necessary for federation to endure, especially when there is heterogeneity among the participants. This compensatory need for redistributional transfers is in addition to any case for them on efficiency or equity grounds.

These results are used to address the second question of why the CGC, equalisation and equality goals seem to assume such importance in Australia’s federal arrangements. It is argued that the CGC, and the principle of equalisation, were developed in response to a need to compensate the ‘smaller’ states, such as Western Australia, Tasmania and South Australia, from losses they may have suffered as a consequence of federation. The CGC, and the equalisation it undertakes, may, therefore, be seen, at least in part, as necessary for federal unity. They are the
'glue' which holds the federation together and allows it to secure the net social surplus from union.

Thus, while Gramlich (1984) may have been right to suggest that there is a general concern in Australia for egalitarian principles in federal relations, the analysis here suggests that this apparent preoccupation with equality of outcomes may also be a response to the need to ensure federal unity and allow the States collectively to reap the net benefits of federation.

It was claimed previously that Australia's relatively extreme degree of vertical imbalance was partly due to a high centralisation of taxation powers, which in turn has its historical roots in the relinquishing of excise taxes to the Commonwealth at federation, through Section 90 of the Constitution. In Chapter 6, a spatial model of tax competition and tax exporting is developed, and the motives behind the inclusion of excise taxes in Section 90 of the Constitution are examined. It is argued that giving up excise taxes to the Commonwealth may have been the result of fears about tax competition between the States threatening the sufficiency of State revenues, together with concerns over federal unity. This is in contrast to the usual view which emphasises the distortions to free internal trade as a reason for centralising such taxes.

Further, it is suggested in Chapter 6 that centralisation of excise taxes through Section 90 may indeed have alleviated State concerns over sufficiency of revenues, depending on the revenue sharing rule adopted and the operation of another key Constitutional Clause. In particular, by characterising cooperative equilibria and comparing them with the Nash-competitive equilibria, it is argued that total Commonwealth excise tax revenue collections may have been higher than total collections if the States had retained independent excise tax powers. However, because

7. Some may argue that egalitarian principles pervade public life generally in Australia and have a strong presence in the Australian psyche.
of the presence of Section 99 (which effectively imposed a uniform tax rate constraint on the Commonwealth), and the Braddon Clause (which was essentially a revenue sharing rule), some States may have lost excise revenue as a result of Section 90, implying the need for compensating transfers. Therefore, the Chapter presents the view that minimisation of tax competition and sufficiency of revenues were important motives behind at least one instance of tax centralisation in Australia.

Apart from these results of interest in an Australian context, the Chapter also yields many results on tax competition and tax exporting, which are of a general interest.

While Australia's fiscal federal arrangements have been largely motivated by concerns over equity, and, as argued in Chapter 5, at least partly on federal unity concerns, in recent years there has been a growing interest in the efficiency implications of the federal system. This interest has been strongest in relation to fiscal equalisation, as practiced by the CGC, and efficiency. However, to date very little analytical work has been done on the issue of whether there is, or is not, an efficiency case for equalisation in Australia. This is in contrast to Canada where there is a substantial literature analysing fiscal equalisation in an efficiency context [see for example, Boadway and Flatters (1982a), (1982b)].

In an attempt to redress this, Chapter 7 extends the model of Chapters 3 and 4 to: (i) allow for labour mobility; (ii) characterise a free migration equilibrium (with no public good externalities); (iii) present the case made in the Canadian literature for fiscal equalisation on efficiency grounds; and (iv) highlight the issues which need to be resolved if one is to assess whether this literature has anything to say about the case for, or against, fiscal equalisation on efficiency grounds in Australia.

Chapter 8 returns to examining issues of a general theoretical interest. In particular, it extends the migration model of Chapter 7 (effectively the model of Boadway and Flatters (1982b)) to allow for
local public good externalities, thus bringing public good externalities and labour mobility together in one model of a federal economy. It is shown that this has important implications for the optimal equalising transfer derived by Boadway and Flatters (1982b), the nature of free migration equilibria and interdependence between matching and equalising grants.

Finally, Chapter 8 returns to the questions of neutrality and the fly-paper effect from Chapter 4, where they were examined in a fixed regional population context, and it is shown that mobility has interesting implications for the break-down of neutrality and the fly-paper effect when public good externalities are also present.

The last Chapter, Chapter 9, presents the main themes and ideas from the Thesis overall.

1.5 General Comments

There are a number of general comments which should be noted.

First, as may be obvious from the review of Chapters above, each Chapter addresses a particular set of issues using a model developed specifically for the purpose, with particular conclusions being made at the end of each Chapter. Accordingly, for the most part, the Chapters are written so that they can be read as independent pieces of work, with the possible exception of Chapters 7 and 8, which should be read together, and to a lesser extent Chapters 3 and 4.

Second, however, it becomes clear as one progresses through the material that there are interconnecting themes, both in terms of ideas and the underlying modelling methodology. Chapter 9, the concluding Chapter to the Thesis, presents these major themes and draws together general conclusions from the Thesis considered as a whole. It does not seek to restate the specific conclusions found in the concluding sections of each Chapter.
Third, a word about the behavioural model of government adopted and assumptions about preferences. Chapters 3, 4, 7 and 8 all adopt the simplifying assumption that governments optimise the preference function of a representative resident. As will be discussed in Chapter 2, this assumption pervades much of the theoretical work in the literature. The advantage of making this assumption is that it enables one to derive results while abstracting from the added complexities of government 'preferences' which differ from those of citizens.

More realistically one would like to be able to capture the influence of government decision-making on resource allocation and welfare by modelling governments as self-interested economic agents rather than simply replicating residents' preferences perfectly. To this end, Chapter 5 adopts a median voter model of government decision-making. As will be seen, it is the resolution of the public choice problem in this Chapter which is the source of a major cost of federation, and takes a central place in the analysis. Similarly, in Chapter 6, a leviathan model of government is adopted in the Brennan and Buchanan (1980) tradition. Again, it is the role of governments as revenue maximisers without regard for residents' preferences, which generates many of the results in this Chapter.

These comments about behavioural models of government also lead one to think about assumptions made regarding preferences. Much of the literature adopts the assumptions of identical preferences, allowing the application of the representative consumer/resident assumption which facilitates analysis in complex models. This assumption is also adopted in this Thesis, again with the notable exception of Chapters 5 and 6. In Chapter 5, heterogeneity of preferences and the median voter model of government decision-making go hand in hand, while in Chapter 6, regional governments are allowed to have different 'preferences' over tax-expenditure mixes. In both chapters, diversity of preferences is important in generating the results.

Finally, the following numbering convention is adopted. Each equation, figure and table is referenced by two numbers: the first is the
chapter number and the second is the number of the equation, figure or table within that chapter. For example, equation 6.5 is equation number 5 within Chapter 6. When citing an equation, figure or table within the same chapter, only the second number is referred to. However, when citing an equation, figure or table in another chapter, both numbers are used.

1.6 Conclusion

This Thesis is a study of some specific issues in the theory of fiscal federalism and local public economics, including local public good externalities, neutrality, lump-sum transfers, the fly-paper effect, interregional migration and public good externalities, tax competition and tax exporting. An attempt is made to generalise and extend a number of existing results in the literature, and present some additional insights.

It is also a study of at least three applied issues of interest in an Australian context, but which also have more general theoretical implications. These include; (i) motivations behind the centralisation of a key tax base at federation, namely excise duties; (ii) the reasons for the emergence of the CGC and its central role in Australian fiscal federal relations; and (iii) the motivation behind the development of equalisation and the apparent concern with equity.
CHAPTER 2

SELECTED LITERATURE REVIEW

2.1 Introduction

In Chapter 1 it was claimed that the primary purpose in this Thesis is to analyse selected issues in the theory of fiscal federalism and local public economics. The aim in this chapter is to provide a brief overview of the relevant literature. The discussion is selective, in the sense that emphasis is given to those parts of the literature which are directly relevant. Some aspects are either not referred to at all, or are only mentioned in passing. References used include Tresch (1981), Wildasin (1986), Boadway and Wildasin (1984) and individual papers. In addition to this overview, the individual Chapters contain more detailed reference to the literature where necessary.

The question of why have local economies or federal-type structures is discussed first, and then the issues which flow from the openness of regional economies, including population mobility, tax competition, tax exporting, public good externalities and interaction between regions and central governments are examined.

2.2 Why Have Local Economies or Federal-Type Fiscal Structures?

This question is usually discussed by asking why decentralisation should occur within a mature nation-state. The analysis typically starts with an implicit assumption that there is a central government, and the issue is why a system of sub-national governments with independent fiscal powers should or should not be created. The choice is seen as one of decentralisation versus centralisation.

Important contributions to this issue have been made by Stigler (1957), who developed his 'menu approach', and Oates (1972), who came up
with the notion of 'perfect correspondence' and the 'decentralisation theorem'. In addition to these ideas, the theory of club goods has something to tell us about optimal jurisdiction formation. There are also arguments in favour of decentralisation, or federalism, which rely on appeals to imperfect information on the part of central governments over local preferences: the idea that local governments are closer to the people and 'know' their preferences better. Another case, which has been put forward by Brennan and Buchanan (1980), is that federalism constrains the taxing powers of government in the interests of citizen-voters. Each of these arguments is examined below.

2.2.1 Stigler's Menu Approach

One of the first economists to try to justify the existence of local jurisdictions was Stigler (1957). He developed two principles; first, that representative government works best when it is close to the people, based on the view that local governments perceive their residents' preferences better than 'distant' national governments; and second, that subsets or groups of people in a country have the right to vote for different amounts of public goods than other groups. To Stigler, these two principles imply that decision-making should occur at the lowest level of government consistent with allocational efficiency and equity.

Stigler also argued that the national government is the appropriate body to resolve distributional issues to avoid inconsistencies and competition. Responsibility for allocation throughout the fiscal hierarchy then depends on the geographical extent of externalities and decreasing costs. A governmental body must be large enough to capture all the decreasing costs of a particular service, or to include all citizens affected by an externality creating activity, but no larger. Hence, the optimal size of a jurisdiction will vary.

2.2.2 Perfect Correspondence

Oates (1972) formalized Stigler's original ideas by suggesting the notion of 'perfect correspondence'. The basic idea is that one level of
government should exist for each subset of the population over which the consumption boundary of some public good is defined. This is necessary in order to internalize any benefits and costs associated with provision of local public goods. Oates also explained how each level of government would maximize social welfare and provide a Pareto efficient level of public goods in an ideal world. Public goods in his view should be financed by benefit taxation.

However, as Tresch (1981) argues, perfect correspondence alone is insufficient to justify the existence of lower level governments. It is conceivable that a central government might achieve a Pareto optimum, if it could identify the extent of externalities and decreasing costs associated with local public goods, and provide optimal quantities. To make a convincing case for federalism something more than perfect correspondence is needed.

2.2.3 Decentralisation Theorem

Oates next proposed his 'decentralisation theorem' to justify federalism. His analysis proceeds as follows. Consider two national subgroups 1 and 2 within a total national population. All agents within each group are assumed to have identical preferences but preferences are allowed to vary between the groups. Also assume that the economy produces two private goods, x and y, and that all members of the population consume both x and y. Further suppose that y is produced by a government, central or local. Let the distribution of income be optimal. This implies that each subgroup can be seen as containing a single 'representative' agent.
In this simple economy, social welfare maximisation can be achieved by solving

\[
\text{Max } u_1(x_1, y_1) \quad (2.1)
\]

\[
(x_1, y_1, x_2, y_2)
\]

\[
\text{STo: (i) } u_2(.) = \bar{u} \quad (2.2)
\]

\[
(ii) F(x_1 + x_2; y_1 + y_2) = 0 \quad (2.3)
\]

The first order conditions are

\[
\text{MRS}^1_{x_1,y_1} = \text{MRS}^2_{x_2,y_2} = \text{MRT} \quad (2.4)
\]

If preferences are allowed to differ between the two groups, then \(x_1\) and \(x_2\) will not be equal and nor will \(y_1\) and \(y_2\). In this model, there is no difference in terms of efficiency if a central government provides \(y\) according to (4), or whether a separate government is formed for each subgroup, each individually satisfying

\[
\text{MRS}^1_{x_1,y_1} = \text{MRT} \quad (2.5)
\]

\[
\text{MRS}^2_{x_2,y_2} = \text{MRT} \quad (2.6)
\]

However, at this point Oates introduces second-best notions to the analysis by imposing a uniformity constraint on the central government's problem (1) to (4). In particular, he proposes that the central government be constrained to supply equal amounts of \(y\) to each subgroup: that is, \(y_1 = y_2\) regardless of local preferences.
It is easy to show that a central government can then only achieve the necessary conditions

\[ \frac{\text{MRS}^1_{x_1,y_1}}{x_1,y_1} - \frac{\text{MRS}^2_{x_2,y_2}}{x_2,y_2} - \frac{\text{MRT}_{x,y}}{x,y} + \frac{u_1}{u_2} F_x \]  

(2.7)

\( u_2 \) is a Lagrangean multiplier associated with society's production possibilities. \( u_1 \) is a Lagrangean multiplier associated with the constraint that \( y_1 = y_2 \). From (7) it can be seen that centralism no longer achieves a Pareto optimal allocation of public goods. Oates' decentralisation theorem follows:

'For a public good - the consumption of which is defined over geographical subsets of the total population, and for which the costs of providing each level of output of the good in each jurisdiction are the same for the central or the respective local government - it will always be more efficient (or at least as efficient) for local governments to provide the Pareto efficient levels of output for their respective jurisdictions than for the central government to provide any specified and uniform level of output across all jurisdictions'. (1)

The decentralisation theorem is an exercise in the theory of second-best and does not answer the question of why have a federal system in a first-best context. Oates only finds centralism to be sub-optimal by resorting to a policy constraint. This seems a little ad-hoc and it would be preferable for uniformity to be endogenous so that it is the product of an explicit collective choice mechanism. In this way, it might be possible to show in a first-best context that centralism results in uniformity with associated welfare costs. Nevertheless, standardisation of services provided by central government does seem to be observed in practice. Although at first sight Oates' expenditure uniformity constraint on central governments may appear arbitrary, it is in reality highly relevant to most federal countries and one can mount a compelling argument for its application in models of centralised provision of local public goods.

The decentralisation theorem only holds when comparing a first-best decentralised solution with a second-best centralised solution. However, we know that there are likely to be market failures particular to decentralisation. The most important and well documented are consumption externalities in the form of benefit or cost spillovers (discussed later). These externalities may not be internalised in federal systems. If there are significant externalities associated with decentralised provision, Oates decentralisation theorem may still not provide a justification for federalism, even within a second-best framework, if the social costs of uninternalised externalities exceed the social costs of uniformity. Indeed, if the costs of externalities are high, then one would need to resort to policies to correct for such externalities, such as Pigouvian subsidies, in order to resurrect federalism as a preferred system of government.

2.2.4 Local Jurisdictions as Clubs

The theory of optimal club size has been adapted to try to justify decentralisation, or federalism, and explain the formation of local jurisdictions. For a treatment of the theory of clubs see Cornes and Sandler (1986). The following discussion draws on their work and using a basic model of homogeneous clubs with fixed utilisation rates, shows what the theory of clubs may offer by way of explaining the formation of jurisdictions. Cornes and Sandler (1986) define a club as

'...a voluntary group deriving mutual benefit from sharing one or more of the following: production costs, the member's characteristics, or a good characterized by excludable benefits.'(2)

The latter is a club good, that is, a good with excludable benefits shared by the members of a voluntary group. Clubs must be voluntary and involve sharing. There must be an exclusion mechanism present to limit club size. The essential elements of clubs and club goods and their relationship with federalism can be illustrated within the context of a simple model of homogeneous clubs with fixed utilisation rates.

Consider two goods, a private good $y$ and a club good $x$. Homogeneous members of the club possess identical preferences and initial endowments. A representative club member is assumed to have the following preference function:

$$u_i = u_i(y_i, x_i, s) \quad (2.8)$$

$y_i$ is the $i$th member's consumption of private good $y$, $x_i$ is the $i$th member's consumption of club good $x$ and $s$ is club membership size in terms of the number of members. Note that $x_i = X$ for all members because of the assumption of identical utilization rates. Thus, each member uses what is made available. Member's utility functions are assumed to satisfy conventional requirements. Congestion is assumed to result in a decline in utility as $s$ expands beyond a certain value, $s^*$ (that is: $\frac{\partial u_i}{\partial s} < 0$ for $s > s^*$ and $\frac{\partial u_i}{\partial s} \geq 0$ for $s < s^*$). It is also assumed that there exists a costless exclusion mechanism. Together with the assumption of congestion, this implies that the club good is not a pure public good.

Members maximize their utility subject to a resource constraint $F_i(y_i, x_i, s) = 0$ where $\frac{\partial F_i}{\partial y_i}$ and $\frac{\partial F_i}{\partial x_i} > 0$. Suppose also that $\frac{\partial F_i}{\partial s} < 0$ implying that each member accepts a smaller share of the club's total costs as membership increases, ceteris paribus. Thus, there is a trade-off between the cost of increasing congestion once club membership exceeds a certain size and the benefit of a declining share of the club's total costs as membership rises. When marginal benefit and marginal congestion cost are equated, club membership is at an optimum.

A representative member's problem is to

$$\text{Max } u_i = u_i(y_i, x_i, s) \quad (2.9)$$

$$\text{STo: } F_i(y_i, x_i, s) = 0 \quad (2.10)$$
The necessary conditions are:

\[
\text{MRS}^i_{x,y} - \text{MRT}^i_{x,y} \quad i = 1,\ldots,s. \quad \text{(Provision)} \quad (2.11)
\]

\[
\text{MRS}^i_{s,y} - \text{MRT}^i_{s,y} \quad i = 1,\ldots,s. \quad \text{(Membership)} \quad (2.12)
\]

(11) shows that, for each member, the MRS between x and y must be equal to the MRT between x and y: that is, members must equate marginal cost with marginal benefit of membership. At the margin, if the club is breaking even, the sum of member's marginal cost or payments must be equal to the club's marginal cost. This means that

\[
\sum_{i=1}^{S} \text{MRT}^i_{x,y} = \text{MRT}_{x,y} \quad (2.13)
\]

(11) and (13) together imply the Samuelson condition for efficient pure public good provision.

The interesting outcome of this simple club goods analysis, with implications for federalism, relates to (12), the membership condition. It effectively determines the size of the club, that is, membership. Within the club, each member equates the MRS between group size and the private good y, thus achieving an equality between the marginal benefit (cost reductions due to cost sharing) of an additional club member and marginal cost of congestion. In other words, (12) implies that it is optimal to supply public goods to subsets of the population, rather than equal amounts to the whole population, because of the presence of congestion costs associated with impurity of the public good balanced against a tax price benefit as s expands.

Three points should be noted about this result. First, (11) and (12) must be determined simultaneously. Second, utility is maximised for representative members. This will lead to Pareto optimality overall only if certain conditions are met. In particular, the club must be replicable and the entire population must be a multiple of the optimal...
membership size according to (12), implying that the total population can be partitioned into a set of clubs with no-one left out.

Third, and most importantly for present purposes, this result does not provide a rationale for fiscal federalism. There is no reason why a central government cannot provide club goods, if it takes into account: (i) variations in the cost of the club good as access to it varied; and (ii) that it is not optimal to provide uniform levels of a club good with access to all, but rather different levels to various groups within the total population. Moreover, local autonomy will not guarantee that (11) and (12) are achieved, because people may not actually form themselves into optimal sub-groups.

2.2.5 Federalism Brings Government Closer to the People

Decentralisation may be justified if the assumption of perfect information is relaxed and uncertainty introduced. The following discussion draws on Tresch (1981).

Consider an economy with only one pure public good, $x_g$. Consumption is assumed to affect a subset of the population. Assume $h = 1, \ldots, K$ to be the affected subset and $h = K + 1, \ldots, H$ to be the unaffected subset. All other goods are private goods. With certainty, the first order conditions are:

$$\sum_{h=1}^{K} MRS^h_{g,l} = MRT_{g,l} \quad (2.14)$$

(14) is just the Samuelson condition. Now suppose that a local government can observe $MRS^h_{g,l}$ perfectly, but that a central government can only observe

$$MRS_{g,l} = MRS^h_{g,l} + c \quad (2.15)$$
Let MRS be the true marginal rate of substitution, observed by the local jurisdiction, and c be a random variable such that $E(c) = c$. In general, social welfare will be maximized by allowing the local jurisdiction to provide $x_g$ rather than allowing the central government to provide $x_g$ according to:

$$
\sum_{h=1}^{K} \frac{MRS_{g,l}}{MRT_{g,l}} = 2.16
$$

If the mean of $c$ is not equal to zero, the central government's decision rule will be biased with under or over-provision being the result. However, even if the mean of $c$ is zero, a risk-averse society may still prefer local provision under certain conditions (for discussion see Tresch (1981), p 575).

Those who support federalism on the grounds that local governments and politicians are somehow 'closer to the people' (this notion is implicit as far back as Stigler's menu approach discussed earlier), may have such uncertainty in mind. Geographic distance from central governments to local areas may adversely influence the transmission of information, so that there is something of a principle-agent problem. As Tresch notes

'...uncertainty is a more compelling argument for fiscal federalism, even though it may be merely another variation of a second-best decentralisation theorem'.

This idea remains to be pursued in the literature.

2.2.6 Federalism as a Restraint on Leviathan

Brennan and Buchanan (1980) provide a somewhat different rationale for federalism. They model governments as surplus or revenue maximising leviathans in order to test 'worst possible outcomes' against which political and fiscal constitutions need to protect citizens. It is

argued that one effective constraint on the taxing powers of a Leviathan central government is to break up its power among lower level governments and that decentralisation of power between competing governments, that is, federalism, will do this. Inter-jurisdictional competition, in particular, tax competition, 'constrains' the taxing powers of competing Leviathan governments relative to the revenue raised by a single Leviathan central government.

However, Flowers (1988) challenges the view that federal systems of government can constrain Leviathan and shows that the welfare losses from tax competition in a federal economy can exceed the losses associated with revenue maximisation by a central government Leviathan. Bell (1989) points out that there is another cost of federalism which must be offset against any benefits it may yield in terms of constraining Leviathan: the possibility that externalities associated with provision of local public goods will be ignored. He examines a trade-off which must be made between the costs of uninternalised externalities and the benefit of lower governmental taxing powers as decentralisation increases and concludes that the existence of externalities reduces the desirable degree of decentralisation needed to constrain Leviathan. This is because as decentralisation occurs the welfare losses from uninternalised externalities rise, partly offsetting the gains from reducing Leviathan's power. Nevertheless, Bell shows that some degree of decentralisation will be optimal even in the presence of externalities.

2.2.7 Summary

Attempts have been made to answer the question of why have federal-type systems on the basis of the need to satisfy diverse preferences, the uniformity costs of centralised provision (in the presence of diversity), informational considerations, club goods analysis and the possible benefits from constraining governmental taxing powers. The issue has generally been addressed by asking, what is the justification for decentralisation within an existing mature federal state, rather than asking, what is the inducement for independent political entities to federate? Nevertheless, the literature does provide important insights
into the costs and benefits of centralised versus decentralised forms of
government.

2.3. Openness of Local Economies and Free Mobility

Putting aside the basic question of why have federal systems and assuming
that we have a given federal structure, there are many issues which arise
from the openness of one region to another. For example, (as discussed
previously) openness of local economies in federations results in free
migration between regions. This raises a range of economic issues.

Much of the literature dealing with this aspect of local economies
began with the seminal work of Tiebout (1956). He attempted to show that
in a federation with a large number of regions, each choosing a mix of
local public goods and taxes, and with free mobility, the level of
provision of local public goods in each region would be optimal and
residents would locate between regions efficiently (an optimal population
distribution). However, Tiebout's work was not rigorous and he made a
number of restrictive assumptions. In particular, he supposed that: (i)
residents had full information about all alternatives; (ii) the number of
regions was high enough so that residents had a wide variety of tax and
expenditure choices; and (iii) residents' incomes were independent of
locational choice. Tiebout's conjecture was clearly stimulated by a
claim from Samuelson (1954) that people have no incentive to reveal their
true preferences for public goods and indeed face an incentive to conceal
them if the taxes they pay depend upon those preferences.

Tiebout's hypothesis offers a mechanism for truthful revelation of
preferences, at least for local public goods. Mobility between regions
means that residents can 'shop around' for the region offering the tax
and public good mix closest to their preferences. By 'voting with their
feet' people may reveal their preferences. Eventually, residents living
in a particular region might be expected to have similar preferences so
that people sort themselves by 'type' into various regions. In this way,
Tiebout claimed that the problem of preference revelation would be solved
for local public goods and optimal levels of provision achieved.
An extensive literature has subsequently emerged on Tiebout's conjecture. The literature can be usefully categorized under the following headings: (i) analysing the implications of household mobility for locational efficiency; (ii) studies testing for a Tiebout mechanism; (iii) positive theories of local public good expenditure determination in the presence of household mobility; and (iv) the general implications of mobility for local public good provision. A brief review of each of these literatures is presented below.

2.3.1 Location Efficiency and Mobility

There are four issues which are usually discussed under the heading of location efficiency. The first seeks to define a region's optimal population, the second looks at the optimal distribution of a given national population between regions, the third examines the efficiency consequences of free migration across localities and the fourth looks at optimal equalizing transfers.

(a) Optimal Population

The following discussion examines the issue of determining the optimal population of a region within a federation. This question has been studied by, among others, Flatters, Henderson and Mieszkowski (1974), Stiglitz (1977), Atkinson and Stiglitz (1980) and Hartwick (1980).

Characterising optimal local populations analytically is made more difficult when there are heterogeneous individuals. Hence, the literature assumes that all households in a jurisdiction are identical, in terms of incomes and preferences, and that all migrants are treated in the same way by local governments as existing residents.

Other assumptions made in these models include: (i) fixity of a factor, usually land, which generates regional rents; (ii) invoking the community preference model of local decision-making (discussed later) and assuming that regional governments adopt the Samuelson condition; (iii) cost functions for public goods incorporate a population term to capture
congestion and a public good output term to capture economies of scale; (iv) regional governments can control the number of residents in a locality; (v) no existing or new resident retains ownership of resources outside the region; and (vi) households leaving the region surrender ownership of local resources.

The key result is that a representative region \( i \) can maximise its per capita-welfare by adding residents to its population until the marginal product is equal to per-capita consumption of the private good, or

\[
MP_i = x_i
\]  

(2.17)

where \( MP_i \) is the marginal product of the marginal person in region \( i \) and \( x_i \) is per-capita consumption of private good in region \( i \). A migrant to region \( i \) consumes \( x_i \) but contributes \( MP_i \). Thus, entry will increase per-capita utility until \( MP_i = x_i \).

One can also show that when (17) is satisfied, rents earned on the fixed factor are equal to local public good expenditure [see Stiglitz (1977), Atkinson and Stiglitz 1980], Wildasin (1986) and Hartwick (1980) for further discussion]. That is:

\[
p_i q_i = f(n_i) - MP_i n_i
\]  

(2.18)

where \( f(n_i) \) describes aggregate regional output as an increasing concave function of \( n \) and \( MP_i \) is the marginal product of labour in region \( i \). This has been termed a Henry George Theorem.

The assumptions upon which these models of optimal population are based are open to question. One criticism is that, in practice, governments cannot independently vary the size of local populations to achieve an optimum since, as will be discussed below, in reality people

4. A detailed discussion of this result can be found in Wildasin (1986), p.25-26.
migrate freely between regions in federal economies. With free migration, regions will in general not achieve their optimum populations. The notion of optimal population and a free migration equilibrium are generally incompatible.

Nevertheless, the notion of an optimal population is of some interest as benchmark against which to compare free migration outcomes.

(b) Population Distribution Between Regions

The discussion above revolved around determining a region's optimal population when considered in isolation from other regions in a federation. Buchanan and Wagner (1970), Buchanan and Goetz (1972), Flatters, Henderson and Mieszkowski (1974) and Wildasin (1980) have examined the issue of how a given national population should be allocated efficiently across jurisdictions. The models used usually pose a planner's problem analogous to the one adopted in the optimal population models. The key results from this work are as follows. Suppose that the national economy consists of \( i = 1, 2 \) regions. For the federation's population to be distributed between the two regions optimally requires that the net marginal social benefit, or \( NMB_1 \), from adding an extra person to region 1, where \( NMB_1 = MP_1 - x_1 \) from the optimal population condition, equal the net marginal social benefit, or \( NMB_2 \), from adding a person to region 2, where \( NMB_2 = MP_2 - x_2 \) from region 2's optimal population condition. In other words, a federation's population is distributed optimally when the following holds:

\[
NMB_1 = MP_1 - x_1 = NMB_2 = MP_2 - x_2 \tag{2.19}
\]

(c) Free Migration Equilibrium

It is argued that (19) will not be replicated at a free migration equilibrium, because of the presence of two externalities associated with the free migration process [for example, see Boadway and Flatters (1982a) and (1982b)].
The first is a 'fiscal externality' which works as follows. When a resident migrates to, say, region 1 from region 2, they contribute to the cost of public good provision in region 1 (via their tax payment) and hence confer a benefit on all residents in region 1. On the other hand, the migrant ceases contributing to public goods in region 2, and hence a cost is imposed on region 2. It is argued that these costs and benefits are not taken into account by migrants in their personal cost-benefit calculus. A clear statement of this argument can be found in Buchanan and Goetz (1972), p.30.

The other potential source of distortion at a free migration equilibrium is a rent externality. The idea here is that the presence of regional rents accruing from a fixed factor may induce inefficient migration. If labour receives a share of rents on the basis of residency alone, they respond to their average rather than marginal product. At a free migration equilibrium, it is then possible that marginal products between regions would not be equated.

However, if fiscal and rent externalities are absent then free migration equilibria will yield an optimal population distribution. Wildasin (1986), p.14-17 provides a discussion of cases where free migration equilibria may be efficient. In addition to the points made by Wildasin, one should also note the following. The importance of fiscal externalities as a source of distortion depends upon the 'publicness' of the public expenditure of local jurisdictions. To the extent that regional expenditure is on publicly provided private goods, this distortion diminishes and in the extreme disappears. Thus, how important fiscal externalities are in practice is an open question. The significance of rents as a source of distortion depends upon the rents accruing publicly and being disbursed to residents on the basis of residency alone. However, if all rents went to persons solely on the basis of ownership of the rent-creating fixed factor, the distortion would disappear because ownership and residency would be determined independently.
(d) **Fiscal Equalisation Transfers**

The studies by Boadway and Flatters (1982a) and (1982b) highlight these two sources of distortion, and show that free migration equilibria may be inefficient. They argue that:

'This inefficiency can be eliminated by a particular system of interregional transfers of private goods either voluntarily arranged by the provinces or imposed by the central government'.

The authors call this an 'equalisation transfer' and suggest that it can be made by a central government or by regions themselves. Myers (1990) takes up this latter point. His analysis is discussed in Chapter 7. Others to demonstrate similar results include Hartwick (1980) and Stiglitz (1977). The essential idea behind the transfer is that it reallocates residents between regions until (19) is satisfied. Moreover, the transfer is a function of regional differences in the per-capita fiscal and rent externalities.

(e) **Summary**

To summarise this discussion of location efficiency and mobility, what the literature argues is that to achieve a Pareto optimum in a federation with free mobility, local public goods should be provided according to the Samuelson condition and population should be distributed so that net marginal benefits are equalised across regions. Because of the presence of fiscal and rent externalities, the latter condition is generally not achieved, implying the need for equalising transfers between regions, implemented by a central authority or by regions.

These ideas have made a contribution to the policy debate over fiscal equalisation and efficiency in Canada. In Australia, as argued in Chapter 1, fiscal equalisation has been seen more in the light of equity arguments, although in recent years the relation between efficiency and equalisation has emerged as an issue. Finally, there are many

qualifications to these results, most of which are discussed in some depth in Chapter 7.

2.3.2 Tests of Tiebout's Conjecture

A considerable amount of work has been devoted to testing Tiebout's conjecture. For example, it is often argued that property taxes, which may be used to finance local public goods are 'capitalised' into the value of property. If such capitalisation does exist, it is evidence that Tiebout's conjecture may be correct. The presence of capitalisation implies that people are not ignorant of local policy, since they are taking it into account in their market transactions. Accordingly, evidence of capitalisation is support for Tiebout's hypothesis. However, this literature takes us too far afield for the purposes of this Thesis, and is not reviewed here. For a discussion, see Wildasin (1986).

2.3.3 Theories of Local Government Behaviour

Openness of localities and free mobility also place an extra dimension on theories of how local governments determine their expenditure on local public goods. In the following discussion, some of the theories of government behaviour adopted in the literature are reviewed. The discussion serves as background to the behavioural models used in later Chapters.

(a) Community Preference (Benevolent Despot) Model

The simplest model is based on the view that a regional government acts like a single household, or group of identical households. This is a natural starting point for many theoretical and empirical studies of local issues because of its relative simplicity, and is sometimes referred to as the community preference, or benevolent despot model. It is adopted in Chapters 3, 4, 7 and 8.

It is usually assumed when applying this model in a federalism context that a region acts as an individual with an exogenously
determined level of income, or aggregate regional income. This income can be allocated between private and public good consumption. A jurisdiction chooses its level of local public good provision so as to maximise the welfare of its representative resident, subject to a regional budget constraint. Hence, the community preference model is really the two-person model of standard consumer theory, except that there are two regional governments rather than consumers, and the budget constraint is obtained by aggregating over a homogeneous regional population.

The community preference model continues to be used widely in theoretical work but not so much in empirical work. For example, as will be seen later, it is used in the theoretical analysis of inter-governmental transfers including the neutrality literature, tax exporting, tax competition and optimal local taxation. Although the model abstracts from any collective choice aspects of local government behaviour, effectively by assuming them away, it is often a necessary simplification in theoretical work in order to allow one to simplify some problems to a level which permits analysis. This explains its continued wide-spread use in theoretical work.

(b) **Median Voter Models**

Probably the simplest alternative to the community preference model is the median voter model, discussed in Mueller (1989). This is the model of government behaviour adopted in Chapter 5. The basic idea is as follows. Suppose that a public issue, for example, determining the level of provision of a local public good, is to be decided in an electorate of a fixed size by a number of pair-wise votes over a set of alternatives. Assume further that there is a simple majority voting rule. The pair-wise voting procedure continues until a policy (level of expenditure) is found which cannot be defeated by any pair-wise contest against any other alternative. Call this a majority voting equilibrium. If issues are defined along a single dimensional vector and each voter's preferences are single peaked in that one dimension, then this majority voting equilibrium will be the preferred outcome of the median voter. Given a
diversity of preferences over local public goods, the median voter model predicts that the median’s preferences will be implemented.

If single-peakedness is not met, it is possible that ‘cycling’ may occur whereby it is possible to keep re-defining an issue so as to benefit some people and harm others. New winning coalitions, containing some members of previously losing coalitions, and excluding members of the previously winning coalition, are always feasible.

The median voter model has been applied widely in empirical work on local public economics. For a review see Wildasin (1986) p.42-52. However, median voter models have a number of limitations. First, they often assume that all households within a given class have identical preferences and only differ in their incomes and tax prices. Second, it is usually assumed that preferences take some specific form which imposes additional restrictions on outcomes. Third, there are the ‘multiple’ and ‘fractile’ fallacy problems noted by Romer and Rosenthal (1979b). The multiple fallacy problem is simply that the level of public good output actually chosen by a region may not be the level preferred by the median voter. Instead, the actual level may only be related to the median’s preferences. The fractile fallacy refers to the problem that if local expenditures are decided by a decisive voter, as the median voter theorem suggests, how does one know that this voter is actually the one with median preferences?

Wildasin (1986) p. 53, notes that the multiple and fractile fallacy problems may be irrelevant in some cases. This would be so if the objective is to build a behavioural model with good predictive power and at the same time be certain that levels of provision are always some given multiple of the median’s preferred outcome. He also claims that a more compelling defence of the median voter model would be to show that it is in fact superior to proposed alternatives.
(c) Revenue Maximisation and Leviathan

Brennan and Buchanan (1980) argue that a leviathan government is interested in maximising a 'surplus,' $S$, which is the excess of revenue collections, $R$, over spending on specified uses, $G$, so that:

$$S = R - G$$

where

(i) $G = \alpha R$ and $0 \leq \alpha \leq 1$

(ii) $S = (1-\alpha)R$  \hspace{1cm} (2.20)

The authors go on to note that:

'Presumably, the tax-payer would prefer to have $\alpha$ set at unity, so that the entire revenue collected is expended on goods and services from which he and/or other tax-payers benefit. But even if $\alpha$ were nominally set at unity, it seems unlikely that no slippage would occur. And even if it did not, in the absence of specific restrictions on the tax side, revenue maximisation remains a good approximation for leviathan's maximand.' (6)

A revenue maximising model of government behaviour is adopted in Chapter 6 where motives behind the inclusion of excise taxes in Section 90 of the Australian Constitution are examined.

(d) Other Models of Government Behaviour

There are other models of government behaviour not surveyed here, including bureaucratic models, models of profit maximising localities and voting models with property markets. For a detailed discussion, see Wildasin (1986).

2.3.4 The Method of Taxation Literature

The discussion above on location efficiency and mobility assumed Samuelson levels of provision of local public goods, and examined whether location efficiency could be achieved by free migration. There is another literature which asks a slightly different question: under what circumstances will the Samuelson condition be violated in the presence of migration? The key idea here is that changes in local public good provision create interregional migration which in turn leads to changes in congestion levels and the size of a region's tax base. Accordingly, regions may have incentives to provide levels of local public good which are sub-optimal from a national perspective, the nature of the incentives depending upon the method of taxation.

In this regard, both Starrett (1980a, 1980b, 1982) and Boadway (1982) examine the implications of mobility for the optimality of local public good provision. Starrett's result is that a locality chooses efficient levels of provision if congestion effects of migration are internalised. If this does not occur, then regions have an incentive to distort their decisions to attract or repel migrants.

Thus, in Starrett's model it is possible for mobility to distort local public good provision decisions. However, he adopts the utility-taking assumption; that is, regions are small and per-capita utility is not influenced by their decisions. Alternatively, Boadway (1982) develops a model of non utility-taking regions which are open but large. He assumes that each jurisdiction maximises per-capita utility subject to an equal per-capita utility constraint. Boadway also assumes that regions perceive the effect of their decisions on the equilibrium level of utility in the economy as a whole. These assumptions imply that each region is maximising the common level of utility in the economy generally. Boadway argues that Nash-competing regions, under these assumptions, provide Samuelson levels of provision of local public goods if taxes are incident on domestic residents, and non-Samuelson levels when taxes are borne by non-residents.
Thus, whether or not one subscribes to the Starrett or Boadway view of the impact of mobility on local public good provision depends on the assumptions adopted: utility-taking small regions (Starrett), or non utility-taking large open regions (Boadway).

2.4. Regional Interaction

Another feature of federal systems (discussed earlier) is that any one locality is part of a structure containing a central government and other localities, either at the same or other levels. This means that there is a complex web of interactions between governments at the same level, and between governments at different levels. The following discussion examines some of the theories developed to analyse relations between localities of the same level. Issues which arise between regional governments of the same level include externalities, tax exporting, regional competition and income redistribution. As will be seen later, these issues can also arise between central governments and regions. Each issue is briefly addressed below, with the exception of the income redistribution question. For a survey of this source of regional interaction, see Boadway and Wildasin (1984), p. 505-511.

2.4.1 Local Public Good Externalities

As discussed, openness of local economies implies that there may be local public good externalities between regions associated with the production or consumption of local public goods. The discussion here concentrates on positive externalities, although negative externalities are also likely to be important. The efficiency implications of externalities between regions has been a major issue in local public economics. There are many examples of externalities. These include benefits from education, crime prevention, water quality control and environmental protection provided by one region which may be enjoyed by residents of other regions.

On the assumptions that jurisdictions have fixed populations and adopt locally optimising behaviour, one can show that these externalities
are ignored under decentralised provision and Pareto optimality is not achieved. In general, local public goods are under-provided relative to the Samuelson condition for optimal provision of local public goods. Contributions by Williams (1966), Brainard and Dolbear (1967), Pauly (1970) and Boskin (1973) have established this result.

Oates (1972) also gave considerable attention to externalities and their implications for efficiency in federal systems. He saw unaccounted for externalities as the most significant potential cost of decentralised provision of local public goods, and discussed Pigouvian subsidies to correct for any resulting inefficiencies. The idea behind Oates' analysis is that a central government can provide lower level governments with 'matching' expenditure grants that lower the per-unit price of local public goods, and hence increase provision. There exists an optimal matching grant which will establish Pareto optimal levels of provision in the presence of externalities.

Boadway, Pestieau and Wildasin (1989a) also analyse the Pigouvian remedy, although not in an explicitly federal context. They find, using a two-region voluntary contribution model with Nash behaviour, that there is an optimal matching rate grant which can be used to encourage the provision of optimal quantities of public goods. Boadway, Pestieau and Wildasin (1989a) also show that a Nash equilibrium with an optimal matching grant corresponds to a Lindahl equilibrium in which local taxes are benefit taxes.

Therefore, the result that positive externalities create under-provision and negative externalities over-provision, is widely accepted. However, these results only hold within the context of models based on the community preference assumption about government behaviour. Any general view on the implications of local public good externalities for welfare and provision under different assumptions about government behaviour remains to be developed.
2.4.2 Tax Exporting

While local spending can result in benefits for non-residents in neighbouring jurisdictions, local taxes can also be borne by non-residents. When a locality can shift the burden of some or all of its taxes onto other regions this is referred to as 'tax exporting'. It arises when regions value a unit of tax revenue raised from a neighbour more than they value a unit of revenue raised from within their own political boundary (presumably because the political cost of revenue collected from another region is zero).\(^7\)

There are at least three reasons why inter-regional tax exporting is important. First, if regions have an incentive to tax export, this may distort local tax structures creating inefficiencies. Second, tax exporting may induce higher than efficient levels of provision of local public goods. Finally, tax exporting is important from the point of view of tax incidence analysis.

The ability of a region to export taxes is a function of its market power, that is, the market constraints that it faces. In an early study of tax exporting, McClure (1964) showed how a local tax on an exported commodity might raise its equilibrium price according to the elasticity of demand facing the jurisdiction. Generally, the idea is that if a region is a price taker it has no capacity to export taxes. However, if it has some monopoly power, a region can increase its net welfare by imposing a positive tax on exported goods. This finding is analogous to the results from the optimal tariff literature.

This simple result indicates that localities may have an incentive to adopt taxes that may be optimal from a local but not a national perspective. In particular, tax exporting creates a negative externality imposed on other regions by the tax exporting region. As will be seen

\(^7\) There are similarities between regional and international tax exporting. For a discussion of the latter see Bhagwati and Wilson (1989).
below, tax exporting and tax competition are closely related since the latter imposes a positive externality on other regions.

How does tax exporting influence local public good provision? One view is that it leads to over-provision relative to a social optimum because it lowers the effective marginal cost of additional units of local public good. Other regions pay a portion of region i's cost of provision. This result is found, for example, in Oates (1972), Bird and Slack (1983) and Zimmerman (1983).

One exception is the work of Mieszkowski and Toder (1983) who find that tax exporting does not lower the effective price of local public goods and hence does not stimulate demand. However, their results depend on either: (i) no own-residents consuming the taxed good; and (ii) where own-residents do consume the taxed good, differential tax rates being applied to non-residents and own-residents. As noted by Wildasin (1987), these are somewhat special cases. If these assumptions are not met, then the Toder and Mieszkowski (1983) conclusions may not apply. One is then drawn back to the conclusion that tax exporting raises expenditure.

However, Wildasin (1987) shows that this is not necessarily so. He develops a more general model of tax exporting which encompasses the Toder and Mieszkowski (1983) cases, and concludes that tax exporting:

'...may, but does not necessarily, stimulate local public spending. Indeed,...it is possible that tax exporting by a system of jurisdictions might actually reduce local public spending through negative income effects associated with the deadweight loss from the distortion of trade.' (8)

The question of whether tax exporting leads to less or more public good provision must also be qualified by the question; less or more spending relative to what benchmark (this question is raised again in the discussion of tax competition)? In general, it is not clear what the reference point is, although often the level implied by the Samuelson condition is adopted. However, it is feasible that other references

could be adopted with legitimacy [for example, see Mieszkowski and Zodrow (1984)].

Thus, the key result of the tax exporting literature is that a tax in one region affects prices of taxed goods in other regions. This is only part of the effect of taxes however, because the tax will also cause output of the taxed industry to contract and factors to be reallocated creating further factor flows between regions. The issues that these general equilibrium considerations raise are to found in the theory of tax incidence. A number of analyses of these effects have been undertaken, including those by McClure (1967, 1969, 1970, 1971) and Gerking and Mutti (1981). The main insight is that when general equilibrium effects are taken into account, regions may not have an incentive to 'tax export' because there may be more than offsetting changes in the price of goods imported from other regions.

So far it has been assumed in this discussion of tax exporting that regions do not undertake strategic behaviour. In this regard, Kolstad and Wolak (1983) examine regions which adopt Nash equilibrium tax rates and show that tax exporting under Nash behaviour is less than that under cooperative behaviour. Strategic behaviour has also been important in tax competition as will be seen below.

In summary, one can say that tax exporting is likely if localities have market power, are able to impose taxes on traded goods, and the general equilibrium consequences are limited in terms of their effects on the exporting region. Also, to the extent that strategic behaviour is important, the scope for tax exporting may be reduced. Conclusions about the impact of tax exporting on local public good provision are somewhat mixed. Although many studies show that it tends to increase provision, the issue of the reference point is critical. Nevertheless, the literature on tax exporting does reveal the circumstances under which tax exporting might be expected to occur in federal systems, and indicates the direction of change in expenditure which it may generate. It is a matter of deciding whether these conditions might hold for a given federation.
2.4.3 Interregional Competition

There is an extensive literature dealing with interregional competition. It has two contrasting themes. One views competition as beneficial, similar to its role in markets, forcing governments to make efficient tax and expenditure decisions. A cornerstone of this position is Tiebout's hypothesis (reviewed earlier), where individuals choose among competing jurisdictions in much the same way that they choose among competing firms selling private goods. The process of 'voting with one's feet' supposedly ensures an efficient provision of local public goods. Another cornerstone of the beneficent view of competition is the leviathan literature (also encountered earlier), which envisages governments as surplus maximisers unconstrained by citizen-voters. Competition, according to this view, will serve to constrain the taxing powers of governments, to the benefit of citizens.

A second theme argues that competition distorts public choices, leading to welfare losses and underprovision of local public goods, relative to a social optimum. While there are several sub-themes to this view, one of the more important, the 'tax competition' literature, argues, for example, that local incentive schemes to attract investment keep tax rates below levels needed to finance optimal amounts of local public goods [for example, see Break (1967) and Oates (1972)]. Another sub-theme [for example, see Cumberland (1979, 1981)], contends that inter-jurisdictional competition has adverse effects upon the setting of local environmental standards, resulting in lower than socially optimal levels of provision of environmental protection. Oates and Schwab (1988) pursue this idea using a median voter model, and argue that if: (i) communities are relatively homogeneous; (ii) the costs and benefits of public programmes are well understood; and (iii) public decisions reflect the wishes of residents, governments will select optimal environmental standards, in contrast to the Cumberland results. However, if: (i) jurisdictions do not have access to efficient taxes; (ii) public decisions deviate from citizen's preferences; or (iii) conflicts of interest arise, then they argue that outcomes may not be socially optimal.
Research on tax competition has also been undertaken by Beck (1983), Wilson (1985, 1986) and Zodrow and Mieszkowski (1986) in purely competitive cases where the number of regions is large, and by Bucovetsky (1986), Mintz and Tulkens (1986), Wildasin (1988) and de Crombrugghe and Tulkens (1990) in the context of small numbers of regions with strategic interactions. Mieszkowski and Zodrow (1989) provide a survey of this literature. The usual assumptions made are that regions: (i) adopt Nash behaviour; (ii) voluntarily contribute to a public good paid for by taxes on mobile capital (rather than a traded good); (iii) behave according to the community preference model; and (iv) are identical in terms of preferences, incomes and populations. The overall result is that regions compete for capital by reducing their tax rate, and hence local public good provision, below socially optimal levels (from the viewpoint of the federation as a whole).

More recent papers to emerge which consider further issues in tax competition, generally by extending the models mentioned above, include Bucovetsky and Wilson (1991), Wilson (1991), Hoyt (1991), Jensen and Toma (1991), Wildasin (1991a) and Brueckner and Joo (1991), all of which are surveyed in Wildasin and Wilson (1991). Two of these papers are briefly mentioned here. The first is Bucovetsky and Wilson (1991), who note that the undertaxation result to emerge from the tax competition literature depends, among other things, on the assumption that local expenditures are financed by taxes on capital income earned within a region's borders (source-based taxes). They model regions which have access to a source-based capital tax and a wage tax, and show that local public goods are still underprovided. Thus, even without source-based capital taxes, tax competition can still lead to underprovision. However, they also show that if regions are given access to source-based capital taxes and residence-based taxes on capital, local public good provision is optimal. Hence, Bucovetsky and Wilson (1991) conclude that an absence of residence-based capital taxes is responsible for under-provision. The second paper noted here is Wilson (1991), who relaxes the assumption of identical regions made in much of the tax competition literature and finds that competition can actually make a relatively small (in terms of population) region better off, relative to a large region, principally
because it has a higher elasticity of demand for capital, causing it to choose a relatively lower tax rate on capital which in turn induces capital inflow in its favour (from the larger region).

While the literature discussed above deals with tax competition between regions, one must also be aware that competition may occur between a regional government and a central government. In this regard, Cassing and Hillman (1982) analyse the welfare implications of competition arising between a local government and a central government because both tax the same tax base. They argue that rivalry leads to sub-optimal taxes being imposed by each government at a higher deadweight loss, compared with an optimum. The optimal cooperative solution is compared with the competitive outcome and the welfare losses from competition derived.

Overall, the general result that tax competition leads to undertaxation and underprovision of local public goods seems to emerge from the literature on tax competition, although the results are not at all clear-cut and are sensitive to the assumptions made. Moreover, there is the question of the reference point adopted, against which competitive outcomes are compared: that is, the community preference model of government. An interesting question is whether the same result emerges if alternative behavioural theories were adopted.

2.5. Interaction Between Governments at Different Levels

It was noted above that interaction between governments at different levels also raises important questions. The following discussion concentrates on the implications of interaction between regions of one level and a central government. It focuses on grants from the central government made to regional governments, and in particular: (i) the effect of lump-sum versus matching grants on local behaviour; (ii) the fly-paper effect; (iii) the equity implications of grants; and (iv) neutrality of lump-sum transfers.
2.5.1 Effects of Matching and Lump-Sum Grants on Local Behaviour

A number of theoretical results about the effects of matching relative to lump-sum grants and the local expenditure consequences of each are well established. For example, see Oates (1972). The results are as follows. First, it is widely known that matching grants stimulate recipient government spending more than lump-sum grants because they lead to both an income and a substitution effect: that is, they affect relative prices for public goods faced by localities. On the other hand, lump-sum transfers create only an income effect. Second, local government spending increases in response to lump-sum grants from the central government by an amount determined by the income elasticity of demand for local public goods. It should also respond identically to an equivalent increase in income, because a one dollar increase in lump-sum grant should have the same effect on a region's budget constraint as simply relaxing the budget constraint by one unit. Finally, lump-sum transfers which are targeted (such as 'block grants') have the same effect on spending as unrestricted lump-sum transfers (a fungibility argument) as long as the grant is no bigger than total desired spending. These results follow from modelling regional governments as if they were individuals, although in general, similar results can be obtained from median voter models [for example, see Bradford and Oates (1971a, 1971b)].

2.5.2 The Fly-paper Effect

Empirical testing of these theoretical results about grants tends to confirm them, with one major exception, which has generated a large theoretical literature trying to explain the discrepancy. This is the so-called 'fly-paper' effect; the finding that a dollar of lump-sum central government grant increases a region's public expenditure by more than does an extra dollar of income resulting from, for example, an exogenous increase in the region's productivity which shifts the budget constraint outwards (the notion that 'money sticks where it hits'). This contradicts what the theory predicts.
There are numerous explanations for the fly-paper effect, only some of which are examined here. First, Courant, Gramlich and Rubinfeld (1979) and Winer (1983) have suggested that households suffer a 'fiscal illusion' when their locality receives a grant. They perceive that their tax price has fallen. In other words, although they have funded each dollar of federal grant through their central government taxes, they may not perceive a link between this taxation and the grant they receive from the central government. Accordingly, households might treat a dollar of central government grant as a subsidy to their local public good tax price so that there is an income and a substitution effect (as opposed to only an income effect with an increase in income).

Second, Hamilton (1983) shows that at least a part of the fly-paper effect can be explained as a result of the income elasticity of demand for public goods being greater than the estimated income elasticity of demand for public expenditure. This is especially so in higher income regions where there is a higher output per unit of input. A third explanation is that lump-sum grants have implicit matching arrangements which make them behave like matching grants. For more detailed discussion of this view see Chernick (1979), McC Gaule (1975, 1978, 1979) and Brennan and Pincus (1991). Finally, Filimon, Romer and Rosenthal (1982) have put forward another illusion argument. They propose that voters may never get the chance of using grants to reduce their own funding of local public goods because bureaucrats, who are expenditure maximisers, have an incentive to hide such grants from them.

The puzzle may also simply reflect the inadequacy of the two-person consumer theory analysis of the response of localities to grants. The answer may be in looking at recipient government responses to grants in the presence of free migration and richer behavioural models. Also, the fly-paper effect may be explained by regional interdependence which links regional decisions in a way which leads regions to respond differently to grants, which are essentially redistributions of income, and exogenous increases in endowment.
2.5.3 **Equity Aspects of Grants**

The discussion above was concerned with the positive aspects of intergovernmental grants. However, some normative aspects are examined in seminal papers by Buchanan (1950, 1952). He was concerned with the questions of horizontal equity and efficiency, and argued that regions in a federal system would generally choose levels of local public good provision and taxation which meant that individuals who are alike in terms of preferences and incomes would be treated differently between jurisdictions—unequal treatment of equals' or 'horizontal inequity'. This, Buchanan argued, may justify 'equalising grants' between regions on equity grounds.

This idea has spawned a literature justifying fiscal equalisation grants on the basis of equity considerations. This literature is not surveyed here, however, see Eden and Millar (1991) for further discussion, and an example of an equalisation scheme designed on the basis of the equity case.

2.5.4 **Neutrality**

There is a literature which shows under what conditions lump-sum transfers between agents making voluntary contributions to a pure public good will be neutral with respect to their influence on welfare and consumption of the public good. The results from this literature have been applied in a federalism context, and have implications for the effect of lump-sum redistributions by central governments on local government behaviour.

In this regard, it has long been recognised that the effects of transfers between economic agents may very well be nullified by offsetting transfers when those agents have altruistic utility functions. Barro (1974) demonstrated this 'neutrality result' in the case of inter-generational transfers using the Ricardian equivalence theorem.
This is not the only type of neutrality result. More recently, Warr (1982, 1983) has shown that when consumers voluntarily contribute to a pure public good, lump-sum transfers among them have no effect on resource allocation or welfare. He notes that:

'When a single public good is provided at positive levels by private individuals, its provision is unaffected by a redistribution of income. This holds regardless of differences in individual preferences and despite differences in marginal propensities to contribute to the public good.'

Warr's result depends upon the crucial assumptions that: (i) transfers do not alter the set of contributors; (ii) individuals care about the magnitude of their own contributions only in as much as they affect the total level of expenditures; and (iii) all individuals make strictly positive contributions.

Becker (1981), Sugden (1982) and Cornes and Sandler (1986) demonstrate similar results. The latter adopt a model of pure public goods with voluntary contributions by individuals adopting Nash behaviour. They show that what is important for the neutrality result is that the public good be a perfect substitute for income, so that a positive contributor's real situation, in terms of utility, is unaffected by a change in own-income accompanied by an equal and opposite change in everyone else's contribution to the pure public good.

Cornes and Sandler note that:

'The endogenous responses to an income transfer are such that the individual whose income has fallen experiences a spill-in, that is, an increase in the other's contribution, leaving the real situation unchanged'.

Bergstrom, Blume and Varian (1986) extend and generalise the neutrality result to situations with many public goods using the model


adopted by Cornes and Sandler with Nash behaviour and voluntary contributions to a pure public good.

Bernheim (1986) suggests that Warr's result and Bergstrom et al's generalizations are 'only the tip of the iceberg'. He derives a stronger neutrality result, the main thrust of which is that not only will any government policy involving lump-sum transfers be neutral, but so too will any policies involving distortionary taxes and lump-sum transfers. However, his conclusions are based on a model with different behavioural assumptions: that is, individuals are assumed to form correct conjectures about other contributors' responses rather than hold Nash zero conjectures.

The reason why the neutrality literature is important in a federalism context, where local jurisdictions rather than individuals are assumed to contribute voluntarily to local or national public goods, is that it suggests the possibility of 100 percent 'crowding out' of central government contributions to local expenditures. Neutrality suggests that central government untied or lump-sum grants to local jurisdictions may not increase local provision of public goods because local governments will simply reduce their own-contributions by an amount equal to the grant. Bernheim's stronger neutrality result has an even more significant implication: that matching grants, which are traditionally seen as having a real influence on resource allocation at the local level because they distort public good prices, may be neutral.

Boadway, Pestieau and Wildasin (1989b) analyse neutrality in a federalism setting, where contributing agents are local governments who make voluntary contributions to a national pure public good under Nash behaviour, in the spirit of the Bergstrom, Blume and Varian (1986) analysis. They demonstrate a neutrality result for lump-sum transfers, and also show that matching grants, which act like Pigouvian subsidies by altering relative prices faced by local jurisdictions, will not be neutral. However, they do show that matching grants will be neutral if the Nash behavioural assumption is dropped and the behavioural assumptions of the Bernheim (1986) model are adopted.
One should not conclude that neutrality occurs in practice, particularly in federal systems. Rather, the neutrality literature should be seen as establishing the assumptions under which neutrality holds, and of course, the conditions under which it does not hold. In this regard, it has been shown that neutrality breaks down if: (i) there are non-contributors to public goods whose aggregate income changes; (ii) public goods are impure; and (iii) contributors have different productivities. For a discussion of (i) and (ii) see Cornes and Sandler (1986) p 85-87, and for an analysis of the break down of neutrality when contributors have different productivities see Cornes (1992b).

Bernheim and Bagwell (1988) provide a critique of the 'dynastic' model of the family that implicitly underlies models used to generate neutrality results. The dynastic view of the world is that

'...voluntary transfers between parents and children cause the representative dynastic family to behave as though it is a single, finite-lived individual. Policies that fail to affect the family's real opportunities are neutralised through private actions; thus Ricardian equivalence and related propositions...follow directly'. (11)

The interesting point about Bernheim and Bagwell's analysis is that they take the assumptions and logic of the model as given and show that one is led to untenable conclusions. By extending the dynastic view of families to include linkages between families, they show that neutrality results under weaker conditions than those adopted by Barro (1974). In this framework, the efficiency role of the government is severely limited and the distributional role is non-existent.

The author's argue that

'...when results stretch the bounds of credibility past the breaking point, it is natural to question the validity of underlying assumptions....Thus, refusal to accept the practical implications of our results is tantamount to a rejection of the dynastic framework and calls into serious question the results (such as Ricardian equivalence) that follow from it.'(12)

2.6. Conclusion

The purpose of this chapter has been to provide, as background, an overview of some of the issues addressed in the literatures on fiscal federalism and local public economics. The discussion has been selective, emphasising those aspects of the literature referred to in the Thesis, and has attempted to present only the main ideas. More detailed discussion of the literature, and its links with the results in the Thesis, are to be found in each chapter.

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CHAPTER 3

PUBLIC GOOD EXTERNALITIES AND COMPETITIVE REGIONAL BEHAVIOUR: IMPLICATIONS FOR WELFARE AND PROVISION

3.1 Introduction

The introductory chapter noted that a distinguishing feature of regional economies was their openness to the rest of the national economy. The discussion highlighted that this was a source of many of the interesting features of federations, one of which was the generation of externalities associated with the consumption of local public goods.

In this chapter, the implications for welfare and for public good provision of local public good externalities are analysed. A model of two regions, each voluntarily contributing to a local public good with consumption externalities, is developed. It is shown that positive externalities may lead to welfare losses and under-provision of local public goods relative to a clearly defined social optimum. This is achieved by characterising a Nash equilibrium between the two regions, denoted as a Non-Cooperative Externality Equilibrium, or NCEE. The NCEE is modelled in terms of quantities, or levels of voluntary contribution to public goods, and also in terms of total taxes paid by a region for public goods. Policies to correct for these welfare losses are then examined, including matching expenditure grants, matching tax subsidies and bargaining solutions in the Coasian tradition.

There are a number of aims. First, the chapter is intended to be a theoretical basis for subsequent work, particularly Chapters 4, 7 and 8. A second goal is to provide a modern interpretation, using non-cooperative (and cooperative) game theory and the theory of public goods and externalities, of some of the basic ideas in federalism theory, principally those to be found in Oates (1972) and his work on externalities. Third, the intention is to show that consumption externalities introduce a form of competition between regions in the
sense that, at least when the Nash assumption is adopted, each treats the externality generated by another region as parametric, much as prices are treated by agents in competitive market models. Hence, a model of a federation with externalities can be thought of as a model of a competitive federation. This notion of competition is linked to the more usual idea of competition in federal economies which is found in the tax competition literature [see for example, Mintz and Tulkens (1986)]. In this latter literature, the interdependence between regions is introduced via mobile factors or commodity trade across political boundaries rather than directly through an externality appearing in preference functions as in the model here. Nevertheless, the two notions of competition are shown to be analogous since both deal with external effects which are treated as parametric by agents.

Finally, the analysis shows that, under certain assumptions, a Lindahl equilibrium can be supported as an NCEE in quantities, and conversely, an NCEE in quantities can be supported as a Lindahl equilibrium. In other words, there is a direct correspondence between non-cooperative equilibria in taxes and quantities. This result is linked to a similar finding of Boadway, Pestieau and Wildasin (1989a). It follows from this that the traditional Pigovian remedy for externalities can take the form of either a matching expenditure grant or matching tax subsidy paid by a central government. Either will establish optimal provision of local public goods and a Lindahl equilibrium.

Since the model used is an application of the pure public good model from Cornes and Sandler (1986), in parts the discussion draws on Cornes and Sandler. Where this is done, acknowledgement is made.

3.2 Model

Consider an economy with two regions \( i = 1, 2 \). Region 1 has \( j = 1, \ldots, n \) residents each endowed with units of labour income denoted by \( I_1 \) and assumed to have identical preferences. Individual \( j \) can therefore be thought of a representative person from region 1 with preferences over a pure local public good \( Q_1 \) and a pure private good \( x_1 \). Similarly, region
2 has \( k = 1, \ldots, m \) individuals, each endowed with units of labour income and with identical preferences over a pure local public good \( Q_2 \) and a pure private good \( x_2 \). It is assumed that the two local public goods are identical.

The economy has a total population \( N^* \), which is also labour supply and is taken to be a fixed parameter. Residents cannot migrate between regions. In Chapters 7 and 8 this assumption is relaxed and the implications of labour mobility are explored in depth. There are \( n_1 \) people in region 1 and \( n_2 \) in region 2, where \( N^* = n_1 + n_2 \).

Suppose also that there are positive externalities associated with the local public goods such that \( Q_1 \) and \( Q_2 \) can be defined as

\[
Q_1 = q_1 + aq_2 \\
Q_2 = q_2 + bq_1
\]

(3.1) (3.2)

\( Q_1 \) consists of the total voluntary contribution of all consumers in region 1, \( q_1 \), together with a proportion of the contribution by residents in region 2 to \( Q_2 \), that is, \( aq_2 \), where \( 0 \leq a \leq 1 \) is a parameter indicating the proportion of \( q_2 \) benefiting region 1. The \( a \) parameter can therefore be seen as indicating the degree of 'localness' of region 2's local public good or its 'productivity' in generating positive externalities. \( Q_2 \) is composed analogously and it is assumed that \( 0 \leq b \leq 1 \).

1. For purposes of abstraction, \( Q_1 \) could be thought of as an FM radio broadcast by region 1 which is received with perfect clarity in region 1 but not necessarily in region 2 depending on the value of \( b \). An analogous interpretation applies to \( Q_2 \) and the parameter \( a \). This interpretation invites one to think of values of \( a \) and \( b \) which lie between and including zero and one. Practical examples of goods with substantial degrees of public good characteristic provided by Australian states include (i) legal systems; (ii) environmental standards such as water quality and air pollution controls; (iii) regulations such as building and land use laws, health, food product and workforce training standards; and (iv) supervision of non-bank financial institutions.
Alternatively, a and b may be thought of as determining the degree to which units of externality and units of own-provision are treated as substitutes by regions. When \( a = b = 1 \) both regions treat externality and own-provision as perfect substitutes and effectively \( Q_1 \) and \( Q_2 \) can be thought of as a global public good. On the other hand, when \( a, b < 1 \), regions treat units of externality as something less than a perfect substitute for own-provision.

Finally, it is assumed that there are two governments, one for each region, which implement the preferences of the representative resident in each region. Therefore, the community preference model of government behaviour, discussed in Chapter 2, is adopted. The two regional governments solve

(i) Region 1

\[
\text{Max } u_1(x_1, Q_1) \quad \text{(3.3)}
\]

\[
(q_1)
\]

\[
\text{STo: } n_1x_1 + p_1q_1 - n_1I_1 \quad \text{(3.4)}
\]

(ii) Region 2

\[
\text{Max } u_2(x_2, Q_2) \quad \text{(3.5)}
\]

\[
(q_2)
\]

\[
\text{STo: } n_2x_2 + p_2q_2 - n_2I_2 \quad \text{(3.6)}
\]

\(u_1(.)\) and \(u_2(.)\) are the preference functions of a representative resident from region 1 and a representative resident from region 2, respectively. Both preference functions are assumed to be continuous, strictly increasing, strictly quasi-concave and everywhere twice differentiable with respect to all arguments. Equations (4) and (6) are the regional budget constraints faced by each government.

2. \(u_1(.)\) is easily derived from the general preference function with externalities \(u_1(x_1, q_1, q_2)\) by assuming additive separability between \(q_1\) and \(q_2\) and similarly for \(u_2(.)\).
From (4), $x_1$ is the numeraire with a price of one and $p_1$ is the price of each unit of $q_1$ provided by region 1. $n_1l_1$ is total regional income where $I_1$ is the income of a representative resident. A similar interpretation can be given to (6). Indeed, (4) may also be taken to reflect any technology which converts units of $n_1l_1$ into $x_1$ and $q_1$ at a marginal rate of transformation, or MRT, of $p_1$ and similarly for (6). $p_1$ and $p_2$ are allowed to differ.\(^3\)

The first order necessary conditions for provision of $q_1$ and $q_2$ by regions 1 and 2 imply

\[(i) \text{ Region 1}\]

\[n_1MRS_1^Q = p_1\] (3.7)

\[(iii) \text{ Region 2}\]

\[n_2MRS_2^Q = p_2\] (3.8)

where $MRS_1^Q$ is the marginal rate of substitution in region 1 between $x_1$ and $Q_1$. When $a - b = 0$, (7) and (8) are Samuelson conditions for the

---

3. This is an application of the pure public good model in Cornes and Sandler (1986) p.43 where, in the presence of public good externalities, representative individual $h$ (or region $i$ in the present model) solves

Max $U^h(y^h,z^h+\hat{Z}^h)\]

\[(y^h,z^h)\]

STo: $p_zy^h+p_zz^h - I^h$ where:

$y^h$ is consumer $h$'s consumption of private good $y$;

$z^h$ is consumer $h$'s contribution to the pure public good $z$;

$\hat{Z}^h$ is provision of the pure public good by the rest of the community;

$p_y$, $p_z$ are the prices of the private and public good; and

$I^h$ is consumer $h$'s income endowment.
Pareto optimal supply of local public goods. However, this is not the case when \( a, b > 0 \), because (7) and (8) ignore a valuation for the positive externality generated by provision in each region. Under these circumstances, provision of \( q_1 \) and \( q_2 \) would not be optimal. This can be seen by comparing (7) and (8) with the Pareto optimal conditions for the two local public goods which are:

(i) \( \text{For } q_1 \)

\[
\frac{n_1}{MRS^1_Q} + \frac{bn_2}{MRS^2_Q} = p_1
\]

(ii) \( \text{For } q_2 \)

\[
\frac{n_2}{MRS^2_Q} + \frac{an_1}{MRS^1_Q} = p_2
\]

Comparing (9) with (7), one can see that the latter includes the term \( bn_2MRS^2_Q \) which is a valuation of the externality residents in region 2 receive from region 1. This term is ignored by region 1 because representative resident k's preferences do not appear in region 1's objective function. When \( b = 0 \), (9) and (7) are identical and provision of \( q_1 \) is Pareto optimal. A similar interpretation applies to region 2. Moreover, since \( n_1MRS^1_Q < n_1MRS^1_Q + bn_2MRS^2_Q \), it can be concluded that region 1 under-provides \( q_1 \) relative to the socially optimal quantity, and similarly for region 2. This result will be demonstrated more formally later in the discussion.

4. Obtained by solving the central government problem

\[
\begin{align*}
\text{Max } & u_1(. ) + u_2( . ) \\
\text{st: } & (i) \ n_1x_1 + p_1q_1 = n_1I_1 \ (ii) \ n_2x_2 + p_2q_2 = n_2I_2
\end{align*}
\]
The special case where \( a = b = 0 \) is what Oates termed perfect correspondence, where political boundaries correspond perfectly with the economic boundaries associated with the consumption of local public goods. When \( 0 < a, b \leq 1 \), we have what Oates called imperfect correspondence between political and economic boundaries. These concepts form the basis of Oates' decentralisation theorem.

### 3.3 Non-Cooperative Fiscal and Expenditure Behaviour (5)

In applications of the standard model of pure public goods provision with Nash behaviour, individuals usually are assumed to contribute voluntarily to a pure public good. Under-provision and sub-optimality result. In the application presented here, regional governments, rather than individuals, contribute to a local public good. Interaction between regions is introduced via a particular form of consumption externality. As a result of this interdependence, each region, in setting its own contribution level, must take into account the contribution of the other region. One solution concept which seems natural to use in characterising the outcome of this interaction, is that of a Nash equilibrium. As will be seen later, adopting the Nash assumption to model such externalities highlights the notion that they introduce competition into federal relations which has close parallels with the competition inherent in models used in the fiscal competition literature, since both are effectively dealing with externalities.

To characterise a Nash equilibrium between regions 1 and 2, notice first that for region 1 we can obtain an expression for \( x_1 \) from equation (4), substitute the result into equation (3) to eliminate \( x_1 \) and obtain

\[
u_1(x_1, Q_1) = u_1(I_1 - p_1q_1/n_1, Q_1)
\]

This implies that from now on region 1's budget constraint is assumed to hold with equality and similarly for region 2. (11) can also be written as a general function as follows

\[ u_1(I_1 - p_1 q_1/n_1, Q_1) = v_1(q_1, a q_2, p_1, n_1, I_1) \]  

(3.12)

\( v_1(.) \) can be interpreted as an implied preference function for region 1 in the sense that it has been derived from primitive preferences defined by \( u_1(.) \). Similarly, for region 2 we have the implied preference function

\[ v_2(q_2, b q_1, p_2, n_2, I_2) \]  

(3.13)

By assumption, \( n_1, n_2, p_1, p_2, I_1 \) and \( I_2 \) are parameters. Therefore, preferences can be defined over \( q_1 \) and \( a q_2 \) for region 1, and over \( q_2 \) and \( b q_1 \) for region 2 as follows

\[ v_1(q_1, a q_2) \]  

(3.14)

\[ v_2(q_2, b q_1) \]  

(3.15)

A normal form game between regions 1 and 2 can now be defined as

\[ \Gamma = [\phi, (S_L)_{L \in \phi}, (P_L)_{L \in \phi}] \]  

(3.16)

\( \phi \) is the number of players, in this case two; regions 1 and 2. \( S_1 \in S_L \) is the strategy set of region 1. This is the set of feasible contributions to \( Q_1 \) in terms of the region's budget constraint, so that \( S_1 = \{q_1\} \). Similarly, the strategy set of region 1 is the set of feasible contributions to \( Q_2 \); that is, \( S_2 = \{q_2\} \in S_L \). Thus, the strategy combination for the game defined by (16) is \( S = \{S_1, S_2\} \) or \( S = \{q_1, q_2\} \). Payoffs are functions of the strategy set of each region and \( P_L(S) = P_L(q_1, q_2) \). Since the regional governments are assumed to implement the preferences of a representative resident, payoffs are expressed in terms of the utilities of representative residents \( j \) and \( k \), so that \( P_L(S) = u_1(S) = u_2(q_1, q_2) \).
For expositional convenience, a Nash equilibrium of the game given by (16) is defined to be a Non-Cooperative Externality Equilibrium, or NCEE. An NCEE can be characterised in terms of contributions to local public goods (quantities), or taxes paid by residents. Each is considered below.

3.3.1 NCEE in Quantities

An NCEE in quantities is a strategy combination $s^* = (q_1^*, q_2^*)$ such that

\begin{align*}
v_1^*(s^*) &= v_1^*(q_1^*, a_{q_2}^*) \geq v_1^*(q_1, a_{q_2}^*); \text{ and} \\
v_2^*(s^*) &= v_2^*(q_2^*, b_{q_1}^*) \geq v_2^*(q_2, b_{q_1}^*)
\end{align*}

(3.17) (3.18)

The superscript * denotes a region's optimal Nash contribution to local public goods. (17) and (18) show that regions cannot obtain a higher value for $v_1(.)$ or $v_2(.)$ by adopting anything but their Nash strategy. An initial step in characterising an NCEE in quantities is to derive reaction curves for each region in $(q_1, q_2)$ space.

(a) Reaction Curves

In this regard, the reaction curve for region 1 can be derived as follows. Note that one can obtain indifference curves for region 1 in $q_1$ and $a_{q_2}$ space from equation (14). First, observe that higher values of $a_{q_2}$ imply more preferred allocations. Second, the set of points weakly preferred to any reference allocation must be convex. This is because such an allocation is the intersection of two convex sets: (i) the set of allocations preferred to the reference allocation; and (ii) the set of feasible consumption vectors defined by the linear budget constraint. Accordingly, in Figure 1 below, the points in the hatched area bounded by the indifference curve for region 1, denoted by $i_1i_1$, make up a convex set.
region 1's Nash reaction curve, $r_1$, which passes through the minimum point of each indifference curve where the slope is zero. Therefore, at all points on region 1's reaction curve, the slope of region 1's indifference curve between $q_1$ and $a q_2$ is zero. A reaction curve $r_2$ for region 2 can be derived analogously (not shown).

It is useful to describe points on each region's reaction curve algebraically. In this regard, note that movements along any of region 1's indifference curves imply unchanged utility. Observing from (12) that preferences can be expressed in terms of $v_1(q_1, a q_2)$ or $u_1(p_1 q_1/n_1, Q_1)$, then along any indifference curve for region 1 we have

$$\frac{\partial v_1}{\partial q_1} + a \frac{\partial v_1}{\partial q_2} = \frac{\partial u_1}{\partial a q_1} \frac{p_1}{n_1} \frac{\partial u_1}{\partial x_1} - \frac{\partial u_1}{\partial Q_1} = 0 \quad (3.19)$$

The slope of any indifference curve for region 1 is therefore given by:

$$\left. \frac{dq_2}{dq_1} \right|_{u=u} = - \frac{\partial v_1/\partial q_1}{\partial v_1/\partial q_2} = p_1 \frac{\partial u_1/\partial x_1}{n_1} - \frac{1}{a \partial u_1/\partial Q_1} \quad (3.20)$$

(20) is similar to equation (4), p.72, in Cornes and Sandler (1986). The difference is that the present specification incorporates the a parameter and therefore allows varying degrees of localness in the pure public good. When $a = 1$, (20) is identical to the equation obtained by Cornes and Sandler (apart from the presence of $n_1$).

As already shown, Nash behaviour requires that (20), or the slope of each indifference curve for region 1, be equal to zero at the point where it meets $r_1$. This is because an increase in $q_1$ yields a marginal benefit to region 1 of $\partial u_1/\partial Q_1 dq_1$ with a marginal cost of $p_1/n_1(\partial u_1/\partial x_1 dq_1)$. The optimum requires equality of these terms, that is, $\partial u_1/\partial Q_1 dq_1 = p_1/n_1(\partial u_1/\partial x_1 dq_1)$. Dividing through this equality by $dq_1$, yields $\partial u_1/\partial Q_1 = p_1/n_1(\partial u_1/\partial x_1)$ which can be substituted back into
(20) to obtain \( \frac{1}{a} - \frac{1}{a} = 0 \). Therefore, (20) is zero as required by Nash behaviour. From \( \frac{\partial u_1}{\partial q_1} = p_1/n_1(\delta u_1/\delta x_1) \) one also easily obtains

\[
n_1\text{MRS}^1_{Q} = p_1 \tag{3.21}
\]

(21) implies that at all points on region 1's reaction curve, the total marginal benefit derived by residents \( j = 1, \ldots, n \) in region 1 from the local public good \( Q_1 \) is equated with \( p_1 \); that is, (7) holds at all points on \( r_1 \). A similar analysis can be undertaken for region 2 and a reaction curve, \( r_2 \), derived. At all points on \( r_2 \), one can show that

\[
n_2\text{MRS}^2_{Q} = p_2 \tag{3.22}
\]

Thus, when \( a \) and \( b \) are not equal to zero, all points on each reaction curve, while being optimal in a Nash sense, or from each region's perspective, are sub-optimal from a collective or national point of view since the Pareto optimal conditions are given by (9) and (10). For this reason, points on the Nash reaction curve can be thought of as locally optimal. Again, Oates' notion of imperfect correspondence can be interpreted as yielding locally optimal equilibria on the reaction curve.

(b) Subscription Functions

Regional reaction curves can also be derived from the subscription functions underlying the game defined by (16). In this regard, consider region 1's implied utility function \( v_1 \) given in (12). To every set of values of \( p_1, aq_2 \) and \( n_1 \) there corresponds a unique value of own-contribution, \( q_1 \), which maximizes per-capita utility in region 1. Letting this value be \( q_1^* \), it is defined by the condition that, for all feasible \( q_1 \):

\[
v_1(q_1^*, aq_2^*, p_1, n_1) \geq v_1(q_1, aq_2^*, p_1, n_1) \tag{3.23}
\]
(23) implies the following functional relationship for region 1:

\[ q_1^* = s_1(p_1, q_2^*, n_1) \]  

(3.24)

s_1 is region 1's subscription function, which alternatively can be thought of as the region's demand function for Q_1 (this interpretation is used in Chapters 5 to 8). It shows how own-subscriptions to Q_1 vary with changes in p_1, q_2^* or n_1. Again, n_1 and p_1 are parameters so that s_1 can be written as the reaction function of region 1:

\[ q_1^* = r_1(aq_2^*) \]  

(3.25)

(25) shows how region 1's contribution to Q_1 varies with changes in the externality generated by region 2 for given values of p_1 and n_1. This is the reaction curve r_1 of region 1 shown in Figure 1. As a result of the convexity of preferences and constraint sets, (24) and (25) are continuous. By analogous reasoning, the subscription function for region 2 is

\[ q_2^* = s_2(p_2, b_q_1^*, n_2) \]  

(3.26)

Region 2's reaction function is therefore

\[ q_2^* = r_2(bq_1^*) \]  

(3.27)

(c) Equilibrium

The reaction curves derived above can be used to characterise an NCEE in quantities. Before doing so, however, note that the reaction curves show a region's voluntary contribution to local public goods as a function of their neighbour's externality: that is, q_1(aq_2) and q_2(bq_1) for regions 1 and 2 respectively. Given that a and b are parameters, one can also define them simply as q_1(q_2) and q_2(q_1) for given values of a and b and define new reaction curves, depicted in Figure 2, where i_1 and i_1' are
the indifference curves for region 1 defined over \( q_1 \) and \( q_2 \), and \( i_2 \) and \( i_2' \) are the indifference curves of region 2 defined over \( q_2 \) and \( q_1 \).\(^{(6)}\)

Figure 3.2: NCEE in Quantities

The Nash equilibrium, or NCEE, is at point \( N \), the intersection of the two reaction curves.\(^{(7)}\) At \( N \), regions 1 and 2 choose their optimal contributions to local public goods, given their neighbour's contribution via the externality. Region 1's contribution to \( Q_1 \) is measured along the horizontal axis and region 2's contribution to \( Q_2 \) along the vertical axis. The contribution of region 1 to \( Q_1 \) at \( N \) is \( q_1^* \) while the

\[ \text{6. For a detailed explanation of this diagram in the standard pure public good model see Cornes and Sandler (1986), p.76 and 77.} \]

\[ \text{7. The Nash equilibrium at \( N \) can be thought of as a Nash-Cournot Equilibrium since there are two governments choosing quantities to maximise an objective function. This has the obvious analogy with the Cournot equilibrium where two duopolists choose outputs.} \]
contribution of region 2 to $Q_2$ at $N$ is $q_2^*$. When $a = 1$, the total level of consumption of $Q_1$ in region 1 can be determined from the $45^0$ line $TT'$ which passes through $N$. In particular, when $a = 1$, $Q_1 = q_1 + q_2 = OT$; and similarly, $Q_2 = q_2 + q_1 = OT'$ when $b = 1$. However, when $0 < a < 1$, provision in region 1 will be less than $OT$; for example, it might be $OT = q_1 + aq_2$ depending on the value of the parameter $a$. This is because one unit of $q_2$ in region 1 is now worth less than one unit of $q_1$ to region 1. The slope of $Nt$ will depend upon the value of the parameter $a$, and similarly in region 2. (8)

The Nash equilibrium at $N$ is not Pareto optimal and the shaded lens is a set of alternative allocations which are mutually advantageous in the sense that they Pareto dominate the Nash equilibrium at $N$. Any point within this lens yields a higher level of per-capita utility for at least one region. There is also a locus of Pareto optimal allocations, $P'P$, in the lens. $P'P$ is the locus of allocations which maximises the potential utility gains to be made in the lens. Points on this locus are from now on referred to as globally optimal, to reflect the fact that they are optimal from the point of view of the federation as a whole, in contrast to points on the reaction curves which, as previously noted, are only locally optimal.

There also is under-provision of $q_1$ and $q_2$ at the Nash equilibrium $N$ relative to the socially optimal level. This occurs because each region ignores the local public good externality associated with the local public goods, as already shown from the first order conditions adopted by each region. However, the quantitative importance of the inefficiency associated with $N$ is a matter for conjecture, and should ultimately be resolved by quantitative analysis, of which, to date, there has been none.

8. Since this model is an application of the pure public good model, existence, uniqueness and stability of a Nash equilibrium such as $N$ can be demonstrated in the same way as for the pure public good model. For a discussion of existence, uniqueness and stability in the pure public good model see Cornes and Sandler (1986).
Cornes and Sandler (1984) have analysed the implications of adopting non-zero conjectures for non-cooperative equilibria such as N. They conclude that if contributors expect a positive response from others in reaction to an increase in their own provision (that is, positive rather than zero conjectures), then a higher level of equilibrium provision is implied. On the other hand, if they hold negative conjectures, under-provision is worsened. The conjectures held by contributors may be seen as reflecting some form of institutional cooperative mechanism (discussed below).

When \( a - b = 0 \), and there is perfect correspondence between political and economic boundaries, and hence no local public good externalities, region 2's indifference curves in Figure 2 will be vertical lines and region 1's indifference curves will be horizontal lines since preferences of the two regions are independent. In this special case, each region has a dominant strategy and there will be a Dominant Strategy Equilibrium (DSE) between the two regions. A DSE can be related directly to Oates' notion of perfect correspondence that

'Such a structure of governments, in which the jurisdiction that determines the level of provision of each public good includes precisely the set of individuals who consume the good, I shall call a case of perfect correspondence in the provision of public goods.'(9)

One can see that perfect correspondence is really a special case in the present model where \( a = b = 0 \) and the equilibrium is a DSE which is Pareto optimal. However, when \( 0 < a, b \leq 1 \), there is no longer a perfect correspondence and regions engage in Nash competition with one another by treating the externalities of their neighbour parametrically and achieve an NCEE which is locally but not globally optimal.

Oates of course recognised the existence of a lens such as the one depicted in Figure 2, although his analysis was not couched in terms of a Nash equilibrium. He noted that

'....the existence of unresolved external effects implies the existence of what are, in effect, potential gains from trade; it would thus be possible for the various groups of consumers to agree on other levels of the good that would increase the level of welfare of all concerned.'

Finally, note that in the literature the usual way of modelling interactions between regions in a reciprocal externality situation is to characterise a Nash equilibrium in expenditure levels ($q_1$ and $q_2$ in this model). This is the approach in Boadway, Pestieau and Wildasin (1989b). However, one might instead assume that regions adopt levels of consumption (rather than expenditure) as the strategic variables. In this regard, in a model of externalities analogous to the one here, Wildasin (1991a) characterises both a Nash equilibrium in expenditures (comparable to the NCEE in quantities) and a Nash equilibrium in levels of consumption. The two alternatives are shown to lead to different outcomes, implying that the choice of strategic variable is of importance in modelling strategic interactions. This point is also made in Wildasin (1988) where a 't equilibrium' is modelled with tax rates as the strategic variables. This equilibrium is compared with a 'Z equilibrium' in quantities, and it is shown that the two, in general, yield different outcomes.

### 3.3.2 NCEE in Total Taxes Collected

An NCEE can also be characterised in this model in terms of total lump-sum taxes collected by regional governments. In this regard, define total tax collected in each region as $t_1 = p_1q_1$ and $t_2 = p_2q_2$. Since $p_1$ and $p_2$ are fixed parameters, there is a linear relationship between $t_1$ and $q_1$ on the one hand, and $t_2$ and $q_2$ on the other. Accordingly, each point on the reaction curves, $r_1$ and $r_2$, defined in quantity space has a direct one-to-one relationship with a point on a reaction curve defined in total tax space. Existence, uniqueness and local stability of a Nash equilibrium in quantity space implies the same properties for a Nash equilibrium in tax space. Finally, the presence of Pareto dominating equilibria in the lens defined in quantities, implies the existence of an

equivalent lens in tax space. This relationship is characterised in Figure 3.

Figure 3.3: NCEE in Quantities and Taxes

The Nash equilibrium in tax space is at $T_1$. Total tax paid by residents in region 1 is $t_1^*$, while total tax paid by residents in region 2 is $t_2^*$. However, residents in each region do not just benefit from their Nash levels of taxes paid. Indeed, when $a = 1$, the total tax from which residents in region 1 benefit is given by the distance $OS$ (from the 45° line, as in quantity space) and when $a < 1$ it will be an amount such as $OS' = t_1 + at_2$, depending on the magnitude of $a$. A similar argument holds for region 2. Hence, interdependence through externalities related

11. The Nash equilibrium at $T$ is analogous to a Bertrand equilibrium.
to public goods also implies that regions share tax bases. There is not only consumption interdependence resulting from the local public good externality, but also tax base interdependence.

Furthermore, the equilibrium at \( T \) is not Pareto optimal. The shaded lens is the set of alternative equilibria in taxes which Pareto dominate \( T \). This lens has a direct relationship with the lens in Figure 2 in quantity space. \( L'L \) is the set of Pareto optimal equilibria, also directly related to the \( P'P \) locus in Figure 2. Furthermore, just as \( q_1 \) and \( q_2 \) are under-provided at \( N \), so too are per-capita taxes paid in regions 1 and 2 too low relative to the socially optimal level on the \( L'L \) locus. Thus, the existence of local public good externalities in the consumption of \( Q_1 \) and \( Q_2 \) implies that regions share output and tax bases, and that there is under-provision and under-taxation relative to the social optimum.

Furthermore, because of the equivalence between the two notions of equilibrium in this model, (21) and (22) hold on the reaction curves in tax or quantity space. From the cost sharing rules, we know that \( t_1 = p_1q_1 \) and \( t_2 = p_2q_2 \), implying that \( p_1 = t_1/q_1 \) and \( p_2 = t_2/q_2 \) where \( t_1/q_1 \) and \( t_2/q_2 \) are the tax prices facing regions 1 and 2 respectively. Substituting for \( p_1 \) and \( p_2 \) into (21) and (22) yields

(i) Region 1

\[
\frac{t_1}{q_1} = n_1 \text{MRS}_1^Q = p_1
\]

(3.28)

(iii) Region 2

\[
\frac{t_2}{q_2} = n_2 \text{MRS}_2^Q = p_2
\]

(3.29)

It has already been established that the right hand equalities in (28) and (29) hold at all points on each region's reaction curve in quantity space, and hence in tax space. However, now we know that the
left hand sides of the equalities also hold; that is, tax prices applied in each region equal total benefit at all points on the reaction curves, in both tax and quantity space. Hence, (21), (22), (28) and (29) are key relationships which link the NCEE in tax and quantity space.

\[ \frac{t_1}{q_1} \text{ and } \frac{t_2}{q_2} \text{ in (28) and (29) are also Lindahl prices when } a - b = 0; \text{ that is, when there is perfect correspondence and a globally optimal DSE which is equivalent to an equilibrium on the L'L locus. L'L represents a locus of Lindahl equilibria. Thus, the locus of Pareto optimal equilibria in Figure 2, which represents optimal quantities of local public goods, has a parallel set of Lindahl equilibria in tax prices. The intuition behind this result can be seen by recalling that regional governments are assumed, in this model, to act in the interests of representative residents } j \text{ and } k, \text{ and all residents are identical. It follows, therefore, that governments choose the preferred tax price of all residents within their jurisdiction.}

Therefore, as with an NCEE in quantities, the existence of perfect correspondence implies \( a - b = 0 \) and that tax prices faced by consumers are Lindahl prices. This means that non-cooperative regions have straight line indifference curves in tax space and that there is a Pareto optimal DSE in taxes which corresponds to the DSE in quantities. The DSE in taxes is also a Lindahl equilibrium, in the sense that tax prices faced by residents are Lindahl prices. Thus, in this model, the DSE in taxes and a Lindahl equilibrium coincide.

However, when there is imperfect correspondence, we have \( 0 < a, b \leq 1 \) and the non-cooperative regions achieve an NCEE in taxes where tax prices are not Lindahl prices, although they are locally optimal and, therefore, in keeping with previous terminology, could be called local Lindahl tax prices, and the equilibrium is Pareto sub-optimal (a local Lindahl equilibrium).
3.3.3 The NCEE and Nash Competition

There is, therefore, a form of tax competition in this model in the sense that, because of the consumption externalities, regions are also effectively sharing tax bases since regional taxes are used to finance provision in each region; just as regions treat parametrically the consumption externality, so too they treat parametrically the sharing of tax bases. This notion of tax competition is analogous to that appearing in the tax competition literature. The main difference is that, in the latter, interdependence between regional tax bases is introduced via some spatial feature such as factor mobility or commodity trade: in the present model it is implied by the consumption externality which appears directly in regional per-capita utility functions.

For example, the NCEE in quantities is analogous to the Non-Cooperative Fiscal Equilibrium, or NCFE, in Mintz and Tulkens (1986). The difference is that, whereas in the present model, externalities are introduced directly through explicit terms in the regional preference functions, Mintz and Tulkens (1986) introduce externalities by linking two regions' tax bases through a tax on a traded commodity. This means that regions interact by sharing tax bases, just as they do in the present model. Nash behaviour is assumed with respect to this interaction, with the result that there is under-provision of public goods and under-taxation of residents relative to a global optimum. This is analogous to the result obtained from the model above.

Indeed, a model of spatial tax competition is developed in Chapter 6 where two regions select an excise tax on a privately produced commodity. In that model, regions confer externalities on one another through their choice of tax rate. This effectively introduces tax base interdependence in the Mintz and Tulkens (1986) tradition (that is, an indirect externality) rather than direct interdependence through explicit consumption externalities as modelled here. Nevertheless, the notion of Nash competition inherent in both models is equivalent.
3.3.4 The Choice of Strategic Variable

It was noted above that the choice of strategic variable matters in terms of the outcome of a Nash equilibrium. This has been demonstrated in Wildasin (1988, 1991a). In this simple model, there is a one-to-one correspondence between the NCEE in quantities and total taxes collected, implying the same outcome whether total lump-sum taxes or expenditure are the strategic variables. However, this result depends upon the presence of a simple linear relationship between taxes collected and expenditure, a relationship which might not be expected to hold in more complex models. In such cases, one would expect the choice of strategic variable to matter, as found by Wildasin.

3.4 Achieving a Social Optimum

A conclusion above was that provision of local public goods in a federal system characterized by decentralized decision-making and non-cooperative behaviour may not be Pareto optimal: Nash levels of provision of local public goods would generally be Pareto dominated by alternative allocations. The existence of social losses associated with this sub-optimality was also established. An important question, therefore, is, what policies will support a decentralised equilibrium on the P'P locus of Figure 2? In this Section, policies to achieve such an optimum are discussed, including Pigovian subsidies, Coasian bargaining, cooperation and centralisation of local public good provision.

3.4.1 The Pigovian Remedy

Oates (1972) canvasses the use of Pigovian subsidies to correct for the welfare losses created by externalities. A matching arrangement whereby each dollar spent by a region on local public goods is matched by a contribution of x dollars from the central government may secure a decentralised global optimum. To see this, assume that a central government (not modelled explicitly here) imposes an additional lump-sum tax on each resident to pay for a matching grant to regions 1 and 2. The matching rate in region 1 is denoted by $g_1$ and in region 2 by $g_2$. The
first order necessary conditions for regions 1 and 2 in the presence of a matching grant imply

(i) Region 1

\[ n_1MRS^1_Q = p_1(1 - g_1) \]  \hspace{1cm} (3.30)

(ii) Region 2

\[ n_2MRS^2_Q = p_2(1 - g_2) \]  \hspace{1cm} (3.31)

Regions now equate the total marginal benefit of local public goods with a price, or MRT, which is adjusted by the matching subsidy rate. The matching subsidy can therefore be seen as being equivalent to an ad valorem subsidy, since it alters the relative prices for local public goods faced by the regions. Substituting the right hand sides of (30) and (31) into the Pareto optimal necessary conditions defined by (9) and (10), and solving for \( g_1^* \) and \( g_2^* \), the optimal matching rates are

\[ g_1^* = \frac{bn_2MRS^2_Q}{p_1} \]  \hspace{1cm} (3.32)

\[ g_2^* = \frac{an_1MRS^1_Q}{p_2} \]  \hspace{1cm} (3.33)

When the central government adopts \( g_1^* \) and \( g_2^* \) as its matching rates, then the necessary conditions (30) and (31) lead regions to achieve an NCEE on the P'P locus. The larger is the externality term (numerator) on the right hand sides of (32) and (33), the larger is the matching rate required to achieve optimality. Also, \( 0 < g_1, g_2 \leq 1 \) if \( p_1, p_2, bn_2MRS^2_Q, an_1MRS^1_Q > 0 \) and \( bn_2MRS^2_Q \leq p_1, an_1MRS^1_Q \leq p_2 \). Furthermore, in general, \( g_1^* \neq g_2^* \) and a different matching rate will be required for each region. However, in the special case where the right hand sides of (32) and (33) are equal, a uniform matching rate suffices. Finally, when \( a = b = 0 \) (perfect correspondence), then \( g_1^* = g_2^* = 0 \):
that is, a matching rate of zero is required since there is a DSE and globally optimal levels of provision are achieved.

Given the equivalence between an NCEE in total taxes and quantities, it seems natural to suppose that instead of providing a matching expenditure subsidy to secure a social optimum, the central government could provide a matching tax subsidy to secure a Lindahl equilibrium, and that the two types of subsidy should yield an equilibrium on the P'P locus. This turns out to be the case, as the following discussion shows. Consider what happens if the central government matches each dollar of tax revenue raised by the regions with x dollars of its own revenue. To see the consequences, let \( y_1 \) and \( y_2 \) be the matching tax subsidy rates in regions 1 and 2 respectively. Also recall from (28) and (29), that, at all points on \( r_1 \) and \( r_2 \) in tax space, we have, \( n_1 \text{MRS}_1 = t_1/q_1 \) and \( n_2 \text{MRS}_2 = t_2/q_2 \). With a tax subsidy, the necessary conditions for each region imply:

(i) Region 1

\[
 n_1 \text{MRS}_1 = \frac{t_1}{q_1} (1-y_1) \quad (3.34)
\]

(ii) Region 2

\[
 n_2 \text{MRS}_2 = \frac{t_2}{q_2} (1-y_2) \quad (3.35)
\]
Substituting the right hand sides of (34) and (35) into (9) and (10), recalling that $p_1 - t_1/q_1$ and $p_2 - t_2/q_2$ and solving for $y_1^*$ and $y_2^*$ yields

(i) Region 1

$$y_1^* = \frac{bn_2MRS_Q^2}{t_1/q_1}$$

(3.36)

(ii) Region 2

$$y_2^* = \frac{bn_1MRS_Q^1}{t_2/q_2}$$

(3.37)

$y_1^*$ and $y_2^*$ are the optimal tax subsidy matching rates which secure a Lindahl equilibrium. If $y_1^*$ and $y_2^*$ are substituted into (34) and (35), the right hand sides of (34) and (35) become Lindahl prices. The effect of the matching tax subsidy is to reduce the tax price facing each region, thus expanding their provision. This is analogous to the effect of the matching grant on the expenditure side which reduces relative prices to raise provision. As previously, in general, $y_1^* \neq y_2^*$ and differential tax subsidy rates are required. Also, (36) and (37) are identical to (32) and (33) since $p_1 - t_1/q_1$ and $p_2 - t_2/q_2$ and hence $g_1^* = y_1^*$ and $g_2^* = y_2^*$. Therefore, the matching rate tax subsidy required to establish a Lindahl equilibrium on the L'L locus also establishes a Pareto optimal equilibrium in quantity space in this model and vice versa.

The results above show that a Lindahl equilibrium can be supported as an NCEE in quantities with efficient matching expenditure subsidies $g_1^*$ and $g_2^*$, and conversely, an NCEE in quantities can be achieved as a Lindahl equilibrium, where the Lindahl prices are defined by the right hand sides of (34) and (35). However, as noted previously, this one-to-one correspondence depends on the assumption that there is a linear relationship between quantities and total taxes.
These results are analogous to those of Boadway, Pestieau and Wildasin (1989a). Although they do not explicitly model a federal economy with externalities, they do have a similar model to the one here where agents (regions) make voluntary contributions to a pure public good (effectively in their model $a = b - 1$ and the local public good is a pure national public good). Within this context, they find that: (i) there is an easily derived optimal matching rate which will establish optimal levels of provision, and hence an optimal non-cooperative equilibrium; and (ii) there is a one-to-one correspondence between this non-cooperative equilibrium (with optimal matching grants), and a Lindahl pricing scheme. The analysis here implies that this correspondence depends upon the presence of linearity between quantities and taxes, and may not hold in more general models.

3.4.2 Property Rights, Incomplete Markets and Coase’s Theorem

One can view the welfare losses resulting from decentralised provision in the presence of positive externalities as arising because the markets for such externalities are incomplete or missing. By their nature, positive externalities are benefits, for which no property rights have been assigned, which enter regional preference functions. Indeed, Coase’s Theorem [see Coase (1960)] tells us that if property rights were assigned over the externalities to either region, and trade allowed to take place, an efficient equilibrium could be achieved. Efficiency results regardless of who is given the property rights, although the initial allocation will influence income distribution between regions (and hence outputs) at the final equilibrium. Hence, the Coasian solution would be to assign property rights over the externalities. However, the ability of bargaining over property rights to restore an optimum may be limited by the presence of bargaining costs.

3.4.3 Cooperation and Centralisation

In the case of small numbers of regions, there may be strategic behaviour, and the presence of mutually advantageous allocations which
Pareto dominate the Nash equilibrium may be an incentive for regions to bargain over an equilibrium outcome which dominates N. Alternatively, provision of the local public goods generating the externalities could be handed over to a central government which would solve the problem in footnote (4), yielding the globally optimal first order conditions (9) and (10).

3.5 Conclusion

In this chapter, it has been shown that positive externalities associated with the consumption of local public goods lead to under-provision of such goods relative to a social optimum, and under-taxation. Remedies for establishing optimal levels of provision were examined, including Pigovian subsidies, Coasian bargaining, cooperation and centralisation. It has also been shown that externalities introduce competition between regions. Parallels between this analysis and the tax competition literature have been drawn, and it has been pointed out that both model externalities.

Another conclusion is that, complementing the findings of Boadway, Pestieau and Wildasin (1989a), there is a direct correspondence between a Nash equilibrium in quantity space and a Nash equilibrium in tax space, under the assumptions adopted here. Following from this is the conclusion that Pigovian remedies for under-provision caused by externalities can take the form of a matching expenditure grant or matching tax subsidy. Indeed, it has been shown that a Nash equilibrium in quantities with optimal matching grants will also be a Lindahl equilibrium, and conversely, that a Nash equilibrium in taxes with optimal matching tax subsidies will be a Nash equilibrium in quantities.

A theme in this chapter has been the importance of externalities in causing the break-down of optimality conditions when regions are open to one another. As will be seen in later chapters, particularly Chapter 4, which examines comparative statics using this model, Chapter 6 which examines Section 90 of the Australian Constitution using a model of interregional tax competition, and Chapters 7 and 8 which analyse
population mobility, the externality theme and the break-down of optimality conditions resurfaces in much of federalism theory in one guise or another.
CHAPTER 4

NEUTRALITY, PARETO IMPROVING INCOME REDISTRIBUTION AND THE FLY-PAPER EFFECT

4.1 Introduction

In Chapter 1 it was noted that central governments may wish to intervene in the affairs of lower level governments in federations, either on distributional or efficiency grounds, or simply because of centralisation of tax bases coupled with decentralisation of expenditure responsibilities, implying the need for general revenue grants from the centre to allow localities to meet their expenditure commitments (as in Australia). Recall also that lump-sum transfers were one way of achieving distributional and general revenue goals, and that a range of issues were raised by the use of such grants, such as, what are their real effects, and how do recipient and donor regions respond to them? This chapter addresses these theoretical questions using the model of Chapter 3. In particular, three issues are discussed; (i) neutrality of lump-sum income transfers, and the break-down of neutrality in the presence of public good impurities, unequal regional populations and different marginal costs of producing local public goods; (ii) Pareto improving income transfers; and (iii) the fly-paper effect. Each issue is reviewed below.

4.1.1 Neutrality in a Federal Context

The literature on neutrality is reviewed extensively in Chapter 2 and is not repeated here. Recall, however, that the literature seeks to examine the circumstances under which total consumption of a pure public good by voluntary contributors to that public good is invariant with respect to income distribution between the contributors. This idea is important in
a federalism context because it suggests the possibility that untied central government grants to regions could be crowded out by offsetting regional actions and have no real effects on welfare. This is a significant concern since untied lump-sum transfers are used extensively in federal economies to achieve distributional objectives. Moreover, as will be seen in Chapters 7 and 8 where population mobility is allowed, efficiency objectives may also be achieved by lump-sum redistribution. For example, in Australia a large proportion of State revenues is derived from central government lump-sum transfers, the size and distribution of which is determined by the fiscal equalisation procedure.

As noted in Chapter 2, Boadway, Pestieau and Wildasin (1989b), referred to simply as BPW in the rest of this chapter, examine neutrality in a federalism context. Their analysis rests on two assumptions. First, households only care about the aggregate level of funding of a pure public good and not about the level of their own-contribution. Second, households are assumed to behave non-cooperatively, taking the contribution of others as given (Nash conjectures). Other important features of their model include: (i) two regions $i = 1, 2$ each with a single household where preferences can differ between regions; (ii) households have preferences over three goods, a private good $x_i$, a second good $y_i$ (which is assumed to be either a private good or a strictly local public good with no externalities) and $g_i$ which is a national public good; (iii) regional governments choose $x_i$ and $y_i$ to maximise utility of the single household in their region; (iv) a central government which implements lump-sum transfers between localities and makes matching grants to complement local voluntary contributions to the national public good; and (v) all prices are set equal to one. A Nash equilibrium is characterised between the two regions in terms of their voluntary subscriptions to the national public good, $g_i$.

BPW proceed to demonstrate that lump-sum transfers by the central government are neutral in the sense that $dg_1 + dg_2 = 0$ [see Theorem 1, p 164 of BPW]. It is then shown that, unlike lump-sum transfers, matching grants will have real effects and indeed that these real effects can be the reverse of what intuition might tell us. In particular, it is shown
that a matching grant can be at the expense of the recipient and to the benefit of the donor. The reason for this is that following a matching grant, in net terms the recipient is left only with a welfare decreasing substitution effect, because the income effect effectively 'washes out' as a result of neutrality. The donor, on the other hand, experiences no welfare loss as a result of the lump-sum transfer itself, because of neutrality, but receives the benefit of increased provision by the recipient region as a result of its substitution effect. (1) Finally, BPW relax the assumption of Nash conjectures and allow households to correctly conjecture the behaviour of other households. This, they argue, is essentially the Bernheim (1986) assumption about individual behaviour. Under this specification, BPW show that even matching grants can be neutral—-the Bernheim result.

There is one important feature of federal economies not captured in the BPW model, and that is public good externalities. Although the authors do incorporate a local public good, there are no externalities associated with its provision. Moreover, the national public good, to which localities make voluntary contributions, involves essentially 'perfect externalities', whereby each unit of own-contribution benefits all other contributors equally. In this sense, their model does not differ from the standard pure public good model with voluntary contributions to be found in Bergstrom, Blume and Varian (1986), Cornes and Sandler (1986), and indeed in Chapter 3, where \( a - b = 1 \) and units of externality are perfect substitutes for units of externality and contributions to \( q_1 \) and \( q_2 \) effectively become contributions to a global or national public good.

However, if we are to analyse neutrality within a federalism context, it may also by useful to examine cases where regions make voluntary contributions to local public goods with externalities; that is, introduce a degree of impurity or localness into the national public good modelled in BPW. As will be seen below, it turns out that this

1. For a full explanation of this result, see BPW p. 168.
added structure is important for neutrality conclusions in a federal context; a point which is recognised by BPW in the following comment:

'The public good to which contributions are made in our model differs from that sometimes used in the theory of fiscal federalism. The latter...often involves local public goods with externalities where some proportion of a locality's spending spills out to other localities. Thus, one locality's spending is not a perfect substitute for another, unlike in this paper. Our analysis could be extended to these impure public goods but the results are not clear-cut. In particular, the neutrality results no longer apply. Nonetheless, the qualitative results of this paper are at least suggestive for these other cases. Furthermore, all the neutrality results require is one public good to which all contribute, or several public goods in which contributions are overlapping.'

In this Chapter, the challenge of BPW to extend their model to allow for impure public goods is taken up. In particular, a more general model of a federation is developed which is a particular form of the model of Chapter 3 where, in contrast to the BPW model: (i) regions make voluntary contributions to a local public good which generates positive reciprocal externalities (unlike the BPW model where contributions are to a national pure public good); (ii) regions are allowed to have different populations and marginal costs of producing local public goods (unlike the BPW model where all prices equal one and there is only one household in each region). However, unlike BPW, there is no explicit modelling of a central government and matching grants are not considered. These simplifications are made in order to concentrate on the implications of externalities, different marginal costs of producing local public goods and regional populations which are not equal to one. In other respects the model to be used is analogous to that used by BPW.

It is shown that in this federation, neutrality of lump-sum transfers will generally not hold and that this is due to the fact that externalities, different marginal costs and populations other than one resident are allowed. Second, the BPW lump-sum neutrality result (Theorem 1 in BPW) is shown to be a special case in the model here. Finally, the importance of allowing public good impurity for the break-

2. BPW, p.160.
down of neutrality is examined by way of a series of numerical examples. Overall, it is argued that if one is to apply the neutrality idea in a federal setting, it is useful to incorporate some other features of federal economies, since they turn out to have important implications for neutrality.

4.1.2 Pareto Improving Income Transfers: A Federalism Application

A literature appeared in the late 1960s and early 1970s, not specifically in federalism context, which examined the possibility that lump-sum redistributive transfers of income between individuals may yield benefits to donors as well as recipients. This was in contrast to what, until then, had been the implicit assumption made in the theory of public finance that donors were unwilling participants in redistribution. This approach modelled interdependent utility functions whereby donors might: (i) have philanthropic motives towards recipients, usually assumed to be the poor; (ii) wish to contribute to redistribution in order to insure themselves against future income losses; or (iii) wish to minimise social, economic and political unrest associated with income inequities. Analyses of the philanthropic model can be found in Hochman and Rodgers (1969), von Furstenburg and Mueller (1971), Brennan (1973) and Brennan and Walsh (1973). This literature shows that lump-sum transfers of income can be Pareto improving, even though they do not induce a substitution effect for the recipient, when donor and recipient are linked in such a way that the donor receives a positive utility increase from giving which exceeds the utility loss from lower income.

The contribution of this chapter to this literature, and the federalism literature, is to apply the idea of interdependent utility functions to show that lump-sum redistribution between regions making voluntary contributions to a local public good in the presence of externalities, can be Pareto improving. That is, lump-sum redistribution has the potential to yield a post-redistribution Nash equilibrium in the lens of Figure 3.2 which Pareto dominates some initial pre-redistribution Nash equilibrium.
This is an important point, because as noted in Chapter 3, traditionally matching grants (the Pigovian remedy) are considered as the policy prescription to correct for public good externalities since they have an income and substitution (relative price) effect. Here it is shown that Pareto improving Nash equilibria can be obtained with lump-sum redistribution alone, although this requires special, though not unlikely, circumstances. Whether or not a Pareto optimal Nash equilibrium can be achieved through income redistribution is not demonstrated, although the potential for such an outcome is discussed.

Unlike the philanthropic model, the act of giving by one region to another does not generate any utility in the model to be considered here. Hence, philanthropy does not link donor and recipient. Rather, it is the consequence of giving, that is, an increased externality from the recipient, which generates the benefit for the donor.

4.1.3 The Fly-Paper Effect

The fly-paper effect was also reviewed in some detail in Chapter 2, the Review Chapter, and as with the neutrality literature, is not discussed here in detail. The key idea was that a unit of income given to a region as a lump-sum transfer would have a relatively larger positive impact on public expenditure than a one unit exogenous increase in regional income. A contribution is made to this debate here by showing that a fly-paper effect can result from regional interdependence in the following sense. If regions are linked via a positive public good externality, then in determining its response to a redistributive grant, a recipient region will take into account the response of the donor region to its loss of income in such a way that will give an additional boost to the recipient's expenditure, over and above what one may expect in the event of an exogenous increase in endowment in the region. Hence, one government's response to a transfer must take into account the fact that there are simultaneous changes in the transfers received by other regions.
The importance of regional interdependence and simultaneity in explaining the fly-paper effect was grasped by BPW in discussing the implications of their analysis of neutrality (but not exploited by them in their paper) as the following comment indicates:

'...the theoretical analysis of intergovernmental grants [Oates (1972) is a standard reference] implies that matching grants stimulate local public spending more (per dollar of transfers) than lump-sum grants, and that lump-sum grants increase public spending at the same rate (per dollar) as private income. As noted above, our analysis carries the first of these implications. However, an increase in lump-sum transfers to a single locality would be expected to have a very large impact on local spending (e.g. dollar-for-dollar if the matching rates are zero), whereas a ceteris paribus increase in one locality's income would be expected to have a very much smaller effect. Although we are unwilling to draw strong conclusions from this fact, we do note that it is consistent with the celebrated fly-paper effect. More generally, our analysis suggests that empirical analysis of any one local government's response to grant policy may have to take into account the implications of simultaneous changes in the transfers received by other localities. Observations of public expenditure by local governments presumably reflect the fiscal interactions among localities simultaneously adjusting their expenditure levels, and these interactions need to be captured in empirical models if they are to be used to recover underlying structural parameters.' (3)

The model of Chapter 3 is now reformulated in order to examine each of these three issues.

4.2 Model

Adopting a particular functional form for preferences, (3.3) to (3.6) from Chapter 3 become

(i) Region 1

Max $u_1 = x_1(q_1 + aq_2)$

$q_1$

STo: $n_1x_1 + p_1q_1 = n_1(\psi - I_2)$

3. BPW, p.175-176.
(ii) Region 2

Max \( u_2 = x_2(q_2 + bq_1) \) \hspace{1cm} (4.3)

\( (q_2) \)

STo: \( n_2x_2 + p_2q_2 = n_2I_2 \) \hspace{1cm} (4.4)

where it is now assumed that \( \psi = I_1 + I_2 \), where \( I_1, I_2 \) and hence \( \psi \) are parameters. Therefore, \( \psi \) is the sum of per-capita incomes in regions 1 and 2. Note that when \( a = b = 1 \), contributions to \( q_1 \) and \( q_2 \) can be thought of as contributions to a national public good as in BPW. From the budget constraints \( x_1 \) and \( x_2 \) are

\[
x_1 = \psi - I_2 - \frac{p_1q_1}{n_1}
\]

\hspace{1cm} (4.5)

\[
x_2 = I_2 - \frac{p_2q_2}{n_2}
\]

\hspace{1cm} (4.6)

Substituting for \( x_1 \) and \( x_2 \) into \( u_1 \) and \( u_2 \), the problems of regions 1 and 2 become:

(i) Region 1

Max \( u_1 = (\psi - I_2 - \frac{p_1q_1}{n_1})(q_1 + aq_2) \) \hspace{1cm} (4.7)

\( (q_1) \)

(ii) Region 1

Max \( u_2 = (I_2 - \frac{p_2q_2}{n_2})(q_2 + bq_1) \) \hspace{1cm} (4.8)

\( (q_2) \)
Differentiating (7) with respect to $q_1$, setting the result equal to zero and solving for $q_1$, and similarly for region 2, yields the regional subscription functions:

$$q_1 = \frac{(\psi - I_2)n_1}{2p_1} - \frac{a}{2} q_2$$ \hspace{1cm} (4.9)

$$q_1 = \frac{I_2n_2}{2p_2} - \frac{b}{2} q_2$$ \hspace{1cm} (4.10)

Solving (9) and (10) yields the Nash equilibrium levels of provision:

$$q_1^* = \frac{(\psi - I_2)n_1}{2p_1} - \frac{a}{2} \frac{I_2n_2}{2p_2} / D$$ \hspace{1cm} (4.11)

$$q_2^* = \frac{I_2n_2}{2p_2} - \frac{b}{2} \frac{(\psi - I_2)n_1}{2p_1} / D$$ \hspace{1cm} (4.12)

where (i) $D = 1-ab/4$

(ii) $0.75 \leq D \leq 1$, since $0 \leq a,b \leq 1$ by assumption.

---

4. One can establish that: (i) the set of qs from which each region chooses is a compact and convex set of Euclidian space; and (ii) the utility functions are continuous and strictly concave functions of $q$. This implies that a Nash equilibrium exists. It can also be shown that the Jacobian matrix $J$ of the implicit reaction functions is negative definite, implying that at most there is one Nash equilibrium [for this Theorem on uniqueness, see Rosen (1965)]. One can also show that the Nash equilibrium is stable. The model, therefore, has sufficient structure to ensure that a Nash equilibrium exists, is unique and stable.
Substituting $q_1^*$ and $q_2^*$ into (5) and (6) yields the optimal levels of $x_1$ and $x_2$ (given that $q_1^*$ and $q_2^*$ are at their Nash equilibrium levels) as

$$x_1^* = (\psi - I_2)(1 - \frac{1}{2D}) + \frac{ap_1I_2n_2}{4Dn_1p_2} \quad (4.13)$$

$$x_2^* = I_2(1 - \frac{1}{2D}) + \frac{bp_2I_1n_1}{4Dn_2p_1} \quad (4.14)$$

Finally, the levels of per-capita utility in each region at a given Nash equilibrium are

$$u_1^* = x_1^*(q_1^* + aq_2^*) = x_1^*Q_1^* \quad (4.15)$$

$$u_2^* = x_2^*(q_2^* + bq_1^*) = x_2^*Q_2^* \quad (4.16)$$

For given parameter values $p_1$, $p_2$, $I_1$, $I_2$, $n_1$, $n_2$, $a$ and $b$, one can solve for optimal private and public good consumption, levels of public good provision and per-capita utilities in each region and in the federation as a whole. Observe also that the total level of consumption of public goods in each region is $Q_1^* = q_1^* + aq_2^*$ and $Q_2^* = q_2^* + bq_1^*$. Total consumption of local public good in the federation is $Q^* = Q_1^* + Q_2^*$. The Nash equilibrium defined by equations (11) and (12) is characterized diagrammatically in Figure 1, which is analogous to Figure 3.2.
The Nash equilibrium $N_0$ is at the point of intersection of the two regional reaction curves $r_1$ and $r_2$. As noted above, one can solve for the Nash equilibrium once the parameter values are known. As in Chapter 3, the hatched area represents the set of equilibria which Pareto dominate the Nash equilibrium at $N_0$ and $P'P$ is the locus of equilibria which are Pareto optimal.

As will be seen later, equations (11) and (12), which define Nash equilibrium levels of provision of local public good in the presence of public good externalities, are analogous to equations (8.6) and (8.7) in Chapter 8. The difference is that in the present model $n_1$, $n_2$ (regional populations), $I_1$ and $I_2$ (regional endowments) are parameters. By contrast, in the model of Chapter 8, $n_1$, $n_2$, $I_1$ and $I_2$ are determined from a free migration equilibrium condition and are allowed to vary.
Hence, the fixed population model here can be thought of as something of a special case of the model in Chapter 8. Similarly, equations (13) and (14), defining optimal levels of \( x_1 \) and \( x_2 \) at the Nash equilibrium, are analogous to equations (8.8) and (8.9) in Chapter 8, which define optimal levels of \( x_1 \) and \( x_2 \) consistent with both a Nash equilibrium and a free migration equilibrium.

4.3 Neutrality

Now suppose that a central government, not modelled explicitly, redistributes income in a lump-sum fashion from region 1 to region 2. The effect on provision in region 1 is found by differentiating (11) partially with respect to \( I_2 \), yielding

\[
\frac{\partial q_1^*}{\partial I_2} = -\left(\frac{n_1}{2p_1} + \frac{a}{2} \frac{n_2}{2p_2}\right)/D < 0
\]

(4.17)

(17) describes the effect of the income redistribution on provision by region 1. There are two effects within (17), both negative. The first is captured by the \( n_1/2p_1 \) term, which is just the direct effect of a decrease in income on region 1's demand for \( q_1 \). It has a negative sign. The second effect, given by the term \((a/2)(n_2/2p_2)\), is the additional externality generated by region 2 as it receives income from region 1. The increased externality from region 2 has a further negative impact upon \( q_1 \). Thus, region 1 reduces its provision of \( q_1 \) by more than would otherwise be the case in the absence of interdependence through the positive externality. Similarly, the effect of the income redistribution on provision in region 2 is

\[
\frac{\partial q_2^*}{\partial I_2} = \left(\frac{n_2}{2p_2} + \frac{b}{2} \frac{n_1}{2p_1}\right)/D > 0
\]

(4.18)

Again, there are two effects, both of which have a positive influence on provision by region 2. The first is the direct effect of the increase in income, given by \( n_2/2p_2 \). The second, given by the term \((b/2)(n_1/2p_1)\) is
the effect on \( q_2 \) of the fall in externality generated by region 1 as its income falls. The fall in externality from region 1 causes region 2 to increase provision further than would otherwise be the case.

Thus, interdependence magnifies the provision effects of income redistribution relative to what might be expected without interdependence. The extent of this magnification depends upon the strength of the interdependence, in this case \( a \) and \( b \), regional populations and marginal costs (these parameters determine the size of the externalities). This point is exploited a little later on when the fly-paper effect is discussed.

The effect of income redistribution on total consumption of local public good in each region can also be easily determined. In this regard, recall that \( Q_1^* = q_1^* + aq_2^* \) and \( Q_2^* = q_2^* + bq_1^* \). Hence, the effect of income redistribution from region 1 to 2 on total consumption of public good in each region is given by

\[
dQ_1^* = \frac{\partial q_1^*}{\partial I_2} + a \frac{\partial q_2^*}{\partial I_2}
\]

\[
dQ_2^* = \frac{\partial q_2^*}{\partial I_2} + b \frac{\partial q_1^*}{\partial I_2}
\]

Substituting for \( \frac{\partial q_1^*}{\partial I_2} \) and \( \frac{\partial q_2^*}{\partial I_2} \) from (17) and (18) yields:

\[
dQ_1^* = \frac{n_1}{2p_1} \frac{ab}{2} - \frac{a}{2} \frac{n_2}{2p_2} / D
\]

\[
dQ_2^* = \frac{n_2}{2p_2} \frac{ab}{2} - \frac{b}{2} \frac{n_1}{2p_1} / D
\]

(21) and (22) describe the change in \( Q_1^* \) and \( Q_2^* \) for a small redistribution of income from region 1 to region 2. These comparative
static effects will depend upon: (i) regional populations; (ii) the externality parameters a and b; and (iii) marginal costs of producing local public goods. There is no reason to expect (21) and (22) to be zero, except fortuitously. In general, total consumption will be affected by income redistribution.

This contrasts with the neutrality theorem of BPW for three reasons. First, in the model here we allow explicitly for different marginal costs of producing local public goods, rather than set all prices equal to one. Second, here we model voluntary contributions to a local public good with positive externalities, rather than a national public good, although when \( a = b = 1 \) we essentially have the BPW national public good. However, when \( 0 \leq a, b < 1 \) the national public good becomes impure, a possibility not allowed in the BPW model. Finally, regional populations here are allowed to be more than one and can differ as opposed to being set at one household per region. This is an important feature of modelling neutrality in a federal context, because although governments are acting like an individual or representative resident, they are adding the individual demands of all their residents to determine total Nash equilibrium contributions to the local public good. Hence, regional populations help determine the comparative static response of provision to income changes.

Note however, that we do not need all three differences to generate non-neutrality. For example, if we assume that \( a = b = 1 \) and \( p_1 = p_2 = 1 \), as in BPW, then it can be shown from (21) and (22) that we require \( n_1 - n_2 \) to obtain neutrality. If regional populations are not equal, neutrality breaks down, even though the assumption of a national public good is adopted. Alternatively, if \( a = b = 1 \) and \( n_1 = n_2 \) are assumed, then from (21) and (22) \( p_1 = p_2 \) is required for neutrality. Finally, if \( n_1 = n_2 \) and \( p_1 = p_2 \), then \( a = b = 1 \) (the BPW assumption) is required to obtain neutrality. Thus, any one of these differences between the BPW model and the model here is sufficient to result in the break-down of neutrality: that is, unequal marginal costs, different regional populations, and impurity of the national public good.
This implies that when one examines neutrality in a federalism context, only a minimal amount of federal structure or richness is required to result in the break-down of the kind of neutrality found in the models of voluntary individual contributions to a pure public good, and one can conclude that lump-sum transfers will, in general, have real effects in a federal economy. Indeed, as will be shown later, lump-sum transfers can, under certain assumptions, be Pareto improving, depending upon the relative magnitude of externalities generated by regions.

4.3.1 The BPW Neutrality Result

In order to take up the point made by BPW about the effect of allowing for impurity in the national public good in breaking down neutrality, it is useful to consider the case where neutrality does hold, essentially the BPW case, and isolate the role of externalities, or impurity in the national public good, in causing the break down of neutrality and the comparative static effects of lump-sum income transfers. In this regard, suppose that \( n_1 = n_2 = 1 \) and \( p_1 = p_2 = 1 \) as in the model of BPW. Equations (21) and (22) simplify to

\[
\frac{dQ_1}{1} = \frac{ab}{2} \left( \frac{1}{2} \right) \frac{a}{4} \quad (4.23)
\]

\[
\frac{dQ_2}{1} = \frac{ab}{2} \left( \frac{1}{2} \right) \frac{b}{4} \quad (4.24)
\]

Given that \( 0 \leq a, b \leq 1 \) by assumption, one can see that (23) and (24) are only equal to zero when \( a = b = 1 \), that is, if residents in each region treat units of own-provision and units of externality as perfect substitutes. This effectively means that contributions to the local public good are contributions to a national public good, which is of course the basic result of Theorem 1 in BPW.(5)

5. If values for \( a \) and \( b \) outside the range \( 0 \leq a, b \leq 1 \) were considered, \( a - b = 1 \) is no longer the only solution to (23) and (24).
The intuition for this is as follows. As region 1 loses a unit of income, it decreases own-contribution accordingly. This decline filters through, via the externality, to offset exactly region 2's increased own-contribution which results from its income increase. Accordingly, total consumption in region 2 is unchanged. Hence, the increase in provision in region 2 is exactly offset by the decrease in externality generated by region 1. Similarly, region 2's increased provision filters through to region 1, again via the externality, to offset exactly the fall in region 1's own-contribution and total consumption in region 1 is also unchanged. Thus, region 1, post-transfer, consumes the same amount of local public good, but has a lower own-contribution, relying to a greater extent on the externality generated from region 2. Conversely, region 2 has the same level of consumption, but makes a higher own-contribution, relying less on the externality generated by region 1.

Neutrality of income transfers can be seen from a numerical example. Suppose that at an initial Nash equilibrium $N_0$ in Figure 1 we have $I_1 = I_2 = 100$, $p_1 = p_2 = 1$, $n_1 = n_2 = 10$ and $a = b = 1$. Values for the endogenous variables are shown in the left portion of Table 1.

<table>
<thead>
<tr>
<th>Table 4.1: Neutrality of Income Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Equilibrium (N₀)</strong></td>
</tr>
<tr>
<td>$q_1^<em>$ $q_2^</em>$ $x_1^<em>$ $x_2^</em>$ $u_1^<em>$ $u_2^</em>$</td>
</tr>
<tr>
<td>333 333 68 68 44462 44462</td>
</tr>
<tr>
<td>$Q_1^<em>$ $Q_2^</em>$ $Q^*$</td>
</tr>
<tr>
<td>666 666 1332</td>
</tr>
</tbody>
</table>

Suppose that 10 units of income are redistributed from region 1 to 2. The new Nash equilibrium is $N_1$ and the values for local public good
provision and consumption, private good consumption and per-capita utility following the redistribution are presented in the right hand portion of Table 1. The first point to observe is that per-capita utilities, and private and total public good consumption in each region and the federation, are unaffected by the transfer. However, voluntary contributions by each region to the local public good have altered. In particular, a decrease in $q_1^*$ has been exactly offset by an increase in $q_2^*$, and since $a = 1$, all of the increase in $q_2^*$ has filtered back to region 1 as externality leaving $Q_1^*$ unaltered. Similarly, in region 2, the increase in $q_2^*$ has been exactly offset by the decline in $q_1^*$, and since $b = 1$, all of this decline filters through to region 2 as a fall in externality leaving $Q_2^*$ unchanged. Thus, the new Nash equilibrium at $N_1$ has changed levels of voluntary contribution, but in such a way that leaves total levels of consumption of private and public good and per-capita utilities, unchanged.

4.3.2 Externalities and the Break-Down of Neutrality

A number of cases of income redistribution where the $a$ and $b$ parameters are assumed to be less than one, and different, is now examined. In terms of BPW, we can think of this as allowing some impurity or localness into what was assumed to be a national public good in the example above where $a = b = 1$.

(a) A Weaker Neutrality Result with $a = b = 0.5$

In this example, regions are assumed not to treat units of externality and own-provision as perfect substitutes, but it is assumed that $a = b$; that is, they treat them as imperfect substitutes to the same degree. In particular, letting $a = b = 0.5$, (23) and (24) simplify to

$$dQ_1^* = -0.6 \frac{n}{2p} < 0 \quad \text{and} \quad dQ_2^* = 0.6 \frac{n}{2p} > 0$$

(4.25)

Thus, $-dQ_1^* = +dQ_2^*$, implying that $dQ^* = 0$. In this case, the transfer is not neutral with respect to total consumption in each region.
$Q_1^*$ declines and $Q_2^*$ rises. However, the fall in $Q_1^*$ exactly offsets the rise in $Q_2^*$ so that total consumption in the federation is unchanged. Hence, the transfer changes the relative consumption of local public goods by regions 1 and 2, but does not influence the total level of consumption because the changes are symmetric: one region's loss is another region's gain. This can still be thought of as a neutrality result in the sense that total consumption of local public good in the federation is invariant with respect to the distribution of income between regions, although the transfer is not neutral within each region (the stronger neutrality case examined previously). This example is characterised numerically in Table 2 which is the example of income redistribution presented in Table 1, but now assuming that $a = b = 0.5$.

**Table 4.2: A Weaker Neutrality Result with $a = b = 0.5$**

<table>
<thead>
<tr>
<th>Initial Equilibrium ($N_0$)</th>
<th>Final Equilibrium ($N_1$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_1^<em>$ $q_2^</em>$ $x_1^<em>$ $x_2^</em>$ $u_1^<em>$ $u_2^</em>$</td>
<td>$q_1^<em>$ $q_2^</em>$ $x_1^<em>$ $x_2^</em>$ $u_1^<em>$ $u_2^</em>$</td>
</tr>
<tr>
<td>267 267 73 29324 29324 187 347 71 75 25670 33136</td>
<td></td>
</tr>
</tbody>
</table>

Per-capita utility in region 1 declines as a result of its income loss since, for each dollar of income lost in the transfer, it now only receives back $0.5$ of externality (because $a = 0.5$) from region 2. However, in region 2, for each dollar of income gained from the transfer, it only loses $0.5$ in lower externality from region 1 (because $b = 0.5$) so its per-capita utility rises. Observe also that $-du_1^* < +du_2^*$ so that average per-capita utility across the two regions increases as a result of the transfer, although there is no Pareto improvement over the initial
equilibrium. (6) Finally, we have $-dQ_1^* = +dQ_2^*$, so that $dQ^* = 0$ as shown previously.

(b) Non-Neutrality with $a = 0.25$ and $b = 0.5$

Now let $a = 0.25$ and $b = 0.5$. Equations (23) and (24) simplify to

$$dQ_1^* = \frac{n}{2p} < 0 \quad \text{and} \quad dQ_2^* = \frac{n}{2p} > 0 \quad (4.26)$$

Thus, $-dQ_1^* > +dQ_2^*$ which implies that $dQ^* < 0$. The transfer reduces total consumption in region 1 and increases total consumption in region 2 as previously. However, now the fall in region 1 exceeds the increase in region 2. Thus, not only is the transfer not neutral with respect to each region’s consumption, it is also no longer neutral with respect to total consumption in the federation, which falls as a consequence of the transfer. This example is characterised numerically in Table 3 where now $a = 0.25$ and $b = 0.5$ and all other parameters are as for Tables 1 and 2.

6. Note also that in the final equilibrium we have $u_2^* > u_1^*$. This is possible in a model with fixed regional populations, and as will be seen in the examples to follow, is a feature of the equilibria characterised (except when there is symmetry between regions). However, as will be shown in the model of Chapter 8, if citizens are allowed to migrate freely between regions to equalise per-capita utilities, then we can only consider Nash equilibria where $u_1^* = u_2^*$. A free migration equilibrium condition effectively imposes an additional condition on the Nash equilibria which can be considered.
Table 4.3: Non-Neutrality with \( a = 0.25 \), \( b = 0.5 \)

<table>
<thead>
<tr>
<th>Initial Equilibrium (( N_0 ))</th>
<th>Final Equilibrium (( N_1 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>( q_1^\ast )  ( q_2^\ast )  ( x_1^\ast )  ( x_2^\ast )  ( u_1^\ast )  ( u_2^\ast )</td>
<td>( q_1^\ast )  ( q_2^\ast )  ( x_1^\ast )  ( x_2^\ast )  ( u_1^\ast )  ( u_2^\ast )</td>
</tr>
<tr>
<td>452   387   55   61   30051   37572</td>
<td>394   452   51   65   25680   42016</td>
</tr>
<tr>
<td>( Q_1^\ast )  ( Q_2^\ast )  ( Q^\ast )</td>
<td>( Q_1^\ast )  ( Q_2^\ast )  ( Q^\ast )</td>
</tr>
<tr>
<td>549   613   1162</td>
<td>507   649   1156</td>
</tr>
</tbody>
</table>

Again, per-capita utility in region 1 falls and per-capita utility in region 2 rises where \( -dU_1^\ast < +dU_2^\ast \) so that average per-capita utility between the two regions increases, although as before, there is no Pareto improvement over the initial equilibrium. Notice also that now \( -dQ_1^\ast > +dQ_2^\ast \) and hence the fall in consumption of local public good in region 1 exceeds the rise in region 2. This is because, effectively, the transfer has redistributed income from a region with a relatively high productivity in generating externalities, region 1, to a region which has a relatively low productivity in generating externalities, region 2. In other words, for every dollar of income lost by region 1 it receives back as externality only $0.25 of externality. For every dollar of income received by region 2, it loses $0.5 of externality from region 1.

(c) Non-Neutrality with \( a = 0.5 \) and \( b = 0.25 \)

Assuming that \( a = 0.5 \) and \( b = 0.25 \), the reverse of the last example, equations (23) and (24) are

\[
dQ_1^\ast = -0.7 \frac{n}{2p} < 0 \quad \text{and} \quad dQ_2^\ast = 0.8 \frac{n}{2p} > 0 \quad (4.27)
\]
Here, the transfer reduces consumption in region 1 and increases consumption in region 2 as before. However, now the increase in region 2 exceeds the fall in region 1, so that total federal consumption rises, but at the cost of lower consumption in region 1. This is the reverse of the last example and is characterised numerically in Table 4 under the same parameter values as for the previous examples, except that now $a = 0.5$ and $b = 0.25$

Table 4.4: Non-Neutrality with $a = 0.5$, $b = 0.25$

<table>
<thead>
<tr>
<th>Initial Equilibrium ($N_0$)</th>
<th>Final Equilibrium ($N_1$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_1^<em>$ $q_2^</em>$ $x_1^<em>$ $x_2^</em>$ $u_1^<em>$ $u_2^</em>$</td>
<td>$q_1^<em>$ $q_2^</em>$ $x_1^<em>$ $x_2^</em>$ $u_1^<em>$ $u_2^</em>$</td>
</tr>
<tr>
<td>387 452 61 55 37572 30051</td>
<td>323 510 58 59 33319 34890</td>
</tr>
<tr>
<td>$Q_1^<em>$ $Q_2^</em>$ $Q^*$</td>
<td>$Q_1^<em>$ $Q_2^</em>$ $Q^*$</td>
</tr>
<tr>
<td>613 549 1162</td>
<td>578 591 1169</td>
</tr>
</tbody>
</table>

Notice that per-capita utility again falls in region 1, rises in region 2 and that $-dQ_1^* < +dQ_2^*$ implying that average per-capita utility in the federation increases. Again, there is no Pareto improvement over the initial equilibrium. Also, $Q_1^*$ declines but by less than the increase in $Q_2^*$; hence, $Q^*$ increases. The reason for this is that here we have transferred income from the least productive region to the more productive region (in terms of externality generating ability). (7)

7. If one interprets the $a$ and $b$ parameters as indicating the productivity of regions in generating externalities, then in this example one is effectively transferring income from the lower productivity region to a higher productivity region, leading to an increase in total consumption in both regions (although not a Pareto improvement). This result confirms a parallel result in Cornes (1992b).
To summarise this discussion on neutrality in a federal context and the general comparative static effects of income redistribution in the presence of local public good externalities, even in a relatively simple federalism model, lump-sum transfers of income between regions will in general have real effects. While these real effects depend upon a range of parameters, including regional populations and marginal costs of producing local public goods, they also depend upon the strength of the externalities generated by regions, that is, the strength of regional interdependence.

4.4 Pareto Improving Lump-Sum Income Redistribution

One observation which can be made from the above analysis is that although lump-sum transfers may have real effects, in none of the examples was a Pareto improvement achieved as a result of redistributing income between the two regions. Even in the example of Table 4, where total consumption of local public good in the federation as a whole increased because of the transfer to a higher productivity region, there was no Pareto improvement. Indeed, in all the examples, gains in per-capita utility in region 2 were achieved only at the expense of lower per-capita utility in region 1, the region losing income, although it was possible for average per-capita utility to rise. In other words, in none of these examples did income redistribution secure a final Nash equilibrium \( N_1 \) which Pareto dominated the initial Nash equilibrium \( N_0 \) in Figure 1. \( N_1 \) (in the examples considered) is always outside the lens of mutually advantageous equilibria.

However, if the externality generated by region 2, the grant recipient region, is sufficiently strong, one can show that it is possible to reallocate income from region 1 to region 2 and make both regions better-off; that is, establish a new Nash equilibrium which Pareto dominates the initial equilibrium. For example, suppose that \( I_1 = I_2 = 100 \) and \( p_1 = p_2 = 1 \) as in the previous numerical examples. Further, region 2 is assumed to generate a higher level of externality than region 1 through a combination of \( a > b \) and a higher population \( (n_2 > n_1) \). In particular, let \( a = 1, b = 0.5, n_1 = 10 \) and \( n_2 = 15 \). Thus, regions 1 and
2 are assumed to be different but not substantially so. In terms of population for example, region 2 is assumed to have 50 per-cent more people than region 1. Thus, region 2 is assumed to be a relatively large region (in terms of population) and also a relatively large generator of positive externalities. The initial equilibrium is characterised in the left portion of Table 5 while the equilibrium following the redistribution of 10 units of income from region 1 to region 2 is characterised in the right hand portion of the Table.

Table 4.5: Pareto Improving Income Redistribution

<table>
<thead>
<tr>
<th>Initial Equilibrium (N₀)</th>
<th>Final Equilibrium (N₁)</th>
</tr>
</thead>
<tbody>
<tr>
<td>q₁* q₂* x₁* x₂* u₁* u₂*</td>
<td>q₁* q₂* x₁* x₂* u₁* u₂*</td>
</tr>
<tr>
<td>143 714 86 52 73457 41171 43 814 86 56 73474 46549</td>
<td></td>
</tr>
<tr>
<td>Q₁* Q₂* Q*</td>
<td>Q₁* Q₂* Q*</td>
</tr>
<tr>
<td>857 785 1642</td>
<td>857 835 1692</td>
</tr>
</tbody>
</table>

The following can be noted. First, both u₁* and u₂* have increased as a consequence of the income transfer; that is, the transfer has established a new Nash equilibrium N₁ which Pareto dominates the initial equilibrium N₀. In terms of Figure 1, N₁ is now in the hatched lens of equilibria which Pareto dominate N₀. The reason for this result is that for every dollar of income lost by region 1, it now receives more than a dollar back in additional externality from region 2. Since income and externality are treated as equivalent in region 1's budget constraint by assumption, this means that region 1 is better-off as a result of the transfer. Region 2, of course, is made better-off as in the previous examples.
While not modelled here, this example raises the possibility of income redistribution achieving an equilibrium on the P'P locus of Figure 1. One could imagine a situation where income could be transferred from region 1 to region 2, progressively making each better-off, until the potential gains in the hatched lens of Figure 1 are maximised. As income is redistributed, region 1 would come to rely more on externality and less on own-provision, while region 2 would do the opposite; that is, rely less on externality and more on own-provision. Of course, it may be the case that region 1 is driven to zero own-contributions in which case it would rely completely on externality from its neighbour and allocate all of its remaining income to the private good. Another possibility is that region 1's income would be exhausted before the Pareto optimum is reached, precluding the achievement of such an optimum.

Thus, the result here suggests that welfare losses resulting from a failure by each region to internalise externalities can be corrected through lump-sum transfers to the region which is more productive in terms of externalities generated. This is in addition to the possibility of using matching grants, as identified in Chapter 3.

4.5 A Fly-Paper Effect: The Result of Regional Interdependence

Assume now that there is an increase in $I_2$ which leaves all other parameters unchanged, unlike the increase in $I_2$ considered above which was assumed to be the result of a lump-sum redistribution of income from region 1 which lowered $I_1$. This increase in $I_2$ could be thought of as being due to a productivity increase in region 2. (8)

---

8. As a consequence of the fact that $\psi = I_1 + I_2$, then $\psi$ increases by the same absolute amount as $I_2$ so that $I_1 = \psi - I_2$ is unchanged.
The change in region 2's Nash equilibrium provision of local public good as a result of the increase in $I_2$ is, from (11)

$$\frac{\partial q_2^*}{\partial I_2} = \frac{n_2}{2p_2}$$

(4.28)

Comparing (28) with (17), the change in region 2's contribution when the income change is due to a redistribution from region 1 to region 2, it is clear that

$$\frac{n_2}{2p_2} + \frac{b}{2} \frac{n_1}{2p_1} > \frac{n_2}{2p_2}$$

(4.29)

Hence, region 2 increases provision by a larger amount when its budget constraint is relaxed through income redistribution from region 1 than if its constraint is relaxed through an exogenous productivity increase which leaves $I_1 = (\psi - I_2)$ unchanged. This is effectively a fly-paper effect, that is, a lump-sum grant of one unit from region 1 to 2 has a relatively larger impact on public good output in region 2 than simply relaxing the region 2's budget constraint by one unit. The reason for this is as follows. When region 2 receives a lump-sum grant, since it is paid for by region 1, the positive externality generated by region 1 declines. Through region 2's reaction function, this leads region 2 to increase its own-contribution to $Q_2$ by more than it otherwise would in the absence of this interdependence. This extra stimulus to provision is given by the term $b/2(n_1/2p_1)$ on the left hand side of (29), which is region 1's change in provision as it loses income to region 2 as a consequence of the transfer.

Hence, a lump-sum transfer yields a higher public good output response in the recipient region than some exogenous increase in income, simply because the recipient takes into account the output response of the grant donor region, depending upon the degree of interdependence. This additional boost to output is not captured in models which do not account for regional interdependence. Moreover, the fly-paper effect
The strength of the fly-paper effect derived above depends upon the size of the positive externality generated by region 1. This, in turn, depends upon the size of the $b$ parameter, or the extent to which region 2 treats units of externality and own-provision as substitutes, the marginal cost of production in region 1 ($p_1$) and region 1's population. If $b$, for example, is relatively low, one would expect the fly-paper effect to be small. Hence, the strength of regional interdependence will be an important determinant of how significant this type of fly-paper effect is. Also, note that one might expect to generate a comparable result from any model of regional interdependence - for example, from a model of tax competition. In general, all that is needed is that regions be linked by some form of positive externality. The fly-paper effect is shown diagrammatically in Figure 2.

**Figure 4.2: A Fly-Paper Effect**
Assuming that the initial equilibrium is at $N_0$ with levels of provision of $q_1^0$ and $q_2^0$. An exogenous increase in endowment in region 2 which leaves region 1's income unaffected, shifts $r_2$ to the right to $r_2'$ establishing a new Nash equilibrium at a point such as $N_1$ with provision in region 2 higher at $q_2^1$ and provision in region 1 lower at $q_1^1$. However, starting with the same initial equilibrium at $N_0$, an increase in $I_2$ financed by a fall in region 1's income, that is, a redistributinal grant made by a central government, shifts $r_2$ as above, but also shifts $r_1$ to $r_1'$ implying a Nash equilibrium at $N_2$. Provision is now at $q_2^2$ and $q_1^2$. Moreover, in region 1 we have $q_1^0 > q_1^1 > q_1^2$ and in region 2, $q_2^0 < q_2^1 < q_2^2$. The vertical distance $q_2^2 - q_2^1$ can be thought of a measure of the fly-paper effect in this model, expressed in terms of units of $q_2$.

In summary, the fly-paper effect can be explained as the result of regional interdependence, in particular, a positive local public good externality. It was shown that interdependence effectively links donor and recipient regions. This causes the recipient to boost its output response to a lump-sum grant over and above what might otherwise be expected in the absence of such interdependence, since the recipient takes into account a contraction in provision in the donor region.

4.6 Conclusion

In this chapter, the basic model of BPW has been extended to show that if: (i) regions make voluntary contributions to a local public good which generates positive externalities (the same as allowing the national public good in BPW to have some degree of impurity, or localness); (ii) regional populations differ; and (iii) marginal costs of producing local public goods differ across regions, then lump-sum transfers between regions have real effects and neutrality breaks down. Although any one of the above is sufficient to cause non-neutrality, the emphasis in the discussion has been on the way in which impurity in the national public good, or externalities associated with local public goods, leads to non-neutrality.
It has also been shown that lump-sum income redistribution can be Pareto improving when income is redistributed from a region generating relatively low public good externalities, to a region generating relatively high externalities. Thus, lump-sum transfers may yield equilibria which Pareto dominate \( NO \) in Figure 1. Moreover, there is the potential for such transfers to establish a Pareto optimal Nash equilibrium on the \( P'P \) locus of Figure 1 if region 1's endowment is not exhausted before the Pareto optimum is reached. However, this was not modelled explicitly and would need to be established by further research. Thus, under certain circumstances, that is, when one region is generating relatively strong public good externalities, it may be possible to use lump-sum grants alone to correct for the welfare losses created by externalities and under-provision.

Finally, it has been demonstrated that a fly-paper effect can result from regional interdependence and the fact that regional responses to transfers are determined simultaneously. If donor and recipient regions are linked via a positive externality, the recipient boosts its expenditure response to a lump-sum grant by more than would be the case in the absence of such interdependence (for example, if the recipient receives a dollar of extra endowment with no reduction in region 1's income). The implication here is that empirical models which have discovered the fly-paper effect may, to some extent at least, be capturing this interdependence in data measuring a locality's expenditures on local public goods.

Neutrality and the fly-paper effect are examined again in Chapter 8 where the model used here is extended to allow for population mobility. It is shown that mobility has further implications for both neutrality and fly-paper effects.
CHAPTER 5

'THE INDUCEMENT TO FEDERATE AND REDISTRIBUTION IN FEDERAL SYSTEMS(1)

5.1. Introduction

As argued in the Introduction, Chapter 1, perhaps the most fundamental issue in the theory of fiscal federalism is, why would independent political entities wish to federate? It was also argued in Chapter 1 that three other issues of interest in Australian federalism were: (i) why was the Commonwealth Grants Commission (CGC), which has such a central role in federal relations, formed? (ii) what were the motives behind the development of the fiscal equalisation principle? and (iii) is the apparent concern with equality of outcomes the only, or the most important, motive behind equalisation, or does it serve another economic purpose?

In this chapter, an attempt is made to provide some answers to these questions. Indeed, as will be seen, the answers are linked in an interesting way, particularly the question of why federate and the rationale for equalisation, and the formation of redistributive institutions (such as the CGC) in federal economies.

Many of the theoretical techniques used in Chapters 3 and 4 are adopted here with the following differences. First, the previous theme of externalities is continued, but in a slightly different manner. In particular, in this chapter a tax price externality is characterised in contrast to the explicit public good externality of Chapters 3 and 4. The tax price externality is a benefit that federating regions confer on one another when federating in the sense that the public good tax price

1. The analysis in Section 5.4 is based on joint work with Perry Shapiro.
declines. The strength of this externality depends upon the degree of publicness of the public good. Second, governments are no longer assumed to be benevolent despots. Rather, a median voter model is adopted in order to capture a major cost of economic union associated with the collective choice mechanism. Third, three regions are modelled, each with different preferences over an excludable public good. Thus, unlike the previous work, the emphasis in this Chapter is on diversity of preferences and collective choice in explaining the inducement to federate, and the need for transfers and the institutions to facilitate them in federal economies.

It is argued that federation may produce a 'social surplus' of benefit (shown later to be the tax price externality discussed above) over cost which, under certain circumstances, offers a significant inducement for independent regions to federate.(2) Second, it is proposed that, although there may be a social surplus from federation, this surplus may not be distributed 'equitably' and some participants conceivably may be losers. In such cases, federation can only proceed if there is: (i) sufficient social surplus to compensate the losers; and (ii) a system of redistributional transfers in place following federation. Thus, the view is offered that redistributional transfers between regions, which appear to be a feature of federations in practice, including Australia, are necessary for federal cohesion and unity. This is in addition to the traditional arguments made for them on equity [see Buchanan (1950, 1952)] and efficiency grounds [see Boadway and Flatters (1982a), (1982b)].

These results are then applied in an Australian context and used to offer explanations for why the CFC was formed, and the motives behind development of the equalisation principle. In particular, it is

2. A discussion of how a social surplus may arise from federation is provided in Maxwell and Pestieau (1980). Generally, the literature on the surplus from federation is limited to analyses of the gains from trade and the question of whether these gains are dissipated through interregional competition. This aspect of the surplus from federation is discussed in Whalley and Trella (1986).
suggested that a commitment to interstate transfers may have been a necessary condition for the achievement of federal unity, and that the CGC and equalisation evolved as instruments for distributing the surplus from federation in the interests of federal unity. Thus, these procedures, and the CGC, may be rationalised by appeals to fairness or equity, as Gramlich (1984) suggests, but they also play an important part in maintaining the integrity of the union.

5.2. Model

While one can imagine a range of costs and benefits from federation, it is unreasonable to expect to be able to construct an economic theory of federation capable of capturing them all.\(^3\) Nevertheless, some insight can be obtained by analysing the interaction between one benefit and one cost. Such an analysis can be taken as a 'parable' for the other benefits and costs in the sense that it establishes some general principles of federation.

Since the interest here is in the public good and taxation benefits and costs of federation, a model which focuses on a tax price benefit of union and a 'uniformity of provision' cost, is now developed. Consider a world of three autonomous regions or states i = A, B, C (referred to as autarky from now on). The population of each is completely homogeneous: all citizens have identical preferences and income (within each state). While every state has the same population and income (both assumed to be one), interstate differences in preferences are allowed.

Assume that each state provides an identical excludable public good, q, financed by a tax on each individual equal to the average cost per person. The public good is excludable between, but not within,

\(^3\) Maxwell and Pestieau (1980) identify four elements which may make up the surplus from federation. They are (i) the gains from free internal trade; (ii) the pooling of risk between heterogeneous regions; (iii) the joint regional benefits from central provision of public goods (the tax price benefit modelled in this Chapter); and (iv) increased international bargaining power as regions form a single coalition.
regions (excludability may derive from location, for instance). \( q \) may be thought of as goods and services such as defence, legal systems, police protection, environmental standards, welfare support, health regulations and safety and water quality standards which each region provides in autarky as a pure public good within its own boundaries but can exclude residents of neighbouring regions from consuming.

Suppose, for convenience of exposition, that the total per unit production cost of providing the public good is a constant, \( p \), regardless of the number of citizens. Therefore, if states federate and agree jointly to provide a public good for all, they each enjoy the benefit of sharing the constant public good costs over a larger number of people. This is the benefit of federation to be modelled below. It can be thought of as a positive externality which each participant in federation generates for its partners and from now on is referred to as a tax price benefit. However, following federation, states must agree among themselves on 'how much' of the public good to provide. As will be seen below, resolution of the 'how much' question can yield a cost of federation for some regions, and this is the cost that is modelled.

Since the population of a state is completely homogeneous, a state's preferences are exactly the same as those of any individual and can be represented by a representative consumer's preference function. Assuming a particular functional form for preferences, region \( i \) in autarky solves:\(^4\)

\[
\max u = x^\alpha q^\beta \\
(q)
\]

\[
\text{STo: } nx + pq = nI
\]

\( p \) is the constant per production unit price of the public good denominated in units of \( x \). It is assumed that \( p \) is identical across

---

4. Adopting a particular functional form facilitates the later numerical analysis of benefits and costs of federation.
regions, and \( n \) is the number of individuals in region \( i \) (where the \( i \) subscript is dropped when referring to region \( i \) from now on). As noted above, \( n = 1 \), and for expositional convenience, \( p \) is set equal to one as well. The tax price, \( p/n \), is therefore the same in each region and equal to one. Let \( \alpha \) be a taste parameter for good \( x \) and \( \beta \) be a taste parameter for \( q \), both of which are allowed to vary across regions. Finally, let \( I \) be the income of region \( i \).

Suppose that each region has a government which simply implements the preferences of a majority of voters (7). Given that there is only one type of individual in each jurisdiction, this implies that there will always be a unanimous vote in favour of implementing this individual's preferences over \( q \). The majority rule outcome will be the same as that under a simple community preference model.

From (1) and (2), one can show that the demand functions for region \( i \) in autarky are

\[
x = \alpha \quad \text{(demand for private good)}
\]
and

\[
q = n\beta \quad \text{(demand for public good)}
\]

(5.3)

where \( p = I = 1 \)

Assuming that \( \beta_A = 0.1 \), \( \beta_B = 0.2 \) and \( \beta_C = 0.3 \), and recalling that \( n = 1 \), the demand for \( q \) in each region in autarky is \( q_A = 0.1 \), \( q_B = 0.2 \) and \( q_C = 0.3 \). With this distribution of preferences over \( q \), region \( A \) is a 'low demander', region \( C \) is a 'high demander' and region \( B \) has median demand in autarky.

7. This assumption leaves aside the issue of state versus the peoples' interests.
5.3. Tax Price Benefit and Median Voter Cost of Federation

The question now asked is, what are the economic consequences of federation for these three autonomous regions? The potential federations, or coalitions, which the three regions can form are \( S = \{A, B, C\}, \{A, B\}, \{A, C\}, \{B, C\} \). In coalition \( S \), assume that the regions cease separate supply of \( q \) and instead that one public good is supplied jointly to all members of the coalition. It is assumed that one unit of the joint public good supplied in coalition \( S \) is a perfect substitute for a unit of the separately supplied public good. Therefore, units of the joint public good are also denoted as \( q \).

It is also assumed that there is an equal cost-sharing rule for provision of \( q \) in coalition \( S \). The contribution of each region in a coalition therefore depends on the number of members of the coalition. In a coalition of all three regions, each pays a third of the total cost of provision, while in any coalition of two regions, each meets half the cost of provision of the jointly supplied public good.

Further, suppose that in coalition \( S \) the collective choice problem over \( q \), the 'how much' question, is resolved by majority rule. Given that preferences are uni-dimensional in one vector, \( q \), and single-peaked, in any coalition the preferences of the median are decisive. For the three-state coalition \( \{A, B, C\} \) the median is region B while for any two-state federation one can take the average demand of the two as the public good outcome. This corresponds to the expected value if each individual demand is equally likely, or if all values between the high and low demand are equally likely.

There are two important questions. First, what are the net welfare effects for each region from joining the various coalitions? Second, 

6. The political dynamic of why the regions might choose federation, that is, full political union over other forms of cooperation, such as a treaty between the regions to remain independent and centralise provision of the public good, is set aside.

7. Later, \( S \) is referred to as the power set of a coalitional game.
will each state choose to be a member of a coalition, or will some prefer to remain in autarky? These questions can be answered at a general level by considering the welfare consequences for each region from participating in the \((A, B, C)\) coalition.

5.3.1 Region A-Low Demand

The welfare effects of forming coalition \((A,B,C)\) for region A are characterised in Figure 1.

Figure 5.1: Region A's Optima in Autarky and Coalition (A,B,C)

8. These questions have a parallel with those asked in the club goods literature (reviewed in Chapter 2). Club goods are usually impure, unlike \(q\) in the present model, and hence there are congestion or crowding costs associated with adding new members to the club which must be balanced against the benefit that new members share the cost of provision in determining optimal membership size. In the analysis here, a similar question is being asked: that is, what are the costs and benefits of expanding membership of region \(i\) by forming a larger club or federation? As will be seen below, there will be a tax price benefit related to the cost sharing rule, just as in club good models, but no congestion cost because \(q\) is assumed to be pure. However, there is another cost related to the collective choice mechanism, and this is the cost to be balanced against the tax price benefit in the present model.
In autarky, region A consumes 0.1 units of $q_A$. From the budget constraint, this implies that 0.9 units of $x$ are consumed: that is; $x_A = 1 - 1(0.1) = 0.9$. An optimum at point A (autarky) is achieved on indifference curve $u_A^0$. With federation, the tax price falls to one-third of its autarky level because $n = 3$ now rather than one, and the budget line swivels from $bb$ to $bb'$.

This is a tax price benefit of federation. It can be thought of as a fiscal externality which each region generates for its partners in federation. For example, a region’s presence in a coalition generates a tax price fall for its partners in the coalition which it does not internalise: it cares only about the tax price benefit it receives as the result of joining a particular coalition.

If region A could consume its preferred bundle of $x$ and $q$ at this new relative price, an optimum at B would be achieved on indifference curve $u_A^1 > u_A^0$. This tax price benefit of federation makes region A unambiguously better-off. Because Cobb Douglas preferences are assumed, only the demand for $q$ is affected by the fall in the price of $q$, because cross partial price elasticities are zero (from region A’s demand function, consumption at point B is $q_A = 3(0.1) = 0.3$; and, from the budget constraint, $x_A = 1 - (0.3)/3 = 0.9$ as previously).

However, region A is unable to achieve an optimum at point B because under federation with majority rule, region B has median

9. The tax price benefit is a function of the assumed pure publicness of $q$. If $q$ were allowed to be impure, the tax price benefit would be reduced, and in the extreme case where $q$ is a private good, eliminated. One could extend the model to allow such impurity, but the essential idea that there is a benefit of federation related to the publicness and consequent tax price benefit would remain. The present model can be thought of as a ‘best case scenario’ which presents the tax price benefit at its maximum.

10. Note that this tax price benefit, or fiscal externality, is analogous to the fiscal externality modelled in Chapters 7 and 8 which is generated by people migrating to a region within a federation. As they enter the region they lower the tax price faced by all existing residents, but do not take this benefit into account in their own free migration decisions.
preferences over q. From region B's demand function, $q_B = 3(0.2) = 0.6$ in the \((A, B, C)\) coalition. Region A is therefore 'quantity constrained' in this coalition to consume and contribute to 0.6 units of $q$ rather than its preferred level of 0.3. Accordingly, region A can achieve only a quantity constrained optimum at \(C\) in Figure 2, where, from the budget constraint, $x_A = 1 - (0.6)/3 = 0.8$. Thus, the quantity constraint on $q_A$ implies that region A is also quantity constrained in its consumption of $x_A$.

Therefore, region A is constrained to consume 'more' $q_A$ and less $x_A$ than preferred in coalition \((A, B, C)\) because it is the 'low demander' of $q$ relative to the median. At \(C\), region A only achieves indifference curve $u_A^2$ where $u_A^0 < u_A^2 < u_A^1$. In this example, the 'constrained federation optimum' at \(C\) is preferred to the autarky optimum at \(A\), but is less preferred to the 'unconstrained federation optimum' at \(B\). There is a net welfare improvement for region A from federation, despite the utility loss associated with the quantity constraint, from now on referred to as the 'median voter effect' of federation. In general, the quantity constrained optimum for region A can be anywhere on the segment $Bb'$. If the quantity constraint is sufficiently strong, the optimum could be at a point such as E where region A is worse off post-federation than in autarky. Later, this possible outcome is formalised.

5.3.2 Region C-High Demand

The welfare effects for region C from joining the coalition \((A, B, C)\) are characterised in Figure 2.
Before federation, region C consumes $q_C = 1(0.3) = 0.3$ units of the public good and from the budget constraint $x_C = 1 - (0.3) = 0.7$. An optimum at point A (autarky) on indifference curve $u^0_C$ is achieved.

After federation, the unconstrained optimum is at B on $u^1_C > u^0_C$ where $q_C = 3(0.3) = 0.9$ and from region C's budget constraint $x_C = 1 - (0.9)/3 = 0.7$ as before. However, region C is constrained to consume $q_B = 0.6$ units of $q$, the median's preferred level of consumption, and achieves instead, a constrained optimum at point C, where $q_C = 3(0.2) = 0.6$ and $x_C = 1 - (0.6)/3 = 0.8$. At point C, region C is still better-off than in autarky but not as well off as it would be at point B. Again, the possibility exists that if the median voter effect is sufficiently strong, region C may be forced to a point such as D which is inferior to autarky.
5.3.3 Region B-Median Demand

What is the effect of joining coalition (A, B, C) for region B, the median? First, because it is the median and is free to consume its preferred bundle of private and public goods following federation, region B suffers no welfare losses from the median voter effect. Second, region B achieves an unconstrained optimum at point B in Figure 3 where it is unambiguously made better-off from the tax price benefit of federating.

5.3.4 Summary

In summary, high demand region C is forced, via the median voter effect of federation, to a point on its post-federation budget line to the left of its preferred optimum while the low demand region is forced to a point to the right of its preferred optimum. At their constrained optima, the low demand region A has 'too much' q and 'too little' x, while the high demand region C has 'too little' q and 'too much' x. The median region,
on the other hand, receives a welfare gain from the tax price effect and is free to achieve its unconstrained optimum. Hence, the collective choice mechanism, which is required in order to determine the joint output level, may impose a uniformity cost on federating regions, the size of which depends on how diverse the parties to federation are in terms of preferences for public goods. This can be thought of as a political cost of federation in the sense that it is the cost imposed on a region by centralised decisions over the joint supply of \( q \).\(^{(11)}\) As the analysis here suggests, the magnitude of the uniformity cost is a function of how dissimilar the federating regions are.\(^{(12)}\)

In Australia, there is some evidence that preferences for public goods do differ between states, at least in modern times (obviously, it would be difficult to show whether preferences differed at the time of federation). In a study of the demand for education in Australia, Shapiro and Papadakis (1991) show that expenditure per student varies considerably between states. They argue that much of the difference is due to diversity in preferences between states and suggest that the amount spent by states appears to

'...correspond strongly, and is certainly not more than, the amount demanded by the median voter.'\(^{(13)}\)

---

11. There has been considerable interest in the literature on federalism in the costs of uniformity [as discussed in Chapter 2 - see for example, Oates (1972) and Buchanan (1987)]. There are also aspects of a uniformity/diversity trade off idea in other literatures not related directly to federalism. See for example, Usher (1977), Dixit and Stiglitz (1977) and Wilson and Katz (1983).

12. The median voter cost of federation would increase further if the jointly supplied public good was not a perfect substitute for the separately supplied good (that is, if a unit of joint public good does not yield the same utility as a unit of separately supplied public good).

5.4. A 'Social Surplus' From Federation

The previous analysis is now formalised to show that federation may yield a 'social surplus' of tax price benefit over median voter cost. This is achieved using simple game theory and duality techniques, in particular the notion of 'compensating surplus' which measures the welfare effects of a price change in the presence of quantity constraints.\(^{(14)}\)

In this regard, let a coalitional game between regions A, B and C be

\[
\Gamma^C = (N, V) \tag{5.4}
\]

\(N\) is the number of players (states) and \(V\) is the characteristic function of the game to be defined below. The set \(S\) (power set) of possible coalitions is

\[
S = \{\{A, B, C\}, \{A, B\}, \{A, C\}, \{B, C\}\} \tag{5.5}
\]

The level of utility achieved by region \(i\) in autarky can be derived by substituting \(x = I - q/n\) (recalling that \(I = 1\) by assumption and \(n = 1\) in autarky) and the autarky demand function for \(q\) into the direct utility function to obtain

\[
u^* = (1 - \beta)^{\frac{1 - \beta}{\beta}} \tag{5.6}
\]

\(u^*\) is the level of utility obtained by region \(i\) in autarky for a given \(\beta\) (for example, point A in Figures 1 to 3). The question now asked is, in the move from autarky to any coalition in \(S\), what level of compensating income will region \(i\) require in coalition \(S\) to achieve \(u^*\), the level of utility achieved in autarky?

\[14. \text{See Cornes (1992a) for discussion.}\]
Let $I_s^c$ be the compensating income for region $i$ to achieve $u^*$ in coalition $S$. One can find an equation for $I_s^c$, first by defining

$$\left( I_s^c - q_m/n \right) = (1 - \beta)^\beta \frac{\beta}{q_m} - (1 - \beta)^\beta \beta$$

(5.7)

where $q_m$ is the median region's level of demand for $q$ in coalition $S$. Thus, the left hand side of (7) is the level of utility obtained by region $i$ in coalition $S$, given that it must contribute to and consume the median region's preferred level of public good (that is, region $i$ is quantity constrained). This level of utility is set equal to the right hand side of (7), which is the level of utility in autarky from (6).

From (7), one can solve for the level of compensating income, $I_s^c$, which is required in coalition $S$ to make region $i$ as well-off as it was in autarky. The solution yields

$$I_s^c = (1 - \beta)\left( \frac{\beta}{q_m} \right)^{(\beta/1 - \beta)} + q_m/n$$

(5.8)

$I_s^c$ is the level of income required by region $i$ in coalition $S$ which allows it to achieve, in coalition $S$, its autarky level of utility, $u^*$.

As an explanatory example, consider the compensating income required by region A to make it as well-off in coalition (A, B, C) as it is in autarky. In this case, $I_s^c$ defines the distance $CS$ in Figure 1. This is a measure of the welfare effect in region A (in terms of income) of the move from the autarky optimum at point A to a constrained federation optimum at point C. A similar interpretation applies when $i = B, C$.

$I_s^c < 1$ implies that region $i$ is better-off in coalition $S$ than in autarky because region $i$ has less income in coalition $S$ relative to autarky, where it had one unit of income, yet is still as well-off. Similarly, $I_s^c > 1$ implies that region $i$ is worse-off in coalition $S$ than
autarky because it now requires an income of more than one unit to give it the same level of utility as it had in autarky.

The payoff \( P_s \) to region \( i \) from joining coalition \( S \) is therefore

\[
P_s = (1 - I_s^c)
\]

(5.9)

The characteristic function, which defines the total net surplus (in terms of the compensating income measure of welfare change) to coalition \( S \), is the sum of individual regional payoffs in coalition \( S \):

\[
V_S = \sum_{i=1}^{4} P_{i,s}
\]

(5.10)

When \( V_S > 0 \), there is a social surplus, or excess of tax price benefit over median voter cost generated by coalition \( S \). If \( V_S < 0 \), there is a social loss, or excess of median voter cost over tax price benefit in coalition \( S \). The payoff to region \( i \) in coalition \( (A, B, C) \) is characterised in Figure 4, where it is assumed that \( \beta_B = 0.2 \) and hence median demand is 0.6 units of \( q \).
When $\beta = 0$, region $i$ experiences a net welfare loss of -0.2 from joining the (A, B, C) coalition. Region $i$ has no demand for $q$ when $\beta = 0$, but with federation, is forced to contribute to the cost of providing the median's preferred level of output. Region $i$ receives no tax price benefit from federation, but experiences a median voter loss. When $0 < \beta \leq x$, region $i$ continues to experience a welfare loss from coalition because the tax price benefit is outweighed by the median voter cost. However, if $x < \beta < y$, region $i$ receives a net welfare gain from coalition. Over this range of preferences the tax price benefit dominates. Once $\beta > y$, the median voter cost outweighs the tax price benefit and region $i$ experiences a net welfare loss from federation.

Using this model, one can show: (i) the conditions under which federation dominates autarky; (ii) whether the dominance of federation over autarky depends upon income transfers to losers, and if the winners from federation find it in their interests to entice losers into a
coalition with such payments; and (iii) what role is played by diversity in determining the outcomes. The analysis proceeds by presenting four cases, each differentiated by varying assumptions about the distribution of preferences around the median.

5.4.1 Case I: Full Federation With No Income Transfers

Payoffs and social surpluses from each potential coalition when $\beta_A = 0.1$, $\beta_B = 0.2$ (median) and $\beta_C = 0.3$ are shown in Table 1. Three conclusions can be drawn. First, coalition (A, B, C) is preferred by all regions over autarky since each receives a positive payoff from joining this coalition. Second, each region has a higher payoff in coalition (A, B, C) than in any other coalition. Finally, the (A, B, C) coalition generates the largest 'social surplus'.

<table>
<thead>
<tr>
<th>Coalition</th>
<th>Payoff for Region 1 ($P_A$)</th>
<th>Social Surplus ($V_s$)</th>
</tr>
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<tbody>
<tr>
<td>(A, B, C)</td>
<td>A - (0.062)</td>
<td>(0.534)</td>
</tr>
<tr>
<td></td>
<td>B - (0.192)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C - (0.280)</td>
<td></td>
</tr>
<tr>
<td>(A, B)</td>
<td>A - (0.053)</td>
<td>(0.180)</td>
</tr>
<tr>
<td></td>
<td>B - (0.127)</td>
<td></td>
</tr>
<tr>
<td>(A, C)</td>
<td>A - (0.028)</td>
<td>(0.209)</td>
</tr>
<tr>
<td></td>
<td>C - (0.181)</td>
<td></td>
</tr>
<tr>
<td>(B, C)</td>
<td>B - (0.114)</td>
<td>(0.302)</td>
</tr>
<tr>
<td></td>
<td>C - (0.188)</td>
<td></td>
</tr>
</tbody>
</table>

*Calculated for $\beta_A = 0.1$, $\beta_B = 0.2$ and $\beta_C = 0.3$ using (9) and (10).

Thus, when there is limited diversity between the three regions, each directly experiences a net gain from federation (the tax price benefit outweighs the uniformity cost), all regions are within the range
\[ x < \beta < y \] in Figure 4 while all coalitions generate a positive social surplus and are preferred to autarky. However, coalition \((A, B, C)\) dominates since it generates the largest surplus in aggregate and for each state individually.

### 5.4.2 Case II: Partial Federation With No Income Transfers

If one allows region A to diverge further from the median, it can be shown that only regions B and C will federate. Assume that regions B and C have the same preferences over \(q\) as in the previous case, that is, \(\beta_B = 0.2\) and \(\beta_C = 0.3\), but that now \(\beta_A = 0.001\) instead of 0.1 as in Case I.

The payoffs and surpluses from federation with this distribution of preferences are shown in Table 2. Coalition \((A, B, C)\) now has a lower social surplus because, while regions B and C receive the same payoff as in Case I, region A is a net loser from joining the coalition thus reducing the social surplus. When \(\beta_A = 0.001\), the tax price benefit of federation to region A is outweighed by the median voter cost and region A experiences a social loss from federation. However, there is sufficient social surplus generated by this coalition of three to make income transfers to region A (allowing it to be as well off as in autarky) while making regions C and B better-off than in autarky (a Pareto improvement).
Table 5.2
Federation With No Income Transfers and One Region Excluded

<table>
<thead>
<tr>
<th>Coalition</th>
<th>Payoff For Region i ((P_s))</th>
<th>Social Surplus ((v_s))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A, B, C)</td>
<td>A (-0.193) (B = 0.192) (C = 0.280)</td>
<td>(0.279)</td>
</tr>
<tr>
<td>(A, B)</td>
<td>A (-0.094) (B = 0.100)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>(A, C)</td>
<td>A (-0.144) (C = 0.150)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>(B, C)</td>
<td>B (0.114) (C = 0.188)</td>
<td>(0.302)</td>
</tr>
</tbody>
</table>

*Calculated for \(\beta_A = 0.001\), \(\beta_B = 0.2\) and \(\beta_C = 0.3\) using (9) and (10).

However, it is not in the interest of regions B and C to form coalition \((A, B, C)\) since they would be better-off in coalition \((B, C)\) where the social surplus is higher. Rather than form \((A, B, C)\) by making transfers of income to region A, regions B and C would be better off in \((B, C)\) with region A excluded. The extra tax price benefit to regions B and C from having region A in a coalition with them is exceeded by the compensating transfer payments they must make to region A. In this example, diversity limits federation to two regions, B and C.

5.4.3 Case III: Full Federation With Income Transfers

However, if region A is a little closer to regions A and B in terms of its preferences over \(q\), it may be in the interest of regions C and B to 'entice' region A into federation with compensating transfers. This can be seen by allowing region A to have 'stronger' preferences over \(q\) and
letting $\beta_A = 0.05$ (rather than 0.001 as above). The new surpluses and payoffs are presented in Table 3.

Table 5.3

<table>
<thead>
<tr>
<th>Coalition</th>
<th>Payoff For Region i ($P_s$)</th>
<th>Social Surplus ($v_s$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A, B, C)</td>
<td>A = (-0.033)</td>
<td>(0.439)</td>
</tr>
<tr>
<td></td>
<td>B = (0.192)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C = (0.280)</td>
<td></td>
</tr>
<tr>
<td>(A, B)</td>
<td>A = (0.002)</td>
<td>(0.120)</td>
</tr>
<tr>
<td></td>
<td>B = (0.118)</td>
<td></td>
</tr>
<tr>
<td>(A, C)</td>
<td>A = (-0.032)</td>
<td>(0.138)</td>
</tr>
<tr>
<td></td>
<td>C = (0.170)</td>
<td></td>
</tr>
<tr>
<td>(B, C)</td>
<td>B = (0.114)</td>
<td>(0.302)</td>
</tr>
<tr>
<td></td>
<td>C = (0.188)</td>
<td></td>
</tr>
</tbody>
</table>

* Calculated for $\beta_A = 0.05$, $\beta_B = 0.2$ and $\beta_C = 0.3$ using (9) and (10).

There is now sufficient surplus in the (A, B, C) coalition for regions C and B to compensate region A and still be better off than they would be in any of the two-coalitions. The three-coalition with transfers to region A now dominates. Region A can be made at least as well-off as it was in autarky if regions B and C pay it 0.033 units of income while regions B and C will be better-off than in autarky or in coalition (B, C). In this case, it pays regions B and C to make income transfers to region A to join the coalition (A, B, C) because the tax price benefits to regions B and C from including region A exceed the transfer which must be made. A coalition of (A, B, C), under this distribution of preferences therefore, represents a Pareto improvement over autarky and any other potential coalition.

However, the achievement of this Pareto improvement is conditional upon the transfers being made to region A. In the absence of lump-sum
transfers, coalition \( (B, C) \) dominates all potential coalitions and autarky. \( (B, C) \) represents a Pareto improvement over autarky since region \( A \) is no worse off (it remains in autarky) and regions \( B \) and \( C \) are made better off. Thus, even without lump-sum transfers, cooperation between two regions on the joint supply of \( q \) results in a Pareto improvement. What the lump-sum transfers offer is the chance to increase the welfare gain from cooperation for regions \( B \) and \( C \), by including region \( A \) and generating greater tax price benefits, while leaving region \( A \) no worse off and potentially better off.

5.4.4 Case IV: A Federation of Two Regions

Allowing all three regions to be highly dissimilar from the median breaks down the dominance of the three coalition \( (A, B, C) \) even with transfers, but a preference for federations of two regions remains. For instance, allowing \( \beta_A = 0.001, \beta_B = 0.2 \) and \( \beta_C = 0.95 \) yields the payoffs and surpluses in Table 4. In this case, the \( (B, C) \) coalition dominates as it did in Case II when region \( C \) was much closer to the median. Again, region \( A \) is excluded.
### Table 5.4

**Dominance of Coalitions of Two**

<table>
<thead>
<tr>
<th>Coalition</th>
<th>Payoff to Region 1 ($P_s$)</th>
<th>Social Surplus ($v_s$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A,B,C)</td>
<td>A = (-0.193)</td>
<td>(-308.832)</td>
</tr>
<tr>
<td></td>
<td>B = (0.192)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C = (-308.831)</td>
<td></td>
</tr>
<tr>
<td>(A,B)</td>
<td>A = (-0.094)</td>
<td>(0.006)</td>
</tr>
<tr>
<td></td>
<td>B = (0.100)</td>
<td></td>
</tr>
<tr>
<td>(A,C)</td>
<td>A = (-0.468)</td>
<td>(0.007)</td>
</tr>
<tr>
<td></td>
<td>C = (0.475)</td>
<td></td>
</tr>
<tr>
<td>(B,C)</td>
<td>B = (-0.092)</td>
<td>(0.332)</td>
</tr>
<tr>
<td></td>
<td>C = (0.424)</td>
<td></td>
</tr>
</tbody>
</table>

* Calculated for $\beta_A = 0.001$, $\beta_B = 0.2$ and $\beta_C = 0.95$ using (9) and (10).

### 5.4.5 Summary

Summarising these examples, when all three regions are relatively similar in their preferences over $q$, each faces a positive inducement to federate since they can be made better off. If one region (in the example used, region A) is highly dissimilar while the others remain relatively similar in terms of preferences, the different region may be excluded from federation because the compensation it requires from the other two regions exceeds its value to them in terms of additional tax price benefit. However, if such a region is not too dissimilar, the other two regions may have an incentive to entice it into federation with transfer payments. Finally, if all three regions are highly dissimilar, the three-region coalition may never form, but coalitions of two still may be preferred to autarky. Thus, federation may still occur in the presence of high diversity. Overall, diversity places a limit on the size of the federation which forms in this three-region world.
5.5 **Supplementation**

Suppose that in the federation treaty for coalition $S$, region $i$ is allowed to supplement the jointly supplied $q$ with additional units of $q$ financed entirely from its own resources (the other regions do not cost share on these additional units). Further, suppose that region $i$ is able to exclude the other regions from benefiting from these supplementary units of $q$. It is imagined that in coalition $S$ region $i$ contributes to the median level of jointly supplied $q$ from which all members benefit, but can also supply extra units of $q$ at full cost to itself and exclude the other regions from benefiting.

Adopting the example of $q$ as environmental standards again, region $i$ contributes to jointly supplied standards but now may also provide its own additional standards to the benefit of its own citizens. One could think of this as allowing regions to federate and jointly supply $q$ while continuing to supply $q$ separately as an excludable good as they did in autarky.

In choosing the level of supplementation, region $i$ is effectively quantity constrained since it must contribute to the joint public good as a condition of its membership of a coalition. Region $i$ is also tax price constrained in the sense that it must provide supplementary units at the old autarky tax price. Finally, region $i$ may also be constrained to make or receive a lump-sum transfer in coalition $S$ as a condition of its membership of that coalition.

Accordingly, in coalition $S$, region $i$ solves

$$\text{Max } u = x^a (q_m + q_s)^\beta$$

$$\text{STo: } x - t + \frac{q_m}{n} + q_s = 1$$

15. The potential for regions to supplement the centrally provided public good with own-provision was initially suggested by Cliff Walsh.
where $q_s$ is the quantity of supplementary provision of $q$ chosen by region $i$ at a tax price of 1 (recall that this is the tax price in autarky), $q_m$ is the median level of provision of $q$ to which region must contribute at tax price $1/n$ as defined earlier, where $n$ is the population in coalition $S$, $t$ is a lump-sum transfer which can be either negative or positive and income is set equal to 1 as before. Therefore, in coalition $S$ region $i$ chooses $q_s$ given that it (i) must contribute its share of the provision of $q_m$ at the coalitional tax price; (ii) faces a tax price of 1 for $q_s$ rather than the coalitional tax price which is less than 1; (iii) receives or makes a lump-sum transfer as a condition of membership of coalition $S$; and (iv) faces an income constraint.

Solving (11) and (12) yields the demand of region $i$ for $q_s$ as

$$q_s = \beta(1 + t - \frac{q_s}{n}) - \alpha q_m$$

Equation (13) can be solved for each of the four cases of federation considered previously. Restricting each region to positive or zero demands yields the results in Table 5.

<table>
<thead>
<tr>
<th>Region</th>
<th>Region A</th>
<th>Region B</th>
<th>Region C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case I</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Case II</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Case III</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Case IV</td>
<td>0</td>
<td>0</td>
<td>0.347</td>
</tr>
</tbody>
</table>

In the first three cases, there is no supplementation by any region. The reason is that in each case, at the median level of joint supply, all three regions have marginal valuations for additional units of $q$ which are less than the autarky tax price at which they must supplement.
However, in Case IV, region C supplements by the amount $q_S = 0.3476$ units. Its demand for $q$ is sufficiently strong at the median level of supply that its marginal valuation for extra units exceeds the autarky tax price. Case IV is therefore an example of federation with joint supply of a public good, and one region undertaking its own supplementary provision (excluding the other regions). Supplementation by region C makes the surplus from federation higher for region C, since it is able to achieve an equilibrium in coalition $S$ which is closer to its unconstrained coalitional equilibrium. The other regions are not affected by region C's supplementation, since they are excluded from any of the benefits. (16)

In general, for region $i$ to undertake separate supply of $q$ in coalition $S$ requires that

$$\beta > \frac{\alpha q_m}{1 + t - q_m/n}$$

(5.14)

Thus, whether or not a region supplements depends upon the relationship between its preferences for $q$, as captured by $\beta$, and the median level of demand for $q$. Equation (14) can only ever hold for region C, the region with relatively strong demand for $q$.

In summary, the importance of supplementation is that it offers the possibility of enhancing the social surplus from federation by allowing the high demand region to reduce the cost it suffers from having to contribute to and consume the median's preferred bundle of public goods. One might expect to find that in federations with considerable diversity,

16. One can allow neighbouring regions to benefit from region i's supplementation. However, this introduces interdependence. If this interdependence is modelled under the Nash assumption, equation (13) becomes a subscription function with additional terms to capture the interdependence. While this considerably increases the complexity of the model of supplementation, one still gets the result that only region C supplements, the difference being that the other two regions also benefit, in terms of a utility gain, from C's extra provision, making the surplus from federation in Case IV higher still.
there are compensating redistributional transfers and supplementation by higher demand regions of centrally provided public goods.

5.6. **Formation of the CGC and the Development of Equalisation in Australia**

In this Section it is suggested that the first few decades of federation in Australia may have been similar to cases I or III. This period may be thought of as a time during which the size, nature and magnitude of compensatory transfers were a source of tension. To see why this may be so, it is useful to review briefly the first four decades of Australian federal history, a period during which the CGC was formed and the principle of equalisation developed. (17)

Following federation and the centralisation of certain tax powers, such as customs duties and excise taxes through Section 90 of the Constitution, it became necessary to develop a way of determining and transferring general revenue to the states. In addition, the supposedly special position of the small (in terms of population) states (mainly Tasmania, South Australia and Western Australia) required attention. These predominantly primary producing states were seen to have suffered from federation because of the introduction of uniform tariffs. An attempt was made in the financial settlement at federation to provide a solution to both problems.

The general tax revenue issue was addressed by Sections 89, 93 and 94 in the Constitution which provided each state with revenues related to the monthly surplus balance between Commonwealth revenues and expenditures in the states. Each state's share was determined on a population basis which is mildly equalising if per capita contributions to revenue are larger in bigger states. The Braddon Clause, or Section 87, was also included to guarantee that the states received three

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17. The discussion here draws on May (1971). For consistency, May's convention of referring to South Australia, Western Australia and Tasmania as the 'small states' is adopted in this discussion.
quarters of Commonwealth revenue from customs and excise duties. The main measure embodied in the Constitution to solve the small states' problem was Section 96 which allowed the Commonwealth to give financial assistance to any state on such terms and conditions as it saw fit. This was seen as a general safeguarding clause. Western Australia was also permitted temporarily to continue to levy customs duties on interstate imports (Section 95). Finally, Section 101 allowed for the creation of an Interstate Commission with adjudicating powers in trade and commerce.

As May emphasises, both the general revenue and small states measures were designed to be temporary (the 'transitional period'):

'Sections 87 and 96 applied only in the first ten years of federation...; Section 95 was to operate only in the first five years after uniform customs duties were imposed; Sections 89 and 93 related respectively to the periods before and five years after uniform customs duties; and Section 94 was imprecise and was later to be an enabling power and not a binding obligation on the Commonwealth'.

Thus, in the first ten years of federation, the transitional financial arrangements guaranteed the states a share of customs and excise duties. However, this did not keep the states, in particular the small states, content for long. By 1903, Tasmania and Western Australia were objecting strongly to the supposed adverse consequences of federation on their budgetary positions. Also, all states were concerned about Commonwealth-state financial arrangements after 1910 when many of the transitional arrangements were due to end. In 1906, the Premiers' Conference passed a resolution in favour of an eventual move towards a system of per capita grants to the states. From 1906 to 1910 negotiations between the Commonwealth and the states continued.

18. May (1971), p.6. Note that both Sections 87 and 96 could be extended beyond the ten year period, and indeed, Section 96 was.
May notes two interesting results of these discussions:

'One was the rejection by the states in 1908 of the Commonwealth's suggestion that a separation of State and Commonwealth finances be achieved as early as possible—even at that early stage it was clear that the states prime concern was not with maintaining financial autonomy but with making sure of having sufficient revenue to meet a desired level of expenditure and, if this revenue was raised for them by another government, all the better. The other was the growing recognition of the special difficulties of the small states.'

Agreement was reached in 1909 (enacted in the Surplus Revenue Act 1910) for annual grants to the states on a per capita basis to replace the grants made under the transitional arrangements. In addition, Western Australia was given special payments which were to decline annually. Although payments under this agreement were supposed to expire after a further ten years, they actually continued until 1927. Tasmania also continued to press for special assistance under Section 96 after 1910, and a Royal Commission on the matter recommended in 1911 that such payments be made.

Therefore, by 1912 Tasmania and Western Australia were receiving special grants apparently as a result of the supposed negative economic effects of federation on their state budgets. World War I further increased the relative superiority of the Commonwealth as it entered new taxation fields (including estate and death duties and income taxation) and inflation associated with the war eroded the real value of the small states' special grants. In 1919, the provisions of the Surplus Revenue Act were due for review and the Commonwealth again proposed an end to per capita grants. However, this proposal was rejected by the states and the small states in particular. In 1920 a Royal Commission on Taxation was appointed and reported in 1921 through to 1923. Based on its recommendations, the Commonwealth again offered to vacate a significant portion of the tax base in return for an end to per capita grants.


20. Equal per capita grants do, of course, 'equalise' to some extent (at least as long as tax yields and service costs per capita differ between states).
although special arrangements were to be made for the smaller states. However, like those before it, a conference on the matter in 1923 failed to produce any agreement.

By this stage the smaller states' claim that they had suffered disabilities from federation, mainly because of the uniform tariff, became more intense as tariffs were increased in 1921, 1926 and 1928. Indeed, the resistance became so strong that there was a Tariff Board enquiry in 1921 into the adverse effects of tariffs on Western Australia's economy. The Board concluded that the state had suffered as a result of the uniform tariff and recommended a number of measures. A committee in 1929 reviewing the Australian tariff concluded that

'[t]he states which naturally depend more than others upon the export industries feel the burden, not only upon their individuals, and industries, but upon the state finances'.

However, during the 1920s other sources of grievance for the small states against federation emerged. First, the Navigation Act 1921 produced considerable conflict. Second, the small states argued that the Commonwealth Conciliation and Arbitration Act, which encouraged state wage awards to increase to Commonwealth levels, worked against them. According to May

'...the particular complaints reflected a general feeling of discontent over the outcome of federation in the smaller states, a feeling that the smaller states were not participating fully in the nation's development and this was due at least in part to the fact that the large states by virtue of their size were able to dictate the broad trend of federal policies'.

This discontent assisted the popularity of secession movements in Tasmania and Western Australia during the 1920s. In 1924, the Commonwealth established a Royal Commission on the Finances of Western Australia as Affected by Federation. It effectively recommended that

Western Australia be compensated for its losses or 'disabilities' from federation. In Tasmania, a Disabilities Committee was appointed in 1925 and undertook similar work to the 1924 Royal Commission in Western Australia. It found that although Tasmania had suffered as a result of the tariff, the Navigation Act and the operations of the Commonwealth Arbitration Court, overall the state had received a net gain from federation.

The Tasmanian Disabilities Committee noted that

'...the particular disabilities of Tasmania under Federation merge at all points into the more general disabilities to which the weaker States are always liable in any system of federation, unless thorough safeguards are taken against them...In particular, it is clear that a State like Tasmania, small both in area and population-even without regard to its insular position-is under a severe handicap in a federation which adopts internal free trade and heavy protection against the rest of the world, along with the other methods of regulating industry...All such regulation is inevitably designed and administered from the point of view of the principal constituent States. Unless this position is fairly met, Federation must be an incomplete success, with certain flourishing and prosperous States dragging their harassed sisters at their heels....'. (23)

Unlike the 1924 Royal Commission in Western Australia, the Tasmanian Committee made no recommendation for compensation. However, it did propose a system of differential per capita payments with the aim of '...equalising the more general economic conditions between states'. This represented a significant departure from the previous approaches which simply concluded that the small states were net losers from federation and should be compensated. It also provided the first clear statement of the concept of 'equalising' fiscal capacity between states, which can be attributed to the presence of two economists Giblin and Brigden on the Committee. Giblin attached a separate statement to the Committee's Report in which he analysed the economic effects of federation on Tasmania, concluding that they could not be measured and that even if this was possible, disabilities were not an appropriate basis for determining grants. Instead, he argued that a comparison of

state fiscal positions according to some national standard would be more appropriate. As will be seen later, this idea eventually became the basis for a permanent system of equalising grants to the states.

At a conference between state and federal ministers in May 1926 the Commonwealth again proposed to the states that Commonwealth and state finances be separated. The Commonwealth suggested eliminating per capita payments in exchange for it withdrawing from the personal income tax field. There was, however, to be a transition period in which special grants would be paid to Western Australia and Tasmania. However, as on previous occasions, the states rejected these proposals. Instead, an arrangement was accepted whereby per capita payments would cease in return for the Commonwealth taking over state debts and contributing to a sinking fund in respect to these debts. These changes to state federal financial relations were embodied in the Financial Agreement Act 1928, generally considered a milestone in the development of Australia's fiscal federal arrangements. Nevertheless, special grants to the small states continued and in 1927 another committee reported on the financial difficulties of South Australia. Its report followed the lines of the 1924 and 1925 reports on Western Australia and Tasmania. By 1931 the Commonwealth faced a plethora of small state demands for special grants. During that year a number of further enquiries took place and the Commonwealth began to show signs of wishing to find a consistent and longer term basis for dealing with the small states' demands. Adding to these pressures were the reemergence of secession pressures in Western Australia and Tasmania and the effects of the Great Depression on small state finances.

Largely in response to these pressures, the Commonwealth Government formed the CGC in 1933. However, this had little immediate effect on tensions between the smaller states and the Commonwealth. In fact, the secession movement in Western Australia did not reach its peak until after the Commission was established. Tasmania and South Australia continued their secession threats until the mid-1930s. Despite this, by 1936 the CGC had developed a set of principles to formalise special payments to the states. An important feature of these principles was the
rejection, on the surface at least, of the notion that grants should compensate the states for any net disability caused by federation. The Commission used a number of arguments to reject claims by the states' (and Commonwealth Treasury) that compensation should be based on the disabilities of federation, including: (i) compensation for the effects of a Commonwealth Government policy would be inconsistent with the aims of that policy; (ii) compensating states for the disabilities they may have suffered from federation posed insurmountable statistical and theoretical difficulties: as the Commission noted, 'no measurement of net disabilities is possible' (Second Report, 1935); (iii) states suffering net disabilities from federal policy may be prosperous in any case and hence require no grant and conversely if a state was in financial difficulties, whether because of federalism or not, it would require assistance regardless of the cause; and (iv) federation would be meaningless on a strict book-keeping basis of costs and benefits: federating states should commit themselves to absorbing both the costs and benefits.

The CCC adopted, instead, a 'needs' principle for Commonwealth grants to the states. Special grants, according to the Commission in its Third Report:

'...are justified when a state through financial stress from any cause is unable efficiently to discharge its functions as a member of the federation and should be determined by the amount of help found necessary to make it possible for that State by reasonable effort to function at a standard not appreciably below that of other States'.

Thus, redistribution to the smaller states was to be based on the concept of allowing them, with reasonable taxation effort on their own part, to put their finances in as good a position as that of the larger states. Basically, this involved calculating the amount necessary to ensure that each claimant state's per capita budget deficit equalled that of the non-claimant states.

Although the CGC apparently rejected the idea of compensating states for the net disabilities of federation, there is evidence that it realised that the 'needs approach' to grant determination would do this in any case. For instance, in its Second Report (1934) the CGC acknowledged that

'[w]e recognise also that the Commonwealth cannot afford to see a State drifting into a financial breakdown and that grants to set it on its feet may be necessary. On these two grounds also the evidence of a State's disability should be found in its budgetary conditions. It seems therefore, to be unavoidable to use as some measure of disability the financial position of the State'. (25)

May goes on to claim that

'There was in this statement a strong suggestion that the Commission was sympathetic, in principle, to the disabilities basis of determining special grants and that its main reason for not adopting a disabilities approach was the problem of actual measurement'. (26)

The needs principle eventually evolved with the passage of time into the principle of fiscal equalisation as the following comment by the CGC shows:

'By 1967 the Commission had begun to interpret its principle as one of fiscal equalisation rather than financial need....there was no intrinsic philosophical reason for preferring either principle to the other.' (27)

This early period of Australian federation can be interpreted as a time of 'rebellion' by the smaller states against what they perceived to be the adverse effects of federation. Indeed, from this brief survey of the first four decades of Australian federal history, it is clear that the CGC, and the main principle upon which grants to the states are made in present times (fiscal equalisation), represented Australia's attempted resolution of this conflict in federal relations. Therefore, the


emergence of fiscal equalisation in Australia was partly a consequence of concerns over the need to compensate states for the effects of federation in the interests of federal unity.

An important question is whether the small states actually did experience a net disability from federation. May offers the view that

'...we cannot know how they (the small states) would have fared had federation never come about;...federation changed the patterns of consumption of private and public goods in the States and, although under federation the consumption of public goods by citizens in the small states was to some extent subsidised by tax payers in the larger States, this may not have offset the loss of welfare implicit in the enforced change of consumption patterns. Without doubt they did lose some population following federation, some local industries did decline, the prices of certain commodities did rise and the State Governments did feel severely the loss of revenue sources; even if there was no net disability, there were disabilities'. (28)

Essentially, two of the effects of federation noted by May have been modelled in this Chapter: the changed pattern of consumption of public goods (median voter cost) and the subsidisation by tax payers in one state of public goods provided in other states (the tax price benefit). (29) The results suggest that it is feasible that the small states may have been net losers from federation (Case III). Alternatively, all states may have been net winners but conflict may have arisen over the distribution of the net benefits (Case I). Thus, the first few decades of Australian state-federal financial relations could be interpreted as a struggle either over compensatory transfers or the distribution of the net social surplus from federation. The development of the principle of fiscal equalisation and the CGC can be seen as Australia's particular response to the need to formalise compensation to those states which had lost from federation (in the interest of federal unity).


29. By assuming equal populations as the model here does, the fact that the larger states may have subsidised the smaller states is not captured: that is, the small states may have received an 'additional' share of tax price benefits by forming a union with the larger states.
5.7 Conclusion

In a model with excludable public goods (in autarky) and a median voter collective choice mechanism, it has been shown that federation may result in a utility-enhancing tax price benefit. This benefit lowers the tax price faced by all parties to federation and expands their demands for public goods, since the cost of provision of each unit is spread over a larger number of citizens. It can be thought of as a positive fiscal externality created by union, or the benefit of 'society'. However, heterogeneity creates a median voter cost of federation. Members of a federation must contribute to and consume the preferred bundle of public goods of the region with the median preferences. This quantity constrains all but the median region, and leads to utility losses for all but the median.

The relative size of these two opposing influences, and hence the net change in utility for each participant in federation, is a function of the divergence of preferences from the median outcome. If some parties to federation are sufficiently dissimilar from the median in terms of their demands for public goods, they may suffer net welfare losses from federation. In such cases, federation will only proceed if it creates a social surplus sufficient to compensate the losers and leave all participants at least as well off, or better off, than in autarky, or any alternative feasible coalition. Thus, income transfers, or a system of intergovernmental transfers and the institutional mechanisms to facilitate such transfers, may be necessary conditions for federation to occur between dissimilar regions. Such transfers are the 'glue' which holds federal systems together. This 'compensatory' need for redistributional transfers in federal economies is in addition to any case for them which might be made on grounds of efficiency and equity.

Once federating regions are allowed to supplement the jointly supplied public good with their own independent supply post-federation, if the high demand region has sufficiently strong demand for the public good it may undertake such supplementation and increase the surplus it receives from federation. This was shown in Case IV. Supplementation
allows federations to reap the tax price benefits of union while reducing the costs of centralisation in the presence of diversity of preferences.

Although only one cost and one benefit of federation have been modelled, the analysis can be considered as a parable for the other costs and benefits of federation. In this sense, the results may have some value in interpreting the period of Australia's federal history during which the CGC was formed and the equalisation principle developed. For example, if all states were net winners from federation, as modelled in Case I, although there is no need for compensating transfers to induce each to federate, there may still be a struggle over the distribution of the gains. Indeed, the first four decade of Australia's federal history could be interpreted as such a struggle, and the development of the CGC and the principle of fiscal equalisation as attempts at resolving the issue of surplus distribution. In other words, equalisation in Australia can be thought of, at least in part, as a compensatory redistribution made in the interests of federal unity. Alternatively, if some states were net losers from federation as modelled in Case III, this period could be thought of as a struggle for compensatory income transfers for these states. Such transfers needed to be made in the interests of federal unity. Whatever the case, the results suggest that institutions such as the CGC, and the system of intergovernmental grants which finally emerged in the 1930s in Australia, may have been, at least in part, responses to a need to maintain the unity or cohesion of Australian federalism.

Finally, any costs associated with compensatory transfers should not be thought of in isolation, but rather as the costs of securing the social surplus of federation. They are, therefore, costs which must be balanced against a benefit. This should not be taken to imply, of course, that Australia's particular institutional response to securing these gains is optimal. There may very well be alternative procedures which will secure federal unity, yet involve lower cost.
6.1 Introduction

Federation entails agreement to a contract, or Constitution, which commits the participants to a set of behavioural rules. One of the more important aspects of Constitutional agreements are the financial arrangements which usually stipulate, among other things, and to varying degrees, how revenue and expenditure powers are to be distributed between the sub-national and national governments, assignment of property rights over tax bases, the revenue sharing rules to be used in returning surplus (centrally collected) revenues to the regions, and measures designed to restrain the power of the central government (and protect state rights).

There are two important financial arrangements embodied in the Australian Constitution, Sections 90 and 99. In Section 90, the States handed over one of their larger tax bases at the time (following the relinquishing of customs duties in the same Section) to the Commonwealth. As argued in the Introductory Chapter, subsequent High Court interpretation of what constitutes an excise tax has excluded the States from much of the indirect tax base, contributing to the centralisation of taxes and the high degree of vertical fiscal imbalance identified as a distinguishing feature of Australian fiscal federalism. Section 99, the other financial provision of interest, precluded the Commonwealth from treating the states in any way that was discriminatory. This meant that, although the Commonwealth had been assigned property rights over the

1. The analysis in this Chapter is based on joint work undertaken with Perry Shapiro.
excise tax base, it could not apply differential excise tax rates across states. As will be seen below, Section 99 has implications for the economic effects of Section 90, and the motives behind Sections 90 and 99 may have been linked.

In this Chapter, a model of excise tax competition, and excise tax exporting, is developed to provide an economic rationale for the inclusion of excise taxes in Section 90, and the presence of Section 99 in the Australian Constitution. In addition, some further insights are provided as to why interregional transfers are a feature of federal-state relations. Although the analysis focuses on the Australian Constitution, as with the last Chapter, the results have broader implications for federalism theory generally, and the motivation for centralisation of taxes and the creation of uniformity provisions in federal Constitutions. Thus, the work can be seen as making a contribution to our knowledge of Australian federal experience, as well our more general understanding of federalism. The modelling techniques adopted here are analogous to those of Chapters 3 and 4. That is, static Nash equilibria are characterised, but this time in terms of tax rates rather than quantities of public goods and total taxes collected (as previously). The reason for the difference is that here, a tax base externality (resulting from spatial tax competition), as opposed to a direct public good externality, is modelled. Another difference is that here, governments are assumed to be revenue maximising with no regard for citizen preferences. This assumption is adopted both for reasons of analytical tractability and in order to capture what are thought to be some of the key concerns motivating Sections 90 and 99, albeit in a polar form.

There are a number of differences between the model of tax competition developed in this Chapter and those in much of the existing literature (surveyed in Chapter 2). First, in the present analysis regions are allowed to have different preferences over taxation levels. It is this feature of the model which leads to the interesting results on the effects of uniformity and Section 99. Second, much of the tax competition literature adopts the community preference assumption with respect to government behaviour and, therefore, characterises a social
optimum against which to compare competitive outcomes (enabling conclusions about underprovision relative to a social optimum). Here, since revenue maximising governments are assumed, conclusions cannot be made about competitive versus socially optimal outcomes, but rather, about competitive and revenue maximising outcomes. Third, in this model regions can have different populations (this is an outcome of the spatial nature of the model). Finally, the tax imposed by governments is a tax on a privately produced good, as opposed to a tax on mobile capital, as is often assumed in the existing literature.

6.2 The Puzzle of Section 90

At the meeting of 13 March 1891 of the National Australian Constitutional Convention in Sydney, the following proposal was put before the delegates:

‘That the power and authority to impose customs duties shall be exclusively lodged in the federal government and parliament, subject to such disposal of the revenues thence derived as shall be agreed upon.’

Immediately after the proposal was introduced, Alfred Deakin, MP., delegate from Victoria, proposed an amendment: ‘That after the word ‘customs’, the words ‘and excise’ be inserted’.

Adye Douglas, MLC., delegate from Tasmania was the first to speak after Deakin’s proposal:

‘Before that alteration is made we ought to have some explanation as to what the Hon. member [Deakin] would include under the term ‘excise’.’

Either because he thought it prudent, or because Mr. Douglas’ request was lost in the clamour of others who wished to speak, Mr. Deakin never responded with an explanation. This is the origin of a major puzzle in Australian constitutional law.
While there were additional amendments to the proposal, and extensive changes in wording, it survived the numerous debates to appear in the Australian Constitution as Section 90 which reads:\(^{(2)}\)

'On the imposition of uniform duties of customs the power of the Parliament to impose duties of customs and excise, and to grant bounties on the production or export of goods, shall become exclusive (italics mine).'

Andrew Thynne, MLC., delegate from Queensland to the 1893 Constitutional Convention, offered the prophetic comment on the Deakin amendment that

'There is something more in the insertion of the word 'excise' than appears at the first blush. Perhaps the question of states rights may come in a way we do not anticipate.'

Mr. Thynne worries in his continuing comments that the amendment: '....might also have the effect of depriving each separate state of its own legitimate source of revenue.' He was right. A tax on either the production taking place in a state, or its final sales is an obvious source of state revenues. While the constitutional amendment does not specifically prohibit a sales tax, it has come to be interpreted by the High Court of Australia to do so.

The High Court of Australia has prohibited the use of material from the Constitutional debates as supporting evidence in cases related to Section 90. To some extent this is understandable, since original intent is difficult to glean from the records of the debates. Delegates to the Conventions had many different agendas and intentions and it is impossible to infer, through an examination of the discussions, what exactly it was that they had in mind. Even if it were possible to unravel the thoughts of each delegate, we would face the problem of deciding whose intent should govern present day law.

2. Deakin's proposal whereby excise taxes were included in Section 90, along with customs duties, is referred to for expository convenience from now on as the Deakin Amendment.
Nevertheless, it can be instructive to examine the debates to understand what were the issues surrounding the Deakin amendment. It might be particularly interesting in the context of modern times, if the concerns perceived by the framers of the constitution are no longer applicable. In fact, it may very well be that judicial interpretations of the prohibition on an excise tax now hamper rather than help the conduct of the federation, at least from an economic perspective.

In this regard, one can isolate four issues that continue to arise in the debates surrounding the writing of the Australian Constitution. These were (i) free trade between states; (ii) tax competition; (iii) federal unity; and (iv) ensuring that there would be sufficient revenues to manage the affairs of the states and the Commonwealth.

It is difficult to discern which of these was the predominant cause for concern in the minds of the framers of the Constitution. However, through Section 90, the states had already handed over a major source of revenue, the customs duty, and the excise duty was another important tax. That there were concerns over tax competition between the states, and in particular, the potential for tax competition to drive down excise revenues, can be gleaned from some of the debates. For example, Mr. James Munro, MP, Chair of Finance Committee, and delegate from Victoria, was most explicit about the concern over interstate competition when he said

'It will be absolutely impossible to give the import duties to the federal government without the excise duties, unless we are to allow some colonies to take advantage of others.'

Munro explains his concerns with an example:

'If the federal parliament is allowed to put an import duty on whiskey for the whole of the colonies, and one colony puts an excise duty on the local manufacture, and another colony does not do so, the result will be that the colony which does not tax the local whiskey will get the local article produced to the largest extent, and it will be passed on to other places, because being a local manufacture it will not be liable to any duty.'
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Mr. John H. Gordon, M.L.C., delegate from South Australia seemed to feel that the constitution in his words '....is largely a commercial treaty ....[and] it is chiefly in the commercial interests of these colonies that we desire to federate.' He recognized that '....the power of government really lies in the power of the purse.' Mr. Gordon, who appeared more than most to be openly concerned with the financial implications of federation, wanted to include prohibitions against railway competition in the constitution as well, because by allowing it, there would be 'vindictive reprisals' of one state towards another.

Apparently, this attitude was shared by many others. The Report from the Select Committee upon the Federal Union of the Australian Colonies (1856-57) noted that

'On the ultimate necessity of a Federal Union, there is but one opinion....the interest and honour of these growing States would be promoted by the establishment of a system of mutual action and cooperation among them. Their interest suffers, and must continue to suffer, while competing tariffs, naturalisation laws, and land systems, rival schemes of immigration, and of ocean postage, a clumsy and inefficient method of communicating with each other and with the Home Government on public business, and a distant and expensive system of judicial appeal exist;....Neighbouring states of the second order inevitably become confederates or enemies. By becoming confederates so early in their career, the Australian Colonies would, we believe, immensely economize their strength and resources. They would substitute a common national interest for local and conflicting interests and waste no more time in barren rivalry' (emphasis added).

Coper (1976) is highly critical, possibly with considerable justification, of the High Court's decisions relating to Section 90. He has reviewed many of its decisions and finds that no discernible rule can be found from careful analysis of the judicial commentary. Coper claims that the Court has been too concerned with defining excise taxes and asserts that

'....the basic approach, right from the beginning, has been 'what does excise mean' rather than 'why was excise made exclusive to the Commonwealth'. An answer to the latter question might have supplied an answer to the former, but to answer the former was not necessarily to answer the latter.'
To summarise, one of the main objectives of federation in Australia was to create a customs union and impose uniform external tariffs, implying that the states' had to relinquish control over customs duty to the Commonwealth, as they did in Section 90. The fear of tax competition on remaining revenue sources appears to have been a dominant motive behind the decision to include excise taxes in Section 90. Of course, this view does not rule out concerns over the internal trade distorting effects of excise duties and the fact that tax competition could also threaten federal unity in some way. Indeed, it is likely that these concerns may have also been behind the Deakin Amendment.

In this Chapter, three issues are examined in relation to Section 90. First, were the founders of the Constitution correct in being concerned about excise tax competition between states threatening the sufficiency of state revenues, distorting internal free trade and possibly federal unity? In this regard, it is found that states engaging in tax competition (and tax exporting) will in general distort internal free trade in a federation and that, therefore, Section 90 could be regarded as an attempt to minimise such distortions. However, it is also shown that tax competition can lead to lower state revenues, relative to what can be achieved with cooperation, and that in this sense, tax competition could be thought of as a threat to the sufficiency of state revenues. Moreover, it is argued that a single Commonwealth excise tax will also distort internal free trade, but without the same revenue reducing consequences for states. Accordingly, it is suggested that Section 90 may have had less to do with free internal free trade concerns, and more to do with sufficiency of state revenues, and possibly the unity of the new federation.

Second, whether or not Section 90 overcame the revenue sufficiency concerns of the founding fathers is examined. In particular, the issue addressed here is whether Section 90 maintained state revenues above what they would have been in its absence, with the states continuing to impose separate competitive excise taxes. It is shown that there may have been a revenue surplus created by Section 90, that is, an excess of revenue over and above competitive revenues. However, because of the presence of
Section 99 in the Constitution, which effectively prohibited the Commonwealth from imposing different excise tax rates between states, and Section 87 (the so-called Braddon Clause), which ensured that each state received back, for the first ten years after federation at least, its per-capita share of excise tax revenue, this surplus may not have been 'fairly' distributed between the states. Indeed, it is shown that some states may have been losers from the combination of Sections 90, 99 and the Braddon Clause. Losing states may have then pressured the Commonwealth for compensating transfers, which is of course what happened from the outset of Australian federation.

Finally, it is suggested that an important reason why Section 99 was included in the Constitution was to restrain the financial powers of the Commonwealth. The states had been obliged to relinquish excise taxes because of tax competition fears, and imposed Section 99 to limit the extent to which the Commonwealth could use its new monopoly powers over taxes to the states' detriment.

Two models are developed. The first is a spatial model of inter-regional tax competition. This model is used to look at the first question of tax competition (and tax exporting), the distortion of internal trade and sufficiency of state revenues. The second is a more general model, of which the spatial model may be thought of as a special case, and is designed to analyse the issue of whether Section 90 actually ensured sufficiency of state revenues, given the presence of Section 99 and the Braddon Clause.

6.3 Model

Imagine a federation of two politically autonomous regions $i = (1, 2)$. Suppose that a private good $x_i$ is produced competitively in each region at a particular production location. The private good is sold to residents, who are assumed to be located along a continuous line of

3. In the Australian case, these regions might be thought of as two representative colonies prior to federation in 1901.
distance $s$ between the two production points. The supply function for region $i$ is

$$x_i = p_i + Ts \quad (6.1)$$

where $p_i$ is the marginal cost at the point of production and $T$ is a constant per unit distance transport cost, assumed to be the same across regions. Thus, supply in region $i$ is a function of distance from the point of production, marginal cost and $T$.

Assume that each region has a government with only one policy instrument: an ad-valorem excise or sales tax imposed on $x_i$ at rate $t_i$. (4) Suppose that region $i$ sets the rate with only one objective: to maximise revenue. This assumption is made in order to capture the role that Section 99 may have played in limiting the revenue collecting powers of the Commonwealth. It is not suggested by adopting this assumption, that governments behave only in this way. (5)

With the tax included, the supply function for region $i$ at a market of distance $s$ becomes

$$x_i = p_i(1+t_i) + Ts \quad (6.2)$$

Residents are assumed to have price inelastic demand for $x_i$ of one unit. They purchase from region 1 when $p_1(1+t_1) + Ts < p_2(1+t_2) + Ts$ and from region 2 when the reverse holds. There is thus a one-to-one correspondence between the number of units of $x_i$ sold by region $i$, or its market share, and distance $s$ from the point of production.

The model is characterised in Figure 1 where the supply functions for each region, both with and without the tax included, are graphed.

4. The excise or sales tax on good $x_i$ will have income and substitution effects. The consequent efficiency costs of such taxes are well known and not considered directly here.

5. This is the leviathan view of government discussed in Chapter 2.
The intersection of the supply functions with zero taxes yields the free trade economic boundary, $E^f$, while the intersection of the supply price functions with positive taxes yields the competitive economic boundary, $E^c$. Each is derived algebraically and discussed in detail below.

### 6.3.1 Free Trade Economic Boundary

The problems of regions 1 and 2 are to solve

\[
\begin{align*}
\text{Max } R_1 &= p_1 t_1 E \\
(t_1)
\end{align*}
\]  

(6.3)

\[
\begin{align*}
\text{Max } R_2 &= p_2 t_2 (1-E) \\
(t_2)
\end{align*}
\]  

(6.4)
where $R_1$ and $R_2$ are the shaded areas in Figure 1 and $E$, defined to be the economic boundary between the two regions, is the value of $s$ where the regional supply price functions intersect.

Since at $E$ we have $p_1(1 + t_1) + TE = p_2(1 + t_2) + T(1 - E)$, one can solve explicitly for $E$ to obtain

$$E = \frac{p_2(1 + t_2) - p_1(1 + t_1) + T}{2T} \quad (6.5)$$

$E$ is a function of the tax rates in each region, $t_1$ and $t_2$, the marginal costs of production in each region, $p_1$ and $p_2$, and transport costs, $T$. The boundary which results when taxes are zero, defined as the free trade boundary, $E^f$, can be found by substituting $t_1 = t_2 = 0$ into (5) yielding

$$E^f = \frac{P_2 - P_1 + T}{2T} \quad (6.6)$$

6.3.2 Competitive Economic Boundary

The competitive economic boundary, $E_C$, which is the value of $s$, or market share, resulting when positive tax rates are imposed, can be found by modelling a Nash equilibrium in taxes between regions 1 and 2. In this regard, substituting (5) into (3), and differentiating with respect to $t_1$ while holding $t_2$ fixed, the optimum choice of $t_1$ for region 1 is defined by

$$t_1 = \frac{p_2(1 + t_2) + T}{2p_1} \cdot \frac{1}{2} > 0 \quad (6.7)$$

Since $p_1$ and $p_2$ are fixed by assumption, (7) expresses region 1's optimum choice of $t_1$ as a function of $t_2$, region 2's tax choice. Hence, there is interdependence between the tax decisions of each region. As one region chooses a tax rate, it affects the position of the economic
boundary which in turn influences the size of the tax base of the other region. The regional tax bases are linked through the economic boundary.

Thus, $t_2$ can be thought of as a positive externality, or environmental variable over which region 1 has no control, influencing region 1's objective function, in this case a revenue function. Similarly for region 2, $t_1$ can be shown to be a positive externality affecting that region's objective function. (6)

For example, as region 1 raises its tax rate, $t_1$, it shifts the economic boundary closer to its origin in Figure 1 (to the left) and away from region 2's origin. This increases region 2's tax revenue for a given $t_2$. Thus, region 1 imposes a positive externality on region 2 when it sets its tax rate, but does not internalise this effect when determining its optimum $t_1$ and similarly for region 2. It is this failure to internalise the benefit each confers on the other when setting their tax rates, which is the essence of tax competition in this model: that is, regions treat their neighbour's tax rate as a parameter.

Interdependence of tax bases introduces the potential for strategic behaviour which can be modelled using game theory. Adopting the Nash behavioural assumption of non-cooperation between the two regional governments, the reaction functions for each region are:

$$t*_{1} = \frac{p_{2}(1 + t*_{2}) + T}{2p_{1}} - \frac{1}{2}$$  \hspace{2cm} (6.8)

$$t*_{2} = \frac{p_{1}(1 + t*_{1}) + T}{2p_{2}} - \frac{1}{2}$$  \hspace{2cm} (6.9)

6. Hence, the model here is a specific formulation of a general externality model with two interdependent revenue functions of the general form $R_{1}(t_{1}, t_{2})$ and $R_{2}(t_{1}, t_{2})$. See Cornes (1980) for a discussion. As will be seen later, there is sufficient structure in the present model to ensure that a unique and stable Nash equilibrium between the two regions can be found.
In equation (8), \( t^*_2 \) is region 2's optimal Nash strategy and in (9), \( t^*_1 \) is region 1's optimal Nash strategy. Thus, each region chooses an optimum tax rate on the assumption that the other region chooses its Nash rate. Rearranging (8) and (9) to express the endogenous tax variables, \( t_1 \) and \( t_2 \), explicitly as functions of parameters and constants, and using Cramer's rule, one can solve for the Nash equilibrium values of \( t_1 \) and \( t_2 \) as:

\[
\begin{align*}
\hat{t}^*_1 &= \frac{p_2 + 3t - p_1}{3p_1} \quad (6.10) \\
\hat{t}^*_2 &= \frac{p_1 + 3t - p_2}{3p_2} \quad (6.11)
\end{align*}
\]

The Nash equilibrium is characterised in Figure 2.

**Figure 6.2: Nash Equilibrium in Regional Taxes**
The family of iso-revenue curves, $R_1$, show combinations of $t_1$ and $t_2$ which yield constant levels of revenue for region 1, while the iso-revenue curves, $R_2$, show combinations of $t_1$ and $t_2$ which yield constant levels of revenue for region 2. The regional tax reaction curves are $r_1$ and $r_2$. They cut the minimum points of the iso-revenue curves. The Nash equilibrium is at $T^*$, the intersection of the regional tax reaction curves.\(^7\) The equilibrium tax rates are $t_1^*$ and $t_2^*$. One can show that $T^*$ exists, is unique and stable.\(^8\)

The hatched area in Figure 2 represents allocations which are mutually advantageous in the sense that they would yield higher levels of revenue for at least one region if somehow the two regional governments could cooperate and bargain their way to such an equilibrium. Indeed, later it is suggested that Section 90 can be seen as the outcome of such bargaining. This area therefore has an interpretation analogous to the hatched area in Figure 3.4.

However, in this model there is no locus of equilibria which maximises the potential revenue gains from cooperation, since as already noted, regions could in principle set infinite tax rates if they

\(^7\) The equilibrium at $T^*$ is analogous to a Bertrand equilibrium except that here there are two regional governments choosing tax rates to maximise revenue and interdependence between the two players occurs via a tax base externality. Recall also that the NCEE in taxes characterised in Chapter 3 was analogous to a Bertrand equilibrium. However, in that model: (i) the equilibrium was characterised in terms of total taxes collected rather than tax rates as here; (ii) governments were benevolent and omniscient suppliers of local public goods, rather than revenue maximisers; and (iii) interdependence was introduced through an explicit externality (a benefit spillover of public goods) rather than a tax base externality.

\(^8\) It can be established that since $0 \leq t_i \leq 1$ (i) the set of $t$'s from which each region chooses is a compact and convex sub-set of Euclidian space; and (ii) the revenue function $R_i$ (or payoff function) is a continuous and strictly concave function in $t_i$ (region i's strategy set). This implies that a Nash equilibrium in tax rates exists. It can also be shown that the Jacobian matrix $J$ of the implicit reaction functions is negative definite, implying that at most there is one Nash equilibrium \([\text{for this theorem on uniqueness see Rosen (1965)}]\). One can also show that the Nash equilibrium is stable.
cooperated and obtain infinite revenues because of the assumption of price inelastic demand.

The reaction curves in Figure 2 have a positive slope. The intuition for this is as follows. Consider an increase in region 2's tax rate for a given $t_1$. The increase shifts the economic boundary to the right in Figure 1, which is in region 1's favour in the sense that region 1 obtains a larger share of the market. This in turn allows region 1 to adopt a higher tax rate in order to maximise its revenue function. A similar reasoning holds for an increase in region 1's tax rate for a given $t_2$.

Substituting the Nash equilibrium values of $t_1^*$ and $t_2^*$ into (5) yields the economic boundary with tax competition, or the competitive economic boundary, as

$$E^C = \frac{1}{6T} (p_2 - p_1) + \frac{1}{2}$$  \hspace{1cm} (6.12)

$E^C$ denotes the particular value of $E$ which results when regions adopt their Nash or competitive tax rates. Comparing (12) with (6), the free trade economic boundary, it is clear that the two do not coincide: in other words, tax competition shifts the economic boundary away from its free trade position. For example, substituting $p_1 = 1$, $p_2 = 2$ and $T = 4$ into (12) and (6) yields $E^f = 0.625$ and $E^C = 0.542$, implying that tax competition shifts the economic boundary in favour of region 2 from 0.625 in free trade to 0.542. While region 1 has the lower marginal cost of producing $x_1$ it loses market share to region 2 as a result of tax competition. The implication may be that since region 1 is the low cost producer it can afford to yield market share and still maximise revenue. The effect of excise tax competition on the economic boundary is depicted in Figure 3.
6.3.3 Summary

To summarise, the analysis so far tells us in what sense excise tax competition between the states could have led to lower revenues and potentially a sufficiency of revenue problem for the states if the Deakin Amendment had not proceeded. In particular, tax competition yields the revenues implied by the Nash equilibrium tax rates at $T^*$, while with cooperation the states could achieve revenues in the hatched lens. Thus, tax competition could lead to lower revenues for the states relative to the maximum revenue achievable with cooperation, that is, if tax competition could be reduced. Hence, fears that tax competition could lead to insufficiency of revenues are supported by the results above.

The discussion also shows that tax competition will distort the free trade economic boundary between regions. What this means is that
through tax competition, states will influence one another's output of a private good (whiskey in the Munro example quoted earlier) and tax revenues. This supports the view that tax competition and free internal trade could also have been a motive behind the Deakin Amendment to include excise taxes in Section 90.

What the analysis does not tell us is whether these concerns over sufficiency of revenue could also have been of concern from a social welfare point of view. This is because citizen preferences over taxes are not modelled here. In order to compare the Nash outcome characterised above with socially optimal outcomes, one would need to compare the tax revenues implied by society's preferences over taxes with the revenues and taxes generated by $T^*$. It is conceivable that the revenues at $T^*$ could be exactly what society wishes, below society's preferred level of taxation or indeed above it.

6.4. Tax Exporting

The analysis above excluded any consideration of a jurisdictional or political boundary between the two regions. Accordingly, the two governments modelled were implicitly assumed to be indifferent as to which of the residents distributed along the distance $s$ were taxed. However, in practice, there are political boundaries between regions, implying that regional governments care about where they collect their taxes. Presumably they will be less inclined to collect taxes from residents within their own jurisdiction who can vote them out of office, and more inclined to collect revenue from non-residents if this is possible.

In this section, a political or jurisdictional boundary is introduced between the two regions in order to show that a preference for revenue collected from a neighbour's political jurisdiction introduces an additional distortion to the economic boundary, and hence interregional relations, in federal systems. The economic boundary with tax competition and tax exporting by regions is derived so that the effects of both can be identified.
6.4.1 Economic Boundary and Tax Rates

To capture the consequences of introducing a political boundary, let $J$ be an arbitrary jurisdictional boundary between regions 1 and 2. Let the regions put a value on revenue collected, denoted by $v$, where $v < 1$ on revenue collected from own-residents, and $v = 1$ for tax revenue collected from a neighbouring region. In other words, regions are assumed to place a higher value on revenue collected from non-residents, perhaps because such revenue has a lower political cost than revenue collected from own-residents. Thus, $v$ can be thought of as a proxy for the constraining influence of voters on the taxing power of the two regional governments.

On the basis of the spatial competition model, only one region will tax export. In equilibrium, it will be that region for whom the economic boundary is greater than its political boundary. Two cases can be imagined where (i) $E > J$ and region 1 tax exports; and (ii) $E < J$ with region 2 tax exporting.

For purposes of exposition, let region 1 export taxes. This means that residents distributed between $E-J$ are located in region 2, but pay taxes to region 1. Region 1 is, therefore, exporting taxes to residents of region 2. Thus, in this example, region 1 will be able to export its tax by the amount of the tax on $E-J$ of its product. The model with region 1 tax exporting is depicted in Figure 4.

---

9. The analysis and results for $E < J$, with region 2 exporting taxes to region 1, are analogous.
The revenue function of region 1 when it exports taxes to region 2 is

\[ R_1^e = t_1^e p_1 (v J + E^e - J) = t_1^e p_1 (E^e - (1 - v) J) \]  

(6.13)

where an e superscript has been added to the revenue functions to denote revenues in the presence of tax exporting, \( E^e \) is the economic boundary with tax exporting and tax competition (to be defined below) and \( t_1^e \) is the equilibrium tax rate with tax exporting (to be defined below). \( R_1^e \) is the shaded area in Figure 4.
For the region whose economic boundary is fully within its jurisdictional boundary, assumed here to be region 2, the revenue function is the same as (4), that is

\[ R_2^e = t_2^e p_2 (1 - E^e) \] (6.14)

where \( t_2^e \) is the Nash equilibrium tax rate adopted by region 2 in the presence of tax competition and tax exporting, also to be defined below.

Assume further that the jurisdictional boundary \( J \) simply divides the market distance \( s \) into two equal portions, so that \( J = 1/2 \). As previously, the reaction functions, with tax competition and tax exporting (and \( J=1/2 \) and \( E>J \)), can be found by differentiating \( R_1 \) and \( R_2 \) with respect to \( t_1 \) and \( t_2 \) respectively, setting the results equal to zero and solving for \( t_1^* \) and \( t_2^* \). This yields

\[ t_1^e = \frac{p_2}{2p_1} t_2 + \frac{p_2 - p_1 + \nu T}{2p_1} \] (6.15)

\[ t_2^e = \frac{p_1}{2p_2} t_1 + \frac{p_1 - p_2 + T}{2p_2} \] (6.16)

(15) and (16) capture two forms of externality. There is the positive tax base externality generated by each region as a result of tax competition. However, now region 2 generates an additional positive tax base externality for region 1, since the former is paying some of region 1's taxes.
(15) and (16) yield the Nash equilibrium or competitive tax rates with tax exporting by region 1 as

\[ t_1^e = \frac{T}{P_1} + \frac{1}{3} \left( \frac{P_2 - P_1}{P_1} \right) - \frac{2}{3} \left( 1 - v \right) \frac{T}{P_1} \]  

(6.17)

\[ t_2^e = \frac{T}{P_2} + \frac{1}{3} \left( \frac{P_1 - P_2}{P_2} \right) - \frac{1}{3} \left( 1 - v \right) \frac{T}{P_2} \]  

(6.18)

Comparing (17) and (18) with (10) and (11), the Nash tax rates without tax exporting, it is clear that \( t_1^e < t_1^* \) and \( t_2^e < t_2^* \). Regions impose smaller tax rates on own-residents in the presence of a desire to tax export.

The economic boundary with tax competition and tax exporting is now derived. In this regard, recall that the free trade equilibrium given by (6) shows the economic boundary when \( t_1 = t_2 = 0 \), and it has been shown that generally the competitive economic boundary given by (12) does not correspond with (6). However, one might ask whether a desire to export taxes can return the competitive equilibrium to its free trade equilibrium. To consider this, substitute (17) and (18) into (5), and solve for the value of \( E \) at the Nash or competitive equilibrium with tax exporting, which is

\[ E^e = \frac{1}{6} \left( \frac{P_2 - P_1}{T} \right) + \frac{1}{6} \left( 1 - v \right) + \frac{1}{2} \]  

(6.19)

\( E^e \) is the economic boundary in the presence of tax competition and tax exporting.

10. Existence, uniqueness and stability for each regime \( E > J \) and \( E < J \) can be demonstrated as for the spatial competition model without tax exporting (see footnote 8).
Comparing (19) with (6), the free trade economic boundary, it is clear that if \( v \) is small enough, \( E_e \) might coincide with \( E_f \). Indeed, if \( v = 1 - 2[(p_2 - p_1)/T] \), then \( E_e \) does correspond with \( E_f \). In this special case, tax exporting exactly cancels the effect of tax competition, and free trade between the regions is not distorted in net terms. Observe also that when \( v = 1 \), (19) is the same as (12), the competitive economic boundary without any inducement to tax export.

The way in which tax exporting shifts the economic boundary can be seen by substituting \( p_1 = 1, p_2 = 2 \) and \( T = 4 \) from the previous example, and \( v = 0.75 \), into (19) and solving for \( E_e \). This yields \( E_e = 0.58 \) so that \( E_c < E_e < E_f \). Note that if \( v = 0.5 \) in this example, instead of \( v = 0.75 \), then \( E_c < E_e = E_f \).

### 6.4.2 Competitive Revenues With and Without Tax Exporting

It is also of interest to ask whether competitive tax revenues with tax exporting are higher or lower than without tax exporting. In this regard, adopting the parameter values from the above example, yields the equilibrium tax revenues in Table 1.

<table>
<thead>
<tr>
<th>No Tax Exporting</th>
<th>Tax Exporting</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>t_1</em></td>
<td><em>t_2</em></td>
</tr>
<tr>
<td>4.33</td>
<td>1.83</td>
</tr>
</tbody>
</table>

The following conclusions can be drawn. First, as shown previously, competitive tax rates with tax exporting are lower than competitive tax rates without tax exporting. This may be because allowing \( v < 1 \) lowers the marginal benefit to a government (in terms of its objective function) of raising revenue from its own citizens. By attaching a political cost to revenue raised, the tax rate regions wish
to impose on own-residents, relative to the competitive rate when \( v = 1 \), is lower.

Second, total revenues collected by both governments are lower when \( v < 1 \) and region 1 tax exports, relative to competitive revenues without tax exporting.\(^{11}\) The reason for this appears to be that, in the case of region 1, which is tax exporting, the fact that it obtains ‘free’ revenue from its neighbour when \( E > J \) is not sufficient to compensate for the lower overall rate it imposes on its own citizens. Hence, its total revenue falls. Similarly, a lower rate is imposed by region 2 on own-residents when \( v < 1 \), and since there is no tax exporting at all by this region and \( E \) shifts to the right (relative to the competitive economic boundary without tax exporting), its revenue must also fall.

This contrasts with some of the results in the tax competition literature (surveyed in Chapter 2) which show that tax exporting leads to higher revenue collections and expenditure. As discussed in Chapter 2, this result is driven by the fact that tax exporting is seen to lower the marginal cost of additional units of local public good, leading to over-provision relative to a social optimum. However, in this model the marginal benefit of own-revenue is reduced by allowing \( v < 1 \) (or its marginal cost rises) and the marginal benefit of revenue from a neighbour increases (marginal cost falls). The latter is insufficient to outweigh the former so that total revenue falls. Hence, the different results are a consequence of the way that tax exporting is introduced in the model here.

One could think of \( v \) as a proxy for the constraining influence of voter preferences over the power of each government to raise tax revenue, as suggested earlier. In the competitive model without tax exporting, there was no political cost to raising revenue from own-residents. Indeed, the only cost to raising revenue which placed a constraint on governmental revenue raising powers was inter-regional competition. If a state raised its revenue too far, it would shift the economic boundary to

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11. Analogous results can be shown to hold when \( E < J \) and region 2 tax exports.
the point where its share of the market for good $x$ disappears, along with
its tax base. However, with $v < 1$, there is now an additional implicit
cost to revenue raising imposed on each government. This further
restricts taxing powers over and above the effect of inter-regional
competition.

6.4.3 Summary

To summarise this analysis of tax exporting, equations (6), (12) and (19)
together demonstrate the distortionary effects of tax competition and tax
exporting on the economic boundary between regions in a federation. (12)
shows the distortion to free trade from tax competition, and (19)
characterises the distortion due to both tax competition and tax
exporting. Except in the special case noted above, where tax exporting
exactly cancels out the effect of tax competition, the two influences
yield a competitive economic boundary which differs from the free trade
boundary and hence they tend to distort the economic boundary between
regions. Thus, tax competition and tax exporting together lead to a
distortion of internal free trade between regions.

Moreover, tax exporting as modelled here leads to a further
lowering of competitive revenues relative to cooperative outcomes. Thus,
if tax exporting is present, it could add weight to any desire for the
Deakin Amendment and the sufficiency of revenue fears.

6.5 Will Centralised Excise Taxes Be Distortionary?

However, one can easily show in this model that a single unitary
(Commonwealth) excise tax also distorts free trade between regions (a
unitary excise tax is chosen here for reasons to be explained later).
If there was a common tax rate, $t$, for all states, the economic boundary would be (obtained by substituting $t = t_1 = t_2$ into (5) and solving for $E$)

$$E^U = \frac{1}{2} + \frac{P_2 - P_1}{2T} (1 + t)$$

(6.20)

where $E^U$ is the unitary economic boundary or the boundary established under a single central government tax. Comparing $E^U$ with $E^F$, the free trade boundary, one can see again that the two differ. Therefore, a uniform central tax, as established by Section 90, also distorts free internal trade. Moreover, $E^U$ differs from either $E^C$ or $E^E$, and hence establishes a different economic boundary from the competitive outcomes with and without tax exporting.

Thus, although tax competition and tax exporting distort internal free trade and lead to lower levels of revenue relative to cooperative outcomes, a single Commonwealth excise tax will also distort trade between regions. However, as will be seen later, the Commonwealth tax does not reduce tax revenues to the competitive levels implied by $T^*$ in Figure 2. Although one could argue that the founding fathers may not have been so sophisticated, this does imply that free internal trade, and the potential distortionary effects of tax competition and tax exporting, may not have been the dominant issues that guided concerns in the Constitutional debates over competition between states, and the Deakin Amendment. It may have been, instead, a desire to avoid the revenue reducing implications of tax competition and tax exporting which led to the inclusion of excise taxes in Section 90. Moreover, tax competition and tax exporting may have been threats to unity in the new federation because, by shifting economic boundaries, they lead to changes in relative state revenues and output of private goods.

Thus, the analysis to date points to fears over the revenue implications of tax competition, and possibly federal unity concerns,
being the driving forces behind Deakin’s proposal to include excises in Section 90, rather than free internal trade concerns.

6.6 Could Section 90 Have Led to Higher Excise Tax Revenues?

The second question posed in the introduction is now addressed: did Section 90 lead to revenues which were higher than those which the states would have obtained if excise taxes had remained in the hands of the states when one also takes into account the effects of two other Sections impinging upon Section 90: that is, Sections 99 and the Braddon Clause? In other words, did the Deakin Amendment satisfy the concerns over tax competition and sufficiency of revenues?

This question is examined here by modelling a cooperative equilibrium between regions 1 and 2, in particular, a Nash bargaining solution. In taking this approach, one is effectively modelling an equilibrium between the regions which characterises Section 90, without showing any sequential bargaining process leading to this equilibrium. Revenues and tax rates which result under the cooperative outcomes are then compared with the Nash revenues to provide some insight into the answer. Hence, two polar cases are being modelled and compared. (12)

The spatial tax competition model is inappropriate for characterising cooperative equilibria because demand for the product of each state was assumed to be perfectly inelastic, implying that the states could cooperate in such a way that each imposes an infinite tax rate. Between them they could generate unlimited revenues. Therefore, in order to answer this second question, a slightly different model is now developed which does not focus on trade restricting aspects of tax competition and tax exporting, but allows for elastic demand for $x_i$ in the two regions (and also differing elasticities).

In this regard, consider the spatial competition model without tax exporting developed earlier. Assume that the private goods \( x_1 \) and \( x_2 \) produced in each region are substitutes, but not perfect substitutes, as they were assumed to be previously. The supply function for region i's product is defined as

\[
x_i = A_i + B_ip_j(1+t_j) - C_ip_i(1+t_i)
\]  

(6.21)

where \( x_i \) is the supply of private good in region i, \( A_i, B_i \) and \( C_i \) are parameters and all other variables are as previously defined.

An ad valorem excise tax at rate \( t \) (where region 1 is now defined as region i and region 2 as region j) generates the revenue function for region i as

\[
R_i = t_ip_ix_i = a_it_i + b_it_it_j - \left( \frac{c_i}{2} \right)t_i^2
\]

(6.22)

where

(i) \( a_i = (A_i + B_ip_j - C_ip_i)p_i \);

(ii) \( b_i = B_ip_ip_j \); and

(iii) \( c_i = 2C_ip_i^2 \)

Note that the \( c_i \) parameter can be thought of as measuring a region's preference with respect to own-taxation and hence public goods. For example, a higher value of \( c_1 \) relative to \( c_2 \) implies that a given increase in \( t_1 \) in region 1 yields less of a fall in demand for \( x_1 \) than a given increase in \( t_2 \). This in turn implies that region 1 has a higher preference for own-taxation and hence public goods. Thus, differences in \( c_1 \) and \( c_2 \) can be thought of as being indicative of different preferences between the two regions.
6.6.1 Nash Equilibrium in Taxes

Differentiating (22) with respect to $t_1$, setting the result equal to zero and solving for $t_1$, one obtains the reaction function for region $i$ as

$$t_1^* = \frac{a_i + b_i t_j^*}{c_i}$$  \hspace{1cm} (6.23)

The Nash equilibrium tax rates are

$$t_1^* = \frac{c_2 a_1 + b_1 a_2}{c_1 c_2 - b_1 b_2}$$  \hspace{1cm} (6.24)

$$t_2^* = \frac{b_2 a_1 + c_1 a_2}{c_1 c_2 - b_1 b_2}$$  \hspace{1cm} (6.25)

The Nash equilibrium in taxes is characterised in Figure 5.

---

13. Existence and uniqueness can be established as for the spatial competition model.
As previously, the Nash equilibrium is at $T^*$ and the shaded area represents equilibria which are mutually advantageous. However, because this model has elastic demands, there is now a locus of equilibria in this lens, $RR'$, which maximises the potential gains from cooperation. Non-cooperation leaves states at $T^*$, while Section 90, made legally binding by incorporating it within the Constitution, has the potential to allow the states to cooperate and achieve an equilibrium on $RR'$, with higher rates of tax and higher levels of revenue. The way in which Section 90 may have allowed the competing states to achieve an equilibrium outcome on $RR'$ is now discussed by deriving cooperative equilibria using numerical solutions.
6.6.2 Cooperative Equilibria: The Revenue Implications of Sections 90, 99 and the Braddon Clause

Two types of cooperative equilibria are derived. However, before proceeding, one must be aware of the details of Section 99 and the Braddon Clause, since, as will be shown below, both are crucial in answering the basic question posed above about whether including excise taxes in Section 90 would have met sufficiency of revenue concerns.

(a) The Braddon Clause: A Revenue Sharing Rule

In characterising a cooperative equilibrium, the revenue sharing rule determining how cooperative revenues are to be returned to each state must be specified. While many possible rules can be envisaged, and indeed the determination of such rules in federations is in itself a central question, given that it affects the distribution of any revenue surplus and hence the gains from cooperative behaviour, for the purposes of discussion here it is assumed that a state receives back from the Commonwealth the revenue collected within its borders.

This is effectively what happened in Australia in the first ten years of federation through Section 87 (the Braddon Clause). Hence, the analysis to follow assumes that the Braddon Clause applies. This implies that the analysis is strictly relevant to the first decade of Australian federation. It is applicable after that period only in as much as the revenue sharing rules adopted were similar to the Braddon Clause.

(b) Section 99

Section 99 of the Australian Constitution reads:

14. That there was a Section of the Constitution designed to restrain the Commonwealth from treating states differentially was first pointed out by Cliff Walsh.
'The Commonwealth shall not, by any law or regulation of trade, commerce or revenue, give preferences to one state or any part thereof over another state or any part thereof'.

Effectively, Section 99 means that the Commonwealth has had to impose uniform excise duties across all states regardless of interstate differences in preferences over levels of taxation (these differences will be captured in the numerical examples of cooperative outcomes to be modelled here).

There are two possible explanations for the appearance of Section 99. One is that it is derived from some notion of fairness. The second is that it was an attempt by the founders to stop the Commonwealth using its new monopoly power over the excise tax base to increase own-revenues at the expense of the states by exploiting interstate differences in demand elasticities for taxation. As will be seen below, Section 99 has the effect of reducing cooperative revenues below what they would otherwise be if the Commonwealth was free to apply differential rates of excise tax according to different state preferences. Hence, Section 99 could be viewed as a restraining Clause imposed by the founders to limit the power of the Commonwealth (note that the Braddon Clause, which also gave a guaranteed share of total revenue back to the states could be seen in the same light).

Thus, it is clear that both the Braddon Clause and Section 99 have implications for the revenue implications of Section 90. For this reason, the first type of cooperative equilibria derived examines the cooperative tax rates and total and state revenues under Section 90 with the Braddon Clause but without Section 99. In order to isolate the effects of Section 99 on cooperative revenues, the second type of cooperative equilibria derived characterises tax rates and state and total revenues with both the Braddon Clause and Section 99.

15. As observed in Chapter 5, notions of fairness seem to have been important in Australian federalism.

16. Adopting the price discriminating monopolist analogy, Section 99 precluded the Commonwealth from price discriminating.
In the second case, there are two changes which have occurred to make the outcome differ from the competitive case. These are (i) elimination of tax competition through internalisation of the positive externalities between the two regions, and (ii) imposition of a tax rate uniformity constraint. As will be seen below, the tax rate uniformity constraint is crucial in determining the revenue consequences of cooperation in the presence of asymmetries between states.

(c) Cooperative Equilibria with the Braddon Clause

With different tax rates, the cooperative equilibrium can be found by solving the problem of the federal government under Section 90 which is to choose \( t_1 \) and \( t_2 \) to maximise joint revenue raised in regions 1 and 2

\[
\max R = R_1 + R_2 \\
(t_1, t_2)
\]

where \( R_1 \) and \( R_2 \) are defined by (22). The cooperative equilibrium with variable tax rates can be found by differentiating (26) with respect to \( t_1 \) and \( t_2 \) and using Cramer's rule to obtain

\[
t_1^c = \frac{a_1 c_2 + a_2 (b_1 + b_2)}{c_1 c_2 - (b_1 + b_2)^2} \tag{6.27}
\]

\[
t_2^c = \frac{a_2 c_1 + a_1 (b_1 + b_2)}{c_1 c_2 - (b_1 + b_2)^2} \tag{6.28}
\]

The \( c \) superscript on the tax rate terms denote that they are cooperative rates to distinguish them from the competitive Nash rates derived above which have a \( * \) superscript. (27) and (28) show the tax rates adopted by the federal government under joint revenue maximisation with the freedom to apply separate tax rates in each region. Note that in general \( t_1^c \) and \( t_2^c \) are not equal, unless all the parameter values happen to be the same, that is, the regions are identical. In the examples to follow, all parameters will be symmetric, but the \( c_1 \) and \( c_2 \)
parameters, which measure preferences over taxes, will be allowed to differ. Under separate tax rates, the Commonwealth is able to exploit this difference.

Note that the cooperative separate tax rates defined by (27) and (28) are higher than the Nash tax rates given by (24) and (25) so that $t_1^c > t_1^*$ and $t_2^c > t_2^*$. The rates $t_1^c$ and $t_2^c$ are the rates which yield a point on the RR locus of Figure 5 whereas $t_1^*$ and $t_2^*$ are given by the Nash equilibrium at $T^*$. 

(d) **Cooperative Equilibria with the Braddon Clause and Section 99**

If the federal government undertakes joint revenue maximisation with the Braddon Clause, but is constrained by Section 99 to impose the same rate in all states, it solves

$$\text{Max } R = R_1 + R_2$$

$$(t_1, t_2)$$

$$\text{STo: } t_1 = t_2 = t \quad (6.29)$$

The difference between (29) and (26) is that in the latter, the central government faces a uniform tax rate constraint. The solution of (29) yields the optimum uniform rate for the central government as

$$t^c = \frac{a_1 + a_2}{(c_1 + c_2) - 2(b_1 + b_2)} \quad (6.30)$$

The Commonwealth can no longer impose different rates according to different preferences. Indeed, with this uniform cooperative rate solution, the federal government internalises the positive tax base externality (that is, eliminates tax competition), but 'adjusts' the rates applied in each region so that they are equal, thus raising the rate in one region and lowering the rate in the other to achieve
uniformity. As will be seen below, this imposes a cost on both regions in the cooperative equilibrium which increases as regional diversity rises, and has a key influence on the tax revenue benefits of Section 90.

The key point to note about these cooperative equilibria is that they all yield tax rates which internalise the positive externalities between the two states. That is, by undertaking joint revenue maximisation, the federal government is assumed to take into account the fact that one region's tax rate has a positive effect upon the other's tax base. The tax rates derived from the competitive Nash equilibrium ignore this externality. As we shall see below, it is this internalisation which makes the cooperative separate tax rates and revenues higher than the competitive rates and revenues, although this does not necessarily hold for the cooperative uniform solution (depending on the degree of diversity).

6.6.3 Example I: Regions Highly Dissimilar

Assume in this example that regions are highly dissimilar in the sense of having different $c_i$ parameters in the $x_i$ function. In particular, for the sake of demonstration, let $c_1 = 5$ and $c_2 = 10$. This implies that region 1 has a higher demand for taxation, possibly due to a greater demand for public goods, than region 2. The revenue each receives when they cooperate, both with and without Section 99, versus what they receive when they compete, are shown in Table 2.
Table 6.2

Competitive and Cooperative Tax Rates and Revenues: Highly Dissimilar Regions

| Rates          | Revenues | | | |
|----------------|----------|----------------|----------------|----------------|----------------|
|                | State 1  | State 2        | State 1        | State 2        | Total          |
| Competitive:   | 0.211    | 0.110          | 111,361        | 61,110         | 172,471        |
| Cooperative:   |          |                |                |                |                |
| *Separate      | 0.224    | 0.122          | 112,245        | 61,224         | 173,469        |
| *Uniform       | 0.154    | 0.154          | 106,509        | 47,337         | 153,846        |

Note: Estimated for $a_1 = a_2 = 1$, $b_1 = b_2 = 0.5$, $c_1 = 5$, $c_2 = 10$. Revenues have been obtained from the revenue function by substituting in parameter values and Nash tax rates and multiplying by a scalar.

A number of results emerge. First, cooperation with separate rates results in tax rates and revenues which are higher for both regions than the competitive rates and revenues. One would expect this result, since all that has occurred in the move from the tax competitive regime to the cooperative separate rates regime is that the positive tax base externality has been taken into account. There is, therefore, a clear tax revenue surplus from cooperation when separate rates can be applied by the central government.

However, the cooperative regime with the Braddon Clause and Section 99 yields a single rate which lies between the cooperative separate rates, and yields lower revenues for each region relative to the competitive solution. Thus, the effect of Section 99 is to lower the total revenue available under Section 90 and indeed, where the regions are highly dissimilar, the revenue enhancing effect of internalising the tax base externality with cooperation is overwhelmed by the cost imposed by the uniformity constraint. The competitive equilibrium is compared with the cooperative variable rate and uniform rate outcomes in Figure 6.
The cooperative separate rate outcome yields an equilibrium in the hatched lens of equilibria which dominate $T^*$ on the RR' locus, where both tax rates and revenues are higher and each region is on a higher iso-revenue curve. The cooperative outcome with uniform rates, however, selects a pair of tax rates at a point such as B where the tax rate in region 2 is higher than at $T^*$, the tax rate in region 1 is lower than at $T^*$, but revenues in both regions are lower than at $T^*$. Therefore, the cooperative uniform rate solution is not even in the lens of mutually advantageous equilibria.

17. Note that in this diagram $t_1$ is higher than $t_2$ because $c_1 < c_2$; that is, region 1 has a stronger preference for taxation than region 2 and hence adopts a higher rate of tax. This skews the position of the Nash equilibrium to the right hand portion of the $t_1t_2$ space so that the locus of cooperative uniform tax rates does not pass through the hatched lens of mutually advantageous equilibria.
advantageous equilibria, let alone on the RR' locus, and is dominated by the Nash equilibrium at T*.(18)

Hence, although the cooperative solution internalises the tax base externality associated with tax competition, which tends to push the outcome into the lens, the Section 99 constraint is sufficiently binding, in view of the considerable asymmetry between the two regions, so as to overcome this internalising benefit of cooperation and yield a cooperative equilibrium which is dominated by the Nash equilibrium. Diversity in the presence of a uniformity constraint has ruled out a cooperative solution.

6.6.4 Example II: Regions Less Dissimilar

In Table 3, the tax rates and revenues under the three tax regimes are presented for c1 = 9 and c2 = 10, that is, assuming that regions are much closer together in terms of preferences for taxes. All other parameters remain at their previous values.

18. Effectively, the uniformity constraint has caused the individual rationality axiom, required for a Nash bargaining solution, to be violated; that is, both players are actually made worse-off with cooperation relative to their payoff in the event of no agreement, which is assumed here to be their Nash equilibrium payoff [see Friedman (1991) p212-213].
Table 6.3

Nash and Cooperative Tax Rates and Revenues: Regions Less Dissimilar

<table>
<thead>
<tr>
<th>Rates</th>
<th>State 1</th>
<th>State 2</th>
<th>Revenues</th>
<th>State 1</th>
<th>State 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive</td>
<td>0.117</td>
<td>0.106</td>
<td>61,592</td>
<td>56,021</td>
<td>117,613</td>
<td></td>
</tr>
<tr>
<td>Cooperative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Separate</td>
<td>0.123</td>
<td>0.112</td>
<td>61,798</td>
<td>56,180</td>
<td>117,978</td>
<td></td>
</tr>
<tr>
<td>*Uniform</td>
<td>0.118</td>
<td>0.118</td>
<td>62,284</td>
<td>55,363</td>
<td>117,647</td>
<td></td>
</tr>
</tbody>
</table>

Note: Calculated as for Table 1 except now $c_1 = 9$ and $c_2 = 10$.

Again, revenues and tax rates rise with cooperative behaviour if separate rates can be applied. However, the interesting result here is that, with a cooperative uniform tax regime, region 1 has lower revenue while region 2 has higher revenue relative to the tax competitive regime. Because of the Section 99 uniformity constraint, one region is actually made worse off. However, the gain in revenue to region 2 is more than sufficient to compensate region 1 for its loss, leaving both regions better off. Hence, in net terms, there is still a surplus.

However, whether or not the cooperative equilibrium with Section 99 is in the lens of mutually advantageous equilibria, depends upon revenue transfers being made from region 1 to 2 in this example. Unless transfers are made from the surplus, presumably by the Commonwealth, region 1 would be made worse off by the combination of Sections 90, 99 and the Braddon Clause. Hence, as in Chapter 5, we again have the result that because of uniformity associated with centralisation or cooperation, the dominance of cooperative outcomes over competitive outcomes is dependent upon the presence of lump-sum transfers. This outcome is characterised in Figure 7.
As previously, the cooperative outcome with separate rates yields an equilibrium such as C. However, the cooperative outcome with uniform rates is at a point such as D where the tax rate is higher for both regions, but revenue is only higher in region 1 and in fact is lower in region 2, relative to $T^*$. In this example, only a cooperative solution with transfers will dominate the Nash equilibrium and be in the lens of mutually advantageous equilibria.

Hence, when one makes the regions a little less different than in example I, the Section 99 constraint binds less severely and allows a cooperative outcome closer to the lens of mutually advantageous equilibria. However, a solution within the lens depends upon revenue transfers.
6.6.5 Example III: Identical Regions

Finally, the case where both regions are assumed to be identical is presented in Table 4.

Table 6.4
Nash and Cooperative Tax Rates and Revenues:

Identical Regions

<table>
<thead>
<tr>
<th>Rates</th>
<th>Revenues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State 1</td>
</tr>
<tr>
<td>Competitive</td>
<td>0.105</td>
</tr>
<tr>
<td>Cooperative</td>
<td></td>
</tr>
<tr>
<td>*Separate</td>
<td>0.111</td>
</tr>
<tr>
<td>*Uniform</td>
<td>0.111</td>
</tr>
</tbody>
</table>

Note: Calculated as for Tables 1 and 2 except that now \( c_1 = c_2 = 10 \): that is, regions are identical.

In this example, both regions gain equally from cooperation and the cooperative regime with Section 99 yields the same benefits as a cooperative outcome with separate rates. When both regions are identical, Section 99 is not binding, and only the externality internalising benefit associated with cooperation affects the cooperative uniform rate outcome. Figure 8 characterises this outcome.
Figure 6.8: Nash and Cooperative Equilibria With Identical Regions

When the two regions are symmetric, the Nash equilibrium is at $T^*$ and the cooperative outcome with and without Section 99 leads to an equilibrium such as E on the RR' locus. Note that the Nash equilibrium, and both cooperative equilibria, lie on the locus of points at which $t_1 = t_2$. (19)

6.6.6 Summary

In summary, under Section 90 with separate tax rates (no Section 99), revenues and tax rates always increase for both regions. The Commonwealth is able to internalise the tax base externality and exploit differences in preferences between the two regions over taxes. Diversity places no limit on the gains from cooperative behaviour, because it does not bring with it a uniformity cost.

19. When the uniformity constraint is not binding, the individual rationality axiom is no longer violated and the Nash bargaining solution dominates the Nash equilibrium.
However, since Section 90 is accompanied by Section 99, cooperation can only occur with a uniform excise tax rate, and the gains and their distribution between states, depend upon the degree of diversity. This is because federation with uniform rates imposes a cost associated with the equal tax rate constraint on at least one region, and this cost rises as diversity increases. As Table 3 indicated, it is possible that one region may lose from cooperation. In this case, cooperation only dominates the competitive outcome if there are compensating revenue transfers. On the other hand, if regions are highly different, there may be no incentive at all to cooperate.

Thus, diversity places a limit on the potential gains from Section 90 when it is accompanied by Section 99 and the Braddon Clause. Diversity is also a key determinant of whether lump-sum transfers are a necessary condition for a cooperative solution to dominate non-cooperation. The greater the similarity between regions, the more likely it is that the cooperative uniform rate lies in the hatched area of mutually advantageous equilibria. However, the more diversity there is, as captured by differences between $c_1$ and $c_2$, the more likely it is that an outcome such as that in Figure 7 will result, with lump-sum transfers being a necessary condition for the states to support cooperation.

Therefore, in answering the question set out earlier, could the Deakin Amendment have satisfied any state concerns over maintaining state revenues by eliminating tax competition and raising revenues above their competitive levels, the answer is a qualified yes, depending upon the degree of diversity between states and whether compensating transfers which did occur after federation were sufficient to compensate any losers from the uniformity effects of Section 99.

6.7 Conclusion

In the first part of this Chapter, spatial tax competition and tax exporting models were developed. It was argued that a major motive behind the inclusion of excise taxes in Section 90 of the Australian Constitution, what has been termed here as the Deakin Amendment, was to
minimise tax competition because of fears over the sufficiency of state revenues and federal unity.

In the second part of the Chapter, a more general model of tax competition was developed and it was shown that, under the assumption of a particular revenue sharing rule (the Braddon Clause), if the Commonwealth could have applied separate excise tax rates across states, Section 90 would have yielded higher state and total revenues relative to the competitive outcomes. However, given that the Commonwealth has in practice applied uniform rates because of Section 99 of the Constitution, whether or not the Deakin Amendment could have led to higher revenues depends upon the degree of regional diversity. In particular, if states were highly diverse in terms of preferences over taxation, they may all have experienced lower revenues with Section 90. In this case the Section 90 outcome is dominated by the Nash outcome (Example I). If there is more limited diversity, one state may secure higher revenues and total revenue may increase, but one state may lose unless there is some transfer of revenue (Example II). Finally, if states are identical, Section 99 is not binding on the Commonwealth and Section 90 yields unambiguously higher revenues for both states.

Hence, there are two key determinants of whether the Deakin Amendment, together with Section 99 and the Braddon Clause, could have yielded higher state and total excise revenues, relative to competitive outcomes. The first is the level of diversity of preferences over excise taxes between the states. The more diversity, the more binding is the Section 99 constraint, and the more likely it becomes that some states will lose. The second is whether transfer payments are made to compensate any losers in the presence of such diversity. Thus, as in Chapter 5, there is again an argument suggesting that the dominance of a cooperative equilibrium over a competitive equilibrium depends upon the degree of diversity, uniformity constraints and transfers among regions.

This begs the question of why Section 99 was included in the Constitution, given that it had such a marked impact on the distribution of gains and losses from cooperation, and possibly created an additional
reason for Commonwealth grants. As already indicated, there are two explanations, the first that it was based on some notion of fairness and equity. The second is that it was a deliberate attempt by the states to restrain the taxing power of the Commonwealth (along with other restraining Sections of the Constitution). Given that the states had to relinquish customs duties for uniform tariff reasons, they may have wanted the Deakin Amendment because of fears over tax competition and sufficiency of revenue (as argued here), and included Section 99 to limit the discriminatory revenue raising powers of the Commonwealth. This, in turn, may have led to a further need for Commonwealth grants. Regardless of the motive behind Section 99, the fact is it exists, and the analysis here has shown the effect it may well have had on excise tax revenues under the Deakin Amendment versus competitive outcomes.

Therefore, the Chapter offers an economic rationale for: (i) the inclusion of excise taxes (the Deakin Amendment) in Section 90 of the Australian Constitution, along with Customs duties (to minimise tax competition because of fears over revenues, and, possibly, federal unity); (ii) the presence of Section 99 (based simply on a notion of fairness, or designed to restrain the price discriminating powers of the Commonwealth); and (iii) the need for Commonwealth grants to some states, depending on the degree of diversity in preferences for excise taxes.

Finally, a few words should be said about the kind of tax competition modelled here. Recall from the Literature Review Chapter (Chapter 2) that much of the work on tax competition in the small numbers case has been undertaken under the assumption that governments behave as benevolent despots, with the result that tax competition leads to sub-optimal levels of taxation and public good provision (relative to a social optimum). In this model, however, localities are assumed to be revenue maximisers. Tax competition leads to tax rates and revenues which are lower than the optimum, where the optimum is now defined as a joint revenue maximising optimum, not a social optimum as in the benevolent despot model. The locus of optima on the RR’ curve in Figure 5 do not represent social optima, as the locus PP’ did in Figure 3.2.
Thus, here we have an under-taxation result, but under-taxation relative to the joint revenue maximising outcome rather than a social optimum. To say anything about the effects of competition on citizens' welfare when governments are assumed to be revenue maximisers, one would need to compare the joint revenue maximising optimum with a social optimum. This would enable conclusions to be made about whether competition is beneficent (in terms of social welfare) by restraining the taxing powers of revenue maximising governments. As discussed in Chapter 2, this has been claimed to be a benefit of federal-type systems of government.
7.1 Introduction

In Chapter 5 it was argued that Australian fiscal equalisation was motivated initially, at least in part, by a need to redistribute income to the smaller states in order to compensate them for some adverse effects of federation. Apart from this compensation motivation for equalisation, Australian fiscal equalisation has also since been justified by appeals to the Buchanan (1952) horizontal equity argument. For example, Mathews (1978) has drawn on the concept of horizontal equity to support the current practice of equalisation in Australia.

However, as noted in the Introductory Chapter, in recent years there has been increasing criticism of fiscal equalisation in Australia, both of the way in which it is carried out, and of the underlying methodology used by the Commonwealth Grants Commission (CGC), the body responsible for developing and applying the principle in determining grants (discussed previously). In arguing against fiscal equalisation, commentators have: (i) attempted to criticise the fiscal equity argument as a justification for equalisation; and (ii) tried to show that Australian fiscal equalisation has adverse economic efficiency costs. These views have been briefly reviewed in Chapter 1.

To date there has been little analytical analysis of whether there is, or is not, an efficiency case for fiscal equalisation in Australia. This contrasts with Canada, where there is a significant literature on this question [for example, see Boadway and Flatters (1982b)]. Accordingly, the underlying aim of this Chapter is to make a contribution to the emerging debate in Australia by applying the Canadian results in
an Australian context to see to what extent this literature can throw any light on efficiency and equalisation in Australia.

Note that the chapter does not present any results on efficiency and equalisation which are not already known, at least in the Canadian literature. Rather, it confirms existing results. However, by adopting an extension of the model of Chapter 4, the theoretical methodology here is somewhat different to Boadway and Flatters (1982b). One important difference is that in the model here, the free migration equilibrium is characterised algebraically whereas in Boadway and Flatters (1982b) a diagrammatic characterisation is adopted. The advantage of the approach here is that it allows one to solve for the equilibrium endogenous variable values, which include regional populations, local public and private good outputs and per-capita utility. This has enabled the development of a numerical version of the model (not presented here), where numerical comparative statics can be conducted.

Also note that the model considered here is analogous to the basic model in Boadway and Flatters (1982b) and does not consider the introduction of capital and heterogeneous individuals that these authors examine. This is partly because another important aim of the Chapter is to lay the groundwork for Chapter 8, where the model is extended to incorporate public good externalities.

7.2 Background: The Australian Interest in Efficiency and Equalisation

The extent of Australian interest in fiscal equalisation and efficiency can be appreciated by the fact that the CGC was asked recently by the Commonwealth Government to report on the efficiency implications of its present equalising procedures. A brief review of the background to the CGC's enquiry and its results is useful in understanding the way the issues are perceived in Australia.

In this regard, on September 14, 1989, the Hon. Minister for Administrative Services, Stewart West, conveyed to the CGC terms of
reference for a review of certain issues associated with the fiscal equalisation methodology used by the Commission. As part of the terms of reference, the Commission was asked to:

'Consider the likely effects upon the application of the fiscal equalisation principle of taking into account the consequences for economic efficiency and administrative simplicity.'(1)

In other words, the Minister requested that the Commission do two things: first, examine the effects of fiscal equalisation on economic efficiency; and, second, show the implications of this analysis for the way in which fiscal equalisation is undertaken in Australia.

The principle of fiscal equalisation, as practised in Australia, is as follows (this has already been stated in Chapter 1 but is restated here for convenience):

'Each state is entitled to receive a level of general revenue funding from the Commonwealth which would enable it to provide, without having to impose taxes and charges at levels appreciably higher than the levels imposed by the other states, government services at standards that are not appreciably different from the standards provided by the other states.'(2)

The Report brought down by the Commission in October 1990 in response to the Terms of Reference was inconclusive in relation to the implications of fiscal equalisation for economic efficiency, but did recommend that the following process should be pursued in order to address the matter:

'(a) a theoretical framework should be established to represent the relationship between equalisation and efficiency and to map the interrelationship and any trade-off;

(b) a quantitative investigation should be undertaken to determine the parameters of any trade-off—that is, what net losses of efficiency, if any, would occur for different degrees of equalisation; and

(c) a decision should be taken, in the light of (b), on how much loss of efficiency is acceptable to achieve the benefits of equalisation—that is, the preference trade-off should be determined.'

In relation to (a), the Commission noted the need for an ability to model the decisions of firms and people to move from one state to another in response to fiscal and other changes.'

In this Chapter, a preliminary contribution is made to (a), and to a lesser degree (c), by: (i) extending the model of Chapter 4 (without externalities) to allow $n_1$ and $n_2$ to be determined from a free migration equilibrium condition, rather than being fixed exogenously; (ii) using this extended model to set out an efficiency case for (and against) fiscal equalisation; and (iii) making some preliminary assessment of whether there is an efficiency argument for, or indeed against, equalisation in Australia, as it has generally been perceived that there is in Canada. Before commencing the formal analysis, it is useful to review briefly the contribution of the existing literature to the question of migration and economic efficiency. This has been reviewed in Chapter 2, but is restated here for convenience.

7.3 Tiebout. Fiscal Equalisation, Externalities and Regional Rents

Tiebout (1956) argued that in a nation with a large number of communities, each choosing its own mix of local public goods and taxes according to the community's preferences, and with free mobility of individuals, the optimal level of local public goods would be chosen in each locality and the distribution of the nation's population between localities would be efficient. He assumed that (i) residents had full information about all alternatives; (ii) the number of communities was large enough so that individuals had a continuous spectrum of local


public good/tax mixes to choose from; and (iii) a resident's income was independent of choice of location.

While Tiebout's analysis was informal, his conjecture that free migration would somehow foster efficiency in the allocation of resources, in particular by creating a quasi-market solution to Samuelson's problem of preference revelation, at least for local public goods, remains compelling and has stimulated considerable research. Much of this work has generalised Tiebout's results and involved empirical testing (for a review see Wildasin (1986)).

One strand of this research is the 'fiscal externality' literature of which Buchanan and Goetz (1972), Flatters, Henderson and Mieszkowski (1974), Hartwick (1980), Boadway and Flatters (1982a, 1982b) and Myers (1990) are key papers. The main idea is that, contrary to Tiebout's conjecture, free migration will not necessarily lead to an efficient allocation of resources because migration generates a benefit for residents in the region receiving migrants (a lower tax price as the tax base expands), and a cost for residents in the region they leave (a higher tax price as the tax base contracts). It is argued that freely migrating residents do not take these effects, termed 'fiscal externalities', into account in their personal cost-benefit calculus, and that, therefore, free migration equilibria may be inefficient.

Another literature has revealed a second potential source of migration inefficiency caused by the different capacities of regions to tax rents from fixed factors, including natural resources, and disburse the revenue on the basis of residency. The idea is that the presence of differential regional rents from fixed factors which are collected publicly and disbursed in this way, distort free migration decisions. Residents 'rent seek' and migrate in response to their average rather than marginal product, so that in a particular free migration equilibrium, marginal products are not necessarily equalised and inefficiency results. This idea has received attention in Canada, where the resource-rich Western provinces have property rights over their natural resources and it has been feared that, to the extent that these
provinces collect revenue from their resources and spend them locally, they could induce inefficient levels of migration. For a discussion of this argument in the Canadian context see Boadway (1985). Boadway and Flatters (1982b) develop a model capturing both sources of migration inefficiency and characterise an inefficient free migration equilibrium. They show that fiscal equalisation transfers can be made between regions to correct for these inefficiencies, and derive an equation for the optimal transfer. Hence, they show under what circumstances equalising transfers may be needed on efficiency grounds.

Thus, the fiscal externality and regional rent literatures emphasise that free migration, contrary to Tiebout's conjecture, can lead to inefficient equilibria and that fiscal equalisation grants may be needed to correct for these inefficiencies.

7.4 Model

Consider a federation of two regions $i = 1, 2$. Region 1 has $j = 1, \ldots, n$ individuals, each endowed with one unit of labour or income. They are assumed to have identical preferences. Individual $j$ can therefore be thought of as a representative person from region 1 with preferences over a pure local public good, $q_1$, and a private good, $x_1$. Similarly, region 2 has $k = 1, \ldots, m$ individuals each endowed with a unit of labour or income with identical preferences over a pure local public good, $q_2$, and a private good, $x_2$.

It is assumed that $x_1$ and $x_2$ are identical, as are the two local public goods. Therefore, total consumption of private good in the economy is $X = x_1 + x_2$ and total consumption of local public good is $Q = q_1 + q_2$. It is also assumed that representative individuals $j$ and $k$ from each region are identical in terms of preferences (and incomes since each has one unit) and that there are no public good externalities. Thus, a federation of identical individuals is envisaged, with two regions producing identical public and private goods. Region $i$ can therefore be thought of as a representative region.
The federation has a total population $N^*$ (taken to be a fixed parameter) which is also total labour supply. Residents are assumed to be free to migrate costlessly between regions 1 and 2. In equilibrium, $n_1$ people locate in region 1 and $n_2$ in region 2 where $N^* = n_1 + n_2$, $n_1 = N^* - n_2$ and $n_2 = N^* - n_1$.

The distribution of population is assumed to be determined from a migration equilibrium condition which equalises per capita utility between the regions. This equilibrium condition is developed later, but for now note that it has three parameters, $p_1$ and $p_2$, which are the marginal costs (MRTs) of producing $q_1$ and $q_2$ in regions 1 and 2, and $N^*$. Once these parameters are specified, $n_1$ and $n_2$ can be determined from the equilibrium condition. Thus, regional populations are functions of $p_1$, $p_2$ and $N^*$ and we have for region 1 $n_1(p_1, p_2, N^*)$ and for region 2, $n_2(p_1, p_2, N^*)$. Also, as is shown later, $\frac{\partial n_1}{\partial p_1} < 0$ (as $p_1$ rises in region 1 people migrate to region 2 and $n_1$ falls), $\frac{\partial n_1}{\partial p_2} > 0$ (as $p_2$ rises in region 2 people migrate to region 1 thus $n_1$ rises) and similarly for region 2.

In each region, it is assumed that there is a vector of exogenously fixed and spatially immobile factors or resources, denoted by $L$, which could include natural resources such as gas, petroleum and minerals as well as land. Region i can therefore be thought of as having an aggregate concave production function $y = f(n(.), L)$, where $n(.)$ is as defined above, and $L$ is the vector of fixed factors (the $i$ subscript is omitted from now on when referring to region $i$). It is assumed that $L$ is owned by foreigners.(5)

5. The assumption of full foreign ownership, while extreme, may not be a bad approximation in the case of Australia where foreign involvement in resource industries is significant.
For convenience, the convention of referring to \( f(n(.), L) \) as \( f(.) \) is adopted. (6) Let \( f_n(.) > 0; f_{nn}(.) < 0; f(.) \to 0 \) as \( n \to 0; \) and as \( n \to \infty \) \( f(.) \to \infty \) and \( f_n(.) \to 0. \) \( f_n(.) \) is the marginal product of labour (MP) in region \( i.\) (7) Labour is assumed to be paid a wage equal to marginal product, where the wage in region \( i \) is defined to be \( w.\)

In keeping with the fiscal externality literature, regional governments are assumed to implement the preferences of their representative resident. In other words, the community preference model of government behaviour, discussed in Chapter 2, is adopted. Regional governments are therefore assumed to be benevolent and omniscient suppliers of local public goods. (8) Finally, regional governments are assumed to act myopically with respect to the effect of their decisions on migration (9).

---

6. Note that since \( N^* \) and \( L \) are assumed to be fixed parameters they are not referred to explicitly in the \( n(.) \) and \( f(.) \) functions from now on. Endogenous variables are therefore functions of the two parameters \( p_1 \) and \( p_2.\)

7. Stiglitz (1980) provides a detailed discussion of the aggregate output assumptions made in these free migration models. Note however, that in the usual formulation \( n \) is not written as an explicit function of the parameters determining a free migration equilibrium.

8. More plausible stories might, for example, have regional governments subject to the temptation to take advantage of the coercive power of the state apparatus, such as in Chapter 6, where regional governments are modelled as revenue maximisers who have no regard for voter preferences: or alternatively, subject to majoritarian considerations as in Chapter 5 where a median voter model of local government behaviour is adopted. Extending the model to include such positive considerations would be a useful future exercise, but is not undertaken here.

9. This assumption is often made in the literature. Broadway (1982) has shown that it is of no consequence in the sense that governments cannot improve themselves by adopting alternative behaviour.
As with the model of Chapter 4, assuming a particular functional form for preferences, representative region i solves

\[
\text{Max } u - xq \\
(7.1)
\]

\[
STo: n(.)x + pq = f(.) \\
(7.2)
\]

Thus, region i chooses \( q \) to maximise the utility of its representative resident subject to the regional constraint that expenditure on the private and public good equal total regional endowment \( f(.) \), which is, in turn, a function of \( n \) and hence the parameters \( p_1 \) and \( p_2 \). Region i is also implicitly choosing \( x \), implying that residents have no role in choosing \( x \) or \( q \), except via their choice of location.

(2) can be thought of as a regional budget constraint, or alternatively, as any technology which converts units of total endowment into units of private and public good, at marginal rates of transformation of one for the private good and \( p \) for the public good. \(^{10}\)

Finally, in solving (1) and (2), it is assumed that the government of region i imposes a residence-based tax such as a head or wage tax on its representative resident to pay for the units of \( q \) chosen by region i, where the tax price is \( p/n \). \(^{11}\)

From (2), per-capita consumption of the private good \( x \) is

\[
x = \frac{f(.) - pq}{n(.)} \\
(7.3)
\]

---

10. As will be shown later, \( f(.) \) on the right hand side of (2) has two components: labour income and regional rent generated from the vector of fixed factors \( L \).

11. A residence-based tax is one for which liability is determined according to region of residence.
Substituting (3) into (1) yields

\[
\begin{align*}
\text{Max } u &= \frac{f(.) - pq}{n(.)} \\
\text{(7.4)}
\end{align*}
\]

7.5 \textbf{Independent Local Public Good Provision}

Differentiating (4) with respect to \( q \) yields the optimal level of \( q \) as a function of \( p_1 \) and \( p_2 \)

\[
q(p_1, p_2) = \frac{f(.)}{2p} \quad (7.5)
\]

where \( q(p_1, p_2) \), referred to as \( q(.) \) from now on, is region \( i \)'s independent provision of local public good. \( q(.) \) is an increasing concave function of \( n(.) \). To see this, let \( q(.) \) be the demand function for region 1. Differentiating with respect to \( p_2 \) yields

\[
\frac{\partial q_1(.)}{\partial p_2} = \frac{\partial f_1(.)}{\partial n_1} \frac{\partial n_1}{\partial p_2}/2p_1 > 0 \quad (7.6)
\]

We know that \( \partial q_1(.)/\partial p_2 > 0 \) because \( \partial n_1/\partial p_2 > 0 \) (as \( p_2 \) rises in region 2, residents migrate to region 1), \( \partial f_1(.)/\partial n_1 = MP_1 > 0 \) and \( 2p_1 > 0 \). Hence, \( \partial q_1(.)/\partial p_2 \) captures the effect of rising \( n_1(.) \) on region 1's output of \( q_1 \), where the change in \( n_1(.) \) is caused by a change in \( p_2 \) in region 2.

Substituting \( q(.) \) into (3) yields the optimal \( x \) as a function of \( p_1 \) and \( p_2 \)

\[
x(p_1, p_2) = \frac{f(.)}{2n(.)} \quad (7.7)
\]

where \( x(p_1, p_2) \) is referred to as \( x(.) \) from now on.
Independent provision is Pareto optimal for the federation. This can be seen from (4) which yields the MRS condition for \( q \)

\[
\text{\( n(.) \)MRS\( q(.) \) = p } \tag{7.8}
\]

where \( \text{MRS}_q(.) \) is the marginal rate of substitution between \( x(.) \) and \( q(.) \) in region \( i \) as a function of \( p_1 \) and \( p_2 \). Since all residents are identical by assumption, (8) is the Samuelson condition that the sum of marginal rates of substitution equals the MRT. Independent provision leads to Pareto optimal levels of provision for the federation in the sense that all residents' marginal valuations of units of \( q \) are taken into account by the regional government and equated with MRT in deciding on how much \( q \) to provide. This is the usual result in the standard free migration model. As will be shown in Chapter 8, once local public good externalities are introduced, independent provision is no longer optimal.

### 7.6 Optimal Regional Population

To characterise region \( i \)'s optimal population, substitute \( q(.) \) and \( x(.) \) into region \( i \)'s utility function to obtain per capita utility in region \( i \) as a function of \( p_1 \) and \( p_2 \) (given that \( q \) and \( x \) are chosen optimally):

\[
u(p_1, p_2) = \ln\left(\frac{f(.)}{2n(.)}\right) + \ln\left(\frac{f(.)}{2p}\right) \tag{7.9}\]

\( u(p_1, p_2) \) is referred to as \( u(.) \) from now on. \( u(.) \) shows how per capita utility in region \( i \) varies with changes in \( n(.) \), given that region \( i \) chooses \( q(.) \), and \( x(.) \) optimally. Later, \( u(.) \) will be shown to be strictly concave in \( n(.) \).

The optimum optimorum of \( u(.) \) yields the optimal population necessary condition (for region \( i \)) as

\[
MP = \frac{f_1(.)}{2n_1(.)} = x(.) \tag{7.10}
\]
where $MP$ (marginal product) $= \frac{\partial f(.)}{\partial n(.)}$. Thus, $u_1(.)$ reaches a maximum when $n_1(.)$ is such that marginal product, $MP$, equals per capita consumption of the private good in region 1. (12) The intuition behind this result can be seen from Figure 1 where $f(.)$ and $f(.) - pq(.)$ are graphed for region $i$.

Figure 7.1: Optimal Population in Region $i$ (13)

---

12. As Milleron (1977) has shown, if it is assumed that there is strong complementarity between the local public good and private good, an envelope condition holds and an optimum optimorum of $u(.)$ can also be found by taking a fixed value of $q(.)$, say $q_0$, and varying $n$ to maximise $x = [f(.) - pq_0]/n$ from (3). This can be shown to yield (10). Milleron also examines cases where an envelope condition does not hold: in particular, if: (i) there exist several maxima corresponding to the same level of utility; (ii) there is a large degree of substitutability between private and public goods; and (iii) for some reasonable indifference curves, there may exist no tangency point and the optimal population may be zero or infinite. These are possibilities which violate the envelope condition usually assumed in these models.

The following conclusions can be drawn from Figure 1. First, the slope of a ray from the origin to the curve \( f(.) - pq(.) \) measures per capita consumption of \( x(.) \) in region i. For example, the slope of \( OA \) is \( AB/OB \) which equals \( x(.) \) when \( n(.) = B \). As \( n(.) \) increases, one moves progressively along the \( f(.) - pq(.) \) curve, \( x(.) \) increases and reaches a maximum at \( n^*(.) \) where OD is tangential to \( f(.) - pq(.) \). The tangent to \( f(.) - pq(.) \) at \( n^*(.) \) has the same slope as the tangent to \( f(.) \) at \( E \) which is just \( \delta f(.)/\delta n(.) = MP \). Hence, \( n^*(.) \) is the optimal population in region i where \( \delta f(.)/\delta n(.) = x(.) \).

Second, one can see what happens to \( x(.) \) and \( MP \) as \( n(.) \) increases from zero. For example, if the actual population in region i, which as will be seen below is determined from a free migration equilibrium condition, exceeds the optimal population, that is, \( n(.) > n^*(.) \), then \( x(.) \) declines as \( n(.) \) increases, although it is always positive. When \( n(.) < n^*(.) \), \( x(.) \) increases as \( n(.) \) rises. Thus, \( x(.) \) increases while \( n(.) < n^*(.) \), reaches a maximum at \( n^*(.) \) and then declines as \( n(.) > n^*(.) \). However, from the \( f(.) \) curve, \( MP \) declines over the whole range of \( n(.) \), although it is always positive.

Third, Figure 1 indicates what happens to \( MP \) relative to \( x(.) \) as \( n(.) \) increases, and hence what happens to \( u(.) \) as \( n(.) \) increases from zero. In this regard, to the left of \( n^*(.) \), we have \( MP > x(.) \). For example, at \( n(.) = B \) the slope of \( OA \) is less than the slope of the \( f(.) \) curve. Therefore, to the left of \( n^*(.) \), region i’s per-capita utility, defined by equation (9), increases as population increases, because the contribution of an additional person to output, or their \( MP \), exceeds their per capita consumption of the private good, \( x(.) \). However, at \( n^*(.) \) we have \( MP = x(.) \) and \( u(.) \) from equation (9) reaches a maximum. Hence, \( n^*(.) \) is region i’s optimal population. To the right of \( n^*(.) \), we have \( MP < x(.) \) and the cost of an additional person exceeds their benefit. Thus, adding residents past \( n^*(.) \) decreases per-capita utility in region i. Therefore, the graph of \( u(.) \) is strictly concave in \( n \) (single peaked) as claimed earlier.
Moreover, the \( f(.) \) and \( f(.) \) - \( pq(.) \) curves diverge as \( n(.) \) increases. This is because \( q(.) \) is an increasing function of \( n(.) \) as shown in equation (6). Also, for a given \( p \), total expenditure on the local public good, or \( pq(.) \), is an increasing function of \( n(.) \).

Finally, note that \( pq(.)/n \), or tax paid per capita, increases until \( n(.) = n^*(.) \) and reaches a maximum at \( n^*(.) \). It then declines as \( n(.) \) increases beyond \( n^*(.) \). That is, tax paid per capita follows the change in \( x(.) \) as \( n(.) \) increases. This can be seen by noting that substitution of \( q(.) = f(.)/2p \) into \( pq(.)/n(.) \) yields \( f(.)/2n(.) = x(.) \). Thus, tax paid per capita equals per capita consumption of the private good. We know from Figure 1 that \( x(.) \) increases with \( n(.) \) when \( n(.) < n^*(.) \), reaches a maximum when \( n(.) = n^*(.) \) and declines thereafter. Since \( x(.) = pq(.)/n(.) \) it follows that tax paid per capita does the same. (14)

7.7 Henry George Condition

At the optimal population, expenditure on local public goods in each region is equal to regional rent from the vector of fixed factors. This has been termed a 'Henry George' result (see Stiglitz (1977), (1980), Hartwick (1980) and Wildasin (1986) for discussion).

A Henry George condition can be derived for region \( i \) by substituting (3) into (10) and solving for \( pq(.) \) to obtain:

\[
pq(.) = f(.) - l(.) = R(.)
\]

(7.11)

where \( f(.) \) is total output for given \( n(.) \), \( l(.) = \partial f(.)/\partial n(.) n \) is labour income, where \( \partial f(.)/\partial n(.) = MP = w \) and \( l(.) \) is a function of \( p_1 \) and \( p_2 \).

14. This result is a product of the assumption of Cobb Douglas preferences with \( \alpha = \beta = 1 \) implying that total expenditure in region \( i \) is equally divided between \( q(.) \) and \( x(.) \). Thus, expenditure on one good follows expenditure on the other. However, this result should stand under more general preferences, since all one needs is a general linear relationship between tax paid per capita and \( x(.) \) for changes in the two, as a function of \( n \), to have the same sign.
and \( R(.) \) is the rent generated in region from the vector of fixed factors.

Thus, total expenditure on local public goods in region \( i \) when \( n(.) = n^*(.) \) is equal to total output \( f(.) \) less labour income, the difference being rent. The intuition behind this result can be seen from Figure 1. Recall that at \( n^*(.) \), the tangent to \( f(.) \) has the same slope as \( OD \), that is \( \delta f(.)/\delta n(.) = x(.) \). Therefore, \( DE = OG \), where \( DE = pq(.) \) or total expenditure on local public goods in region \( i \), while \( OG = f(.) - \delta f(.)/\delta n(.) = R(.) \). Hence, \( R(.) = pq(.) \) in region \( i \) at \( n^*(.) \). Observe that when region \( i \) has more than its optimal population, as it has at any free migration equilibrium because of the over-population assumption, \( R(.) > pq(.) \). Region \( i \) spends less on the local public good than the rent generated from the fixed factor. This implies that some rent revenue must be going into the private good. Conversely, if \( n(.) < n^*(.) \), \( R(.) < pq(.) \) and something less than the rent generated in region \( i \) is spent on \( q(.) \).

### 7.8 Public Collection and Disbursement of Rents and Source-Based Taxation

There is one final point to be gleaned from Figure 1 related to the collection and disbursement of rents from the vector of fixed factors. In this regard, note that total regional endowment at \( n^*(.) \) is \( f(n^*) \). From the vertical axis, \( f(n^*) \) is made up of \( R(.) \), the distance \( OG \), and labour income \( l(.) \), the distance \( GH \). Therefore, and more generally, regional endowment at any level of population consists of rents accruing from the vector of fixed factors, together with the income generated by labour, and we can write total regional endowment as

\[
f(.) = l(.) + R(.) \tag{7.12}
\]
The problem of region $i$ is now

$$\text{Max } u = xq$$

\[(q)\]

subject to:

$$n(.)x + pq = l(.) + R(.)$$ \hspace{1cm} (7.13)

Therefore, region $i$'s problem is one of transforming units of regional endowment into units of $x$ and $q$, where endowment is now explicitly made up of regional rents and labour income. $q(.)$ and $x(.)$ can, therefore, be thought of as $q(.) = (l(.) + R(.))/2p$ and $x(.) = (l(.) + R(.))/2n$.

An important feature of the model is probably now clear: rents are assumed to be appropriated by the regional government, added to labour income, and transformed into units of $x(.)$ and $q(.)$. In other words, rents are collected publicly by region $i$ and disbursed to own-residents in the form of additional consumption. Moreover, it is usually assumed in these models that region $i$ uses source-based taxes to collect the rents.\(^{15}\) Since the vector of fixed factors is assumed to be owned by foreigners, these source-based taxes are borne only by foreigners.\(^{16}\)

7.9 **Free Migration Equilibrium**

To close the model, $n_1(.)$ and $n_2(.)$ must be determined. In free migration models this is done from an equilibrium condition requiring per capita utilities to be equalised between regions.

---

15. A source-based tax is a tax levied on income for which liability is determined regardless of the region of residence of the owner of that resource. Thus, liability for such taxes is independent of location and cannot be avoided by migration.

16. In Australia, one could consider royalties levied on resource industries by the states as source-based taxes.
In this regard, substituting \(q(.)\) and \(x(.)\) for each region into the free migration equilibrium condition \(u_1(\cdot) - u_2(\cdot) = 0\) yields

\[
\frac{f_1(n_1)}{2n_1} + \ln\left(\frac{f_1(n_1)}{2p_1}\right) - \ln\left(\frac{f_2(n_2)}{2n_2}\right) - \ln\left(\frac{f_2(n_2)}{2p_2}\right) = 0 \quad (7.14)
\]

(14) can be solved for \(n_1\), for various values of \(p_1\) and \(p_2\), and since \(n_2 = N^* - n_1\), for \(n_2\). \(n_1\) and \(n_2\) can be substituted into (5), (7) and (9) to solve for \(q(.)\), \(x(.)\) and \(u(.)\) for each region. Therefore, (14) implies that \(n_1\) and \(n_2\) can be written as functions of the parameters \(p_1\) and \(p_2\). Changes in the parameters result in changes in regional population from (14), which in turn lead to changes in \(q(.)\), \(x(.)\) and \(u(.)\). Numerical solution of (14) indicates that \(n_1\) is an increasing function of \(p_2\) and a decreasing function of \(p_1\) so that \(\frac{\partial n_1}{\partial p_1} < 0\) and \(\frac{\partial n_1}{\partial p_2} > 0\). Similarly, for region 2, \(n_2\) can be shown to be an increasing function of \(p_1\) and a decreasing function of \(p_2\) and we have \(\frac{\partial n_2}{\partial p_2} < 0\) and \(\frac{\partial n_2}{\partial p_1} > 0\) as shown in (14).

A free migration equilibrium is characterised in Figure 2 using the graphs of the per-capita utility curves from equation (9), which as shown before, are single peaked. An equilibrium is at point A, where \(u_1(.) - u_2(.) = 0\). Thus, (14) is the algebraic characterisation of point A in Figure 2. \(n_1(.)\) and \(n_2(.)\) are the regional populations at this free migration equilibrium. The optimal regional populations are \(n_1^*(.)\) and \(n_2^*(.)\) at points B and C. These are the populations which correspond to point D and E in Figure 1 where (10) holds.
To the left of B on $u_1(.)$, $MP_1 > x_1(.)$ and therefore $u_1(.)$ rises as $n_1(.)$ increases. At point B, $MP_1 = x_1(.)$ with $u_1(.)$ at a maximum. To the right of B, $MP_1 < x_1(.)$ and $u_1(.)$ falls as $n_1(.)$ rises. The same applies in region 2 where at point C, $MP_2 = x_2(.)$. To the right of C, $MP_2 > x_2(.)$ and $u_2(.)$ rises as $n_2(.)$ increases. To the left of C, $MP_2 < x_2(.)$ and hence $u_2(.)$ falls as $n_2(.)$ increases.

In keeping with Boadway and Flatters (1982b) it is assumed that $N^* > n_1(.) + n_2(.)$: that is, the federation is over-populated in the sense that each region in a free migration equilibrium always has a population which exceeds their optimal level. This means that at any free

17. Although one can imagine cases where $N^* = n_1 + n_2$ or $N^* < n_1 + n_2$ (under-population), these cases are ruled out in the interests of stability of the free migration equilibrium. See Boadway and Flatters (1982b) p.619 for discussion.
migration equilibrium, region i will be on that portion of its per capita utility curve where \( MP < x(.) \) and hence will have a population such that \( n(.) > n^*(.) \) in Figure 1. Hence, any additions to region i's population generate lower per capita utility.

7.10 Location Efficiency

Consider the migration equilibrium A in Figure 2. One can obtain an expression for the net benefit to the existing residents of region 1 from having one more resident added to its population. From the optimal population condition (10), it is clear that the net benefit to region 1, in terms of per capita utility, from having an additional resident, defined to be \( NMB_1 \), is

\[
NMB_1 = MP_1 - x_1(.) \quad (7.15)
\]

Substituting \( x_1 = [f_1(.) - p_1q_1]/n_1(.) \) into \( NMB_1 \) and rearranging yields

\[
NMB_1 = \frac{p_1q_1(.)}{n_1(.)} - \frac{R_1(.)}{n_1(.)} \quad (7.16)
\]

An analogous expression holds for region 2. \( NMB_1 \) can be thought of as the total amount of \( x \) residents in region 1 would be willing to forego to have an additional migrant, on the assumption that the migrant receives a per-capita share of rent in region 1. \( NMB_1 \) has two components, each of which is discussed below.

7.10.1 Fiscal Externalities

The first component of \( NMB_1 \) is the contribution of the additional resident to the financing of \( q_1 \), which is simply the per-capita tax payment of the extra resident. Recall from the earlier discussion, that this tax payment is assumed to be made via a head or wage tax, known as a residence-based tax. Hence, \( p_1q_1(.)/n_1(.) \) can be thought of as the residence-based tax payment of the extra migrant.
This tax payment is of benefit to all residents of region 1, because of the assumed publicness of q₁, and can therefore be thought of as a fiscal economy, or positive fiscal externality, since, as shown in the fiscal externality literature, this benefit created by migration is not taken into account by migrants. The following comment by Buchanan and Goetz (1972) is typical of this view:

'A person’s tax dollars, wherever they are collected and used, generate public-goods inputs for others in the appropriate sharing group as well as for himself and allow the per-unit cost of public goods to fall for each individual as group size expands. Hence, any move imposes an external diseconomy on all those who remain in the original sharing group and an external economy on all those in the jurisdiction that the migrant enters.'(18)

The authors go on to show that a migrant will not take these economies and diseconomies into account in their own decision process and that, therefore, they are fiscal externalities.(19) Thus, an additional resident consumes the local public good q₁ at zero cost, since there are no congestion costs in this model because q₁ is pure, and at the same time contributes a share to the financing of q₁ thus reducing the tax bill of existing residents. There is a benefit to existing residents of region 1 from an expansion of the tax base in region 1, so that the cost of providing q₁ is spread across more tax-payers, and a cost to the residents of region 2, a fiscal diseconomy or negative fiscal externality, since the tax base in region 2 contracts and the tax bill of residents in that region rises.

The fiscal externality here is analogous to the tax price benefit modelled in Chapter 5. In that earlier Chapter, the tax base of a region was expanded by adding regions together. Here, the tax base of a region is expanded, or contracted, through voluntary migration of tax payers. Either way, the result is that a region’s tax base is expanded, and, depending on the publicness of the public good, this confers a benefit on the existing residents of a region. The fiscal externality idea also

appears in Wildasin (1991b) who models regions in a free migration context which have income redistribution as a policy instrument. He shows that redistribution by one region creates fiscal externalities (a redistribution externality) of two kinds: (i) an external benefit for all other regions as their tax base expands and their redistributive burden falls; and (ii) when the residents of all regions share an interest in the welfare of mobile households, the effects of redistribution on the welfare of migrating households also generates externalities.

7.10.2 Regional Rents

The second term in $\text{NMB}_1$ is the additional person’s per-capita share of the rents generated in region 1 which are distributed evenly across all residents. As $n_1$ increases, $R_1(.)/n_1(.)$ decreases and an extra person reduces the rents of existing residents by $R_1/n_1$. Recalling from the earlier discussion that $R_1$ is assumed to be collected by the government of region 1 using a source-based tax on foreigners who are assumed to own the vector of fixed factors, $R_1/n_1$ can be thought of as the migrant’s share in source-based revenues derived from owners of L.

7.10.3 Will $\text{NMB}_1$ be Zero in Equilibrium?

For $\text{NMB}_1$ to equal zero requires that the fiscal externality created by the last migrant, their net marginal benefit, equal their share of region 1’s rent, or marginal cost. This is the same as saying that their residence-based tax payment equal their share of source-based tax revenue.

In general, this will not be the case at point A in Figure 2. To see why, consider the following. Since $\text{NMB}_1$ is simply an alternative, and slightly rearranged, expression of the optimal population condition given by (10), one would expect it to have the same sign as $\frac{\partial f_1(.)}{\partial n_1(.)} - x_1(\cdot)$. That this is so can be shown as follows. Observe that when region 1 has its optimal population, as at point D in Figure 1, we know from the Henry George condition that $p_1q_1(\cdot) = R_1(\cdot)$. Substituting this into (15) yields $\text{NMB}_1 = R_1/n_1 - R_1/n_1 = 0$. Thus, when $n(\cdot) = n^*(\cdot)$, $\text{NMB}_1$...
- 0 as is also the case from the optimal population condition 
\( \frac{\partial f_1(.)}{\partial n_1(.)} = x_1(.) \) when \( n_1(.) = n^*_1(.) \) as shown in Figure 1. However, when \( n_1(.) > n^*_1(.) \) it has been shown that \( R_1(.) > p_1q_1(.) \). This implies that \( \text{NMB}_1 < 0 \): region 1 derives negative benefit from an additional resident. If \( n_1(.) < n^*_1(.) \), \( R_1(.) < p_1q_1(.) \) and \( \text{NMB}_1 > 0 \). Since we are dealing with equilibria where \( n_1(.) > n^*_1(.) \) because of the stability requirement, \( \text{NMB}_1 \) is always negative. Thus, the sign of \( \text{NMB}_1 \) follows the sign of \( \frac{\partial f_1(.)}{\partial n_1(.)} - x_1(.) \) from (10), a reasonable proposition since one is derived from the other. Thus, \( \text{NMB}_1 < 0 \) at the equilibrium represented by A in Figure 2.

Moreover, the fact that (15) is an alternative formulation of the optimal population condition (10) suggests an alternative explanation for the optimal population condition. Region 1 should add a marginal resident when the fiscal economy they generate exceeds their per capita share of rents. This is equivalent to saying that a resident should be added when their marginal product is greater than their per capita consumption of the private good (see (10)). When the fiscal economy generated by the last migrant equals their per capita consumption of the private good, \( \text{NMB}_1 = 0 \) and any further additions to the population will result in \( \text{NMB}_1 < 0 \). This is analogous to saying that region 1 has its optimal population when \( \frac{\partial f_1(.)}{\partial n_1(.)} = x_1(.) \) from (10). Finally, if the fiscal economy created by a marginal migrant is less than their share of rents, \( \text{NMB}_1 < 0 \). This is equivalent to \( \frac{\partial f_1(.)}{\partial n_1(.)} < x_1(.) \) from (10).

Recall also from the discussion of Figure 1, that the fiscal economy, or fiscal externality, is either increasing in \( n_1(.) \) as long as \( n_1(.) < n^*_1(.) \), at a maximum when \( n_1(.) = n^*_1(.) \) and declines as \( n_1(.) \) increases past the optimal population. Since we are dealing with an over-populated federation by assumption, we know therefore that the fiscal externality entering the \( \text{NMB}_1 \) term is declining as people enter region 1. That is, the fiscal externality generated by migrants decreases as region 1’s population increases.
7.10.4 Optimal Population Distribution

One can utilise equation (15), and an equivalent equation for region 2, to examine whether the free migration equilibrium characterised by A in Figure 2 yields a population distribution which is socially optimal. In this regard, observe that the net benefit to the federation, defined to be NB, from moving a resident from region 2 to 1 is

\[ NB - NMB_1 - NMB_2, \]

or

\[ NB - \left( \frac{P_1q_1(.)}{n_1(.)} - \frac{P_2q_2(.)}{n_2(.)} \right) - \left( \frac{R_1(.)}{n_1(.)} - \frac{R_2(.)}{n_2(.)} \right) \]  

(7.17)

Consider the two terms in the first set of brackets. As a migrant shifts from region 2 to region 1, a positive fiscal externality is created in region 1, which is the extra residence-based tax payment, measured by \( \frac{P_1q_1(.)}{n_1(.)} \), while a negative fiscal externality is created in region 2, which is the residence-based tax revenue lost to region 2 and measured by \( \frac{P_2q_2(.)}{n_2(.)} \). Thus, the first set of brackets is the difference in positive and negative fiscal externalities generated by the movement of a person from region 2 to 1.

Now consider the second set of brackets. \( \frac{R_1}{n_1} \) is the share of the migrant in region 1's rent, or source-based revenue, while \( \frac{R_2}{n_2} \) is the share in region 2's rent given up by the migrant. Thus, \( \frac{R_1}{n_1} \) is a cost to region 1 and a benefit to region 2.

If \( NB = 0 \), location efficiency is achieved.\(^{20}\) There is no net social benefit from reallocating residents from region 2 to region 1 because \( NMB_1 - NMB_2 \) at the free migration equilibrium. However, there is no reason why NB should equal zero, except by chance. One can see this

---

\(^{20}\) This result is analogous to equation (10) in Boadway and Flatters (1982b) except that in the present model \( p_1 \) and \( p_2 \) are explicit parameters which can vary (whereas Boadway and Flatters set MRTs equal to one), and \( q_1(.) \) and \( q_2(.) \) are explicit functions of \( p_1 \) and \( p_2 \). Also, public good impurity is modelled in Boadway and Flatters but not here, although impurity in a global public good sense is introduced in Chapter 8.
from the free migration equilibrium condition. Recalling that \( f(.) = 1(.) + R(.) \), the equilibrium condition can be written as

\[
\ln\left(\frac{R_1 - P_1 q_1}{n_1}\right) + \ln q_1 - \ln\left(\frac{R_2 - P_2 q_2}{n_2}\right) + \ln q_2 \quad (7.18)
\]

where \( w_1 = \frac{L_1(.)}{n_1} = MP_1 \) and \( w_2 = \frac{L_2(.)}{n_2} = MP_2 \). In equilibrium (18) is satisfied, but there is no reason why per-capita rents (per-capita source-based revenues), marginal products or per-capita residence-based taxes would be equalised, except fortuitously. Thus, the equilibrium at A in Figure 2 is likely to yield a population distribution such that \( NB \neq 0 \).

7.11 Fiscal Equalisation Transfers

Since in general \( NB \neq 0 \), there is a net social benefit from reallocating people between regions at any equilibrium established by free migration. The Tiebout conjecture that free migration produces efficient outcomes breaks down when fiscal externalities and publicly collected rents which are disbursed to residents are present. This has led to the argument that 'equalisation' grants, or transfers of income between regions, may be needed to correct for the inefficiency of free migration equilibria.

The fiscal equalisation transfer, which may be implemented by a central authority, or undertaken by regions themselves, aims to re-allocate residents until an optimal population distribution is established where \( NMB_1 = NMB_2 \).

21. Flatters, Henderson and Mieszkowski (1974) have shown that if the compensated elasticity of demand for local public goods is exactly unity in each region, then tax paid per-capita would be equal and hence the terms in the first set of brackets in (17) disappear. However, this is unlikely to occur, and even if it did, one is still left with the per-capita rent differential as a source of migration inefficiency.

22. Wildasin (1986) p14-17 and Boadway and Flatters (1982b) p 621 discuss special cases where population may be optimally distributed at a free migration equilibrium.
The optimal fiscal equalisation transfer can be derived by recalling that \( NMB_1 \) can be expressed as \( NMB_1 = \frac{\partial f_1(.)}{\partial n_1(.)} - x_1(.) \) and \( NMB_2 \) as \( \frac{\partial f_2(.)}{\partial n_2(.)} - x_2(.) \). Letting \( t \) be a transfer of endowment made by the central authority from region 1 to region 2 we can therefore solve for the optimal value of \( t \), say \( t^* \), which ensures that:

\[
\frac{f_1(.) - p_1 q_1 - t}{n_1} - \frac{\partial f_1}{\partial n_1} = \frac{f_2(.) - p_2 q_2 + t}{n_2} - \frac{\partial f_2}{\partial n_2} = 0
\]  

(7.19)

Solving (19) for \( t^* \) yields

\[
t^* = \left( \frac{n_1 n_2}{N^*} \right) \left( \frac{p_2 q_2}{n_2(.)} - \frac{p_1 q_1}{n_1(.)} \right) + \left( \frac{R_1(.)}{n_1(.)} - \frac{R_2(.)}{n_2(.)} \right)
\]

(7.20)

\( t^* \) equalises \( NMB_1 \) and \( NMB_2 \), ensuring that \( N^* = 0 \) in a free migration equilibrium where \( t^* = g(p_1, p_2) \). It is in this sense that it can be thought of as an equalising transfer. Alternatively, one can think of \( t^* \) as being the transfer which ensures that, at a free migration equilibrium, the sum of differences in per-capita residence-based and per-capita source-based tax revenues over the two regions equal zero.

In summary, contrary to Tiebout's initial conjecture that free migration would lead to efficient outcomes, there may be an inherent inefficiency associated with the migration process which results in inefficiency of free migration equilibria. This inefficiency can be

23. Alternatively, one can solve the central authority problem explicitly to obtain \( t^* \) [see Hartwick (1980), p.697 or Boadway and Flatters (1982b), p.622].

24. An interesting point to note here is that \( N^* \) is taken to be a fixed parameter. However, \( N^* \) could be modelled as a central government choice variable, since, through its immigration policy, a national government can influence the total population to be distributed between regions. The optimal equalising transfer would then be a function of the central government’s immigration policy: that is, immigration and fiscal equalisation policies would be interdependent. This notion of policy interdependence is analogous to the policy interdependence between matching and equalising grants modelled in the next Chapter, Chapter 8.
corrected with appropriate fiscal equalisation transfers between regions designed to redistribute residents and increase per capita utility in the federation.

7.12 Post-Transfer Equilibria

With the optimal equalising transfer implemented, region 1 solves

Max $u_1 = x_1 q_1$

$(q_1)$

$STo: n(.) x_1 + p_1 q_1 = f_1(.) - t^*$

(7.21)

where all variables and parameters are as previously defined. The optimal levels of public good provision and private good demand, post-transfer, are

$q_1(.) = \frac{f_1(.) - t^*}{2p_1}$

(7.22)

$x_1(.) = \frac{f_1(.) - t^*}{2n_1}$

(7.23)

and similarly for region 2. The post-transfer free migration equilibrium condition is

\[
\frac{f_1(n_1) - t^*}{2n_1} + \ln\left(\frac{f_1(n_1) - t^*}{2p_1}\right) - \ln\left(\frac{f_2(n_2) + t^*}{2n_2}\right) - \ln\left(\frac{f_2(n_2) + t^*}{2p_2}\right) = 0
\]

(7.24)

As before, one can solve for the post-transfer free migration equilibrium for given values of the parameters $p_1$ and $p_2$, and now also
the policy instrument $t^*$. Thus, the equilibrium, and hence values of all endogenous variables, are also determined by $t^*$.

The effect of the optimal transfer on the initial free migration equilibrium is characterised in Figure 3. The pre-transfer equilibrium is at A, the initial equilibrium from Figure 2, and the post-transfer equilibrium is at point P. At P, the distribution of population in the federation is socially optimal: hence, P is a social optimum and $NMB_1 = NMB_2 = 0$.

Figure 7.3: Socially Optimal Free Migration Equilibrium
7.13 Further Considerations

A number of further considerations should be noted. First, it was noted above that the equalising transfer may be undertaken by regions voluntarily or by a central authority. In this regard, Myers (1990) has shown that the existence of inefficiency in a free migration equilibrium does not necessarily justify fiscal equalisation transfers being made by a central authority. In a model of a two-region federation with free migration, Myers (1990) allows local governments to have two choice variables: (i) the level of provision of a local public good; and (ii) an interregional transfer. Myers then argues that, because of the free migration equilibrium condition, the public good and transfer choices of each region are interdependent, so that behaviour is strategic. On the assumption of Nash conjectures, he shows that regions choose Nash equilibrium levels of contribution to the public good and levels of interregional transfer which lead to Pareto optimality. The transfers chosen by the regions are shown to be those characterised by equation (20) above. Thus, what Myers (1990) effectively does, is to give regions an additional policy instrument, the equalising transfer itself, and argues that states would choose the optimal transfer, without any need for a central authority.

As he indicates, however, Stiglitz (1977) found a similar two-region result and argued it was not likely to hold for more than two regions. This is because it may be in a region's interest not to pay a transfer if other regions do not change their behaviour in response to non-payment. However, Myers shows that, given the strong incentive equivalence between regional authorities introduced by the free migration equilibrium condition, a region will only not pay a transfer if doing so makes every region better off, whether there are two regions or a large number of regions (see Myers (1990), p.115 and Appendix).

Second, the property market has been suppressed in this analysis and one should note that even if rents do accrue publicly and are disbursed to residents in the fashion envisaged above, they may be capitalised into local land prices. To the extent that capitalisation
occurs, the significance of rents as a source of distortion are lessened. There is no evidence on whether, and to what extent, capitalisation takes place in Australia.

Third, if the vector of fixed factors is assumed to be owned by residents of the federation, and hence rents accrue to individuals on the basis of ownership rather than residency as assumed in this model, rents as a source of inefficiency disappear from equation (20), although the fiscal externality inefficiency remains and would need to be corrected. In this case, $t^*$ would not need to equalise source-based revenues. Further, if regions did not utilise residence-based taxes, and only relied on source-based taxes on residents, then free migration equilibria would be efficient, since there would also be no fiscal externalities created by migration. Therefore, as emphasised by Wildasin (1986) p. 5-22, migration equilibria may or may not be efficient depending on the mix of taxes available to regional governments. In this chapter it has been assumed that they utilise residence-based taxes on individuals in the federation, and source-based taxes on foreigners in order to highlight the case where such equilibria are inefficient.

Fourth, one also needs to adopt a cautious approach to the policy implications of equation (20). Perhaps most importantly, $t^*$ is derived on the assumption that regional governments act benevolently. Hence, $t^*$ is a normative policy prescription showing the optimal transfer in a perfect world distorted only by two externalities, one a fiscal externality and the other a rent externality. If a positive model of government behaviour was adopted, it is unlikely that equation (20) would survive in its present form. Aspects of regional behaviour which a positive model might capture include: (i) how regions lobby the central government for equalising grants and expend real resources in the process; and (ii) how they react to lump-sum equalising transfers. These positive considerations may generate efficiency costs associated with the equalising transfer itself, thereby reducing the benefit such transfers may confer in reducing the distortion associated with the two externalities. As discussed in Chapter 2, Walsh (1990) has emphasised that these factors may add significantly to the welfare costs of
equalisation, and indeed, they could emerge as costs of an efficiency based scheme such as discussed here.

Positive considerations may also yield a benefit of free migration not captured in the present model. One of the reasons why economists have been interested in free migration, or voting with the feet, is because it has the potential to impose competitive pressure on governments, driving public decisions closer to optimality. This is perceived to be a major benefit of free migration. Such a benefit is not captured in the model above because we commence with the assumption that governments are benevolent and that the first order conditions for optimal provision are met automatically. The equalising formula given by (20) is, therefore, based on marginal conditions which depend upon governments already acting optimally. The model misses the fact that, while free migration may generate externality-related inefficiencies, it may also drive selfishly motivated governments, such as those modelled in Chapter 6, closer to a socially optimal expenditure and tax mix, yielding social gains. Indeed, one could imagine these gains to be so large as to outweigh any costs associated with externalities.

However, even if these positive considerations were taken into account, the essential idea that a migration equilibrium may not be efficient because of externalities remains, although the equalising formula given by equation (20) would inevitably become more complex. The specific form of equation (20) in a positive world will ultimately depend upon the behavioural theory of government adopted. Moreover, it appears that the fiscal externality literature has adopted the benevolent government assumption, not as a way of denying the competitive benefit of migration in restraining government power, but rather in the interests of analytical tractability and as a way of showing that even with optimal tax and expenditure mixes being adopted by governments, free migration can generate inefficiencies which call for policy intervention.

This underlying aim of the literature is noted by Buchanan and Goetz (1972) in their introductory comments
'We shall demonstrate that there remain inherent inefficiencies in the Tiebout adjustment process, even when this is interpreted in a conceptually idealised form.'(23)

Fifth, it is assumed here that the equalising transfer is made using lump-sum transfers. In practice, distortionary taxes would be used and their welfare cost should also be counted as a cost of the equalising transfer.

Finally, the analysis here has ignored the effects of other central government activity on regional migration decisions, such as matching grants being made to regional governments (and immigration decisions as noted earlier). A more general treatment would include a central government which provides public goods, imposes central taxes and provides other forms of policy intervention, all of which would influence $t^*$.  

7.14 Implications for Efficiency and Equalisation in Australia

Notwithstanding these qualifications, there are some clear implications from this analysis for the emerging debate in Australia on efficiency and equalisation. To the extent that; (i) state expenditure is on activities which have public good characteristics, creating fiscal externalities as people migrate, and residents pay to their state governments residence-based taxes; (ii) rents generated in the states from fixed factors, including natural resources, accrue publicly through source-based taxation incident on foreigners and are disbursed to residents on the basis of location; and (iii) there are differences in resource endowments between regions contributing to differential source-based revenues, then free migration may generate inefficiencies which can be corrected by equalising transfers. These transfers redistribute income between regions in order to establish an optimal population distribution. Specifically, the equalising transfer ensures that the sum of the

differences across regions in per-capita residence-based and source-based tax revenue is equal to zero.

The transfer would tend to favour those states with relatively low per-capita source-based revenues, perhaps due to limited natural resources, and where the positive fiscal externalities generated by extra migrants are relatively high. Whether these conditions hold for Australia remains to be established empirically. To the extent that they are shown to be important, then fiscal equalisation on efficiency grounds may be justified, although if the Myers (1990) argument is taken into account, perhaps even then the argument would not be a strong one. Equation (20) provides a guide to the form that such equalisation could take, based on the assumptions adopted in the model.

However, if one believes that state expenditure is predominantly on publicly provided private goods (although one can argue that a considerable proportion of state expenditure is on goods with a substantial public good component), then the fiscal externality argument for equalisation, while of theoretical interest, may be of less significant empirical, and hence practical, importance. Any efficiency case for equalisation must then rest more on the extent to which Australian states have differential access to source-based revenues, and the extent to which these revenues are passed on to residents and disbursed on the basis of residency.

One factor which will be important in determining a state's access to source-based revenues borne by foreigners, is resource endowments. It is commonly held for example, that as in Canada with its resource-rich Western provinces, states such as Western Australia and Queensland are relatively resource rich while the remaining states are less so and more industrialised. What needs to be established is to what extent these resource rich states generate revenue from natural resources and disburse it on the basis of residency. The interesting point to note here is that the equalising formula would call for such states to transfer revenue to the less resource rich states to discourage 'too much' migration in their favour. This is, of course, the exact opposite of what the current
system of equalisation does: at present, the resource rich states receive transfers in their favour.

In the event that fiscal externalities and differential access to source-based revenues are found to be of little empirical significance in Australia, then one may conclude that there is no case for equalisation on efficiency grounds. The present distribution of national population established by individuals making their own free migration decisions, could be regarded as approximately optimal and $t^* = 0$ from equation (20). One is then drawn to the conclusion that any equalisation which does take place in Australia will lead to inefficient migration, the establishment of a sub-optimal population distribution and welfare losses. Add to this the other potential costs associated with transfers discussed above, and the welfare costs of equalisation, where none is called for, may be that much greater.

However, even if the efficiency case for equalisation was shown not to apply in Australia, this is not to say that equalisation should not be undertaken. Recall from Chapter 5 it was argued that, to some extent at least, fiscal equalisation in Australia compensates the smaller states for the net costs of federation, and is therefore important for federal unity. Equalising payments, which actually benefit the relatively resource rich states at present, may be thought of as the transfer payments necessary for the union to secure the social surplus from federation. Therefore, any costs which might arise, must be offset against the federal unity benefits such payments provide. In this case, therefore, an important trade-off which must be made if fiscal externalities and rents are not shown to be important in Australia, is between the efficiency costs of equalisation and its compensatory benefit.

If Australia's equalising arrangements are defended on this basis, one could still argue that it is possible to modify the arrangements so as to reduce the efficiency costs to a minimum in order to maximise the excess of compensatory benefit over cost. To what extent the present
arrangements would have to be changed to achieve this is an interesting question.

7.15 Conclusion

A modest contribution has been made in this chapter to clarifying the theoretical issues at stake in any discussion of fiscal equalisation and economic efficiency in an Australian context. This has been done by developing a model of a federal economy with free internal migration, locationally fixed resources and regional governments which collect and disburse resource rents through source-based taxes borne by foreigners, and impose residence-based taxes on freely mobile labour. The model used was an extension of the fixed regional population model of Chapters 3 and 4 (without the externalities). This model was then used to show under what circumstances fiscal equalisation can be justified on efficiency grounds. The implications of these theoretical results for Australian federalism were briefly discussed, and the empirical issues which must be resolved, emphasised.

In particular, it was noted that whether there are substantial fiscal externalities created by interregional migration in Australia, and whether migrants respond to differential per-capita rents collected by the states, should be addressed in order to determine whether free migration in Australia is likely to involve any efficiency costs. If it is decided that it may, then fiscal equalisation can be justified on efficiency grounds according to equation (20).

26. A numerical version of the model in this Chapter has been developed. For given values of parameters, one can derive numerical values for per-capita welfare, population distribution, levels of output of public and private goods at a particular free migration equilibrium. Moreover, one can show changes in these equilibrium values for different parameter values and for changes in equalisation transfers. For example, it is possible to show numerically the change in population distribution resulting from the introduction of equalisation, when none is called for on efficiency grounds, and the resulting fall in per-capita welfare. This numerical version of the model was used to confirm the theoretical results in this Chapter.
Alternatively, if fiscal and rent externalities are not thought to be significant sources of distortion, then fiscal equalisation cannot be justified on efficiency grounds. Indeed any equalisation which does occur will lead to welfare losses by creating a sub-optimal population distribution. Nevertheless, it has been shown that even if fiscal externalities and rents are not significant influences on migration within Australia, this does not imply that equalisation should not occur for other reasons, but rather, that the efficiency and welfare costs of equalisation must be offset against other benefits, such as equalisation's compensatory role (as discussed in Chapter 5).
CHAPTER 8

FREE MIGRATION AND PUBLIC GOOD EXTERNALITIES: A SYNTHESIS

8.1 Introduction

As discussed in Chapters 2 and 7, the literatures on fiscal externalities and regional rents show that free migration equilibria may be inefficient and that corrective equalising transfers may be required on efficiency grounds. The models, of necessity, make many simplifying assumptions, as recognised by Boadway and Flatters (1982b):

'Ideally we would like our model to incorporate several features of the real world, including interregional trade and factor mobility, differences in local resource endowments, differences in industrial structure, heterogeneity of tastes, income and labour force quality, complicated federal and provincial tax/tariff subsidy structures, unemployment, and the provision of public services at several levels with possibly some spillover of benefits. However, to begin with it is useful to abstract from many of these features of regional economies in order to concentrate upon the interaction between labour mobility, decentralised public sector decision-making and differences in regional productivity or resource endowments. The tendencies to inefficiency in these simple models will continue to hold in more complex economies.\(^{(1)}\)

One abstraction made by Boadway and Flatters (1982b) and the model in Chapter 7, is that there are no public good externalities. This Chapter relaxes this assumption by extending the model of Chapter 7 to introduce public good externalities. This can also be thought of as an extension of the model in Chapters 3 and 4 to allow for population mobility. Hence, the analysis combines the fiscal externality, pure public good and general externality literatures in one model of a federal economy to capture the interaction between two key features of federal economies identified in Chapter 2: labour mobility across boundaries and

1. Boadway and Flatters (1982b), p. 615. To this list might also be added a richer model of government behaviour as discussed in Chapter 7.
public good externalities, both of which derive from the openness of regional economies.

This leads to a number of new insights. First, it is shown that local public good externalities influence free migration equilibria by affecting the fiscal externality created by migration. The distribution of a federation's population between its constituent regions in equilibrium, therefore, is shown to be a function of public good externalities, fiscal externalities and rents.

Second, provision of local public goods at a free migration equilibrium is shown to be no longer optimal, as it was in the standard model. There is underprovision caused by the presence of the positive public good externality. Thus, free migration equilibria are shown to involve two types of inefficiency: (i) a migration inefficiency caused by the public good externality, fiscal externalities and rents; and (ii) underprovision caused by the public good externality.

Third, it is argued that fiscal equalisation transfers that correct for the inefficiency of a free migration equilibrium, must equalise for differences in per-capita fiscal externalities and rents, as in the model of Chapter 7, but also now for differences in local public good externalities. Fourth, it is shown that the equalising grant (in the presence of explicit public good externalities) corrects for the free migration inefficiency but not for underprovision. Matching grants are required to correct for the latter. Thus, two policy instruments are required to achieve a social optimum. Moreover, the two instruments are shown to be interdependent.

Finally, the implications of considering both local public good externalities and mobility for the neutrality result and the fly-paper effect (discussed in Chapter 4) are examined. For example, it is shown that mobility introduces another cause of the break-down of neutrality: that is, different marginal products of labour between regions. It is also shown that mobility introduces an additional fly-paper effect, which
reinforces the one identified in Chapter 4. There are, therefore, two interrelated explanations offered for this effect.

Overall the Chapter can be thought of as something of a synthesis of the results of Chapters 3, 4 and 7. The discussion proceeds on the assumption that the reader has a detailed familiarity with Chapters 3, 4 and 7, and, for convenience of exposition, the model of Chapter 7 is referred to from now on as the standard model.

8.2 Model

Consider, again, the model of Chapter 7 and assume that region 1's provision of $q_1$ also benefits residents in region 2 and, conversely, that region 2's provision of $q_2$ benefits residents of region 1 such that total consumption of local public goods in each region is

$$ Q_1 = q_1 + aq_2 $$

and

$$ Q_2 = q_2 + bq_1 $$

(8.1)

where $Q_1$ is the total consumption of local public good in region 1, now made up of region 1's own-contribution, $q_1$, together with a portion of region 2's provision, $aq_2$, where $0 \leq a \leq 1$ is a parameter determining the proportion of each unit of $Q_2$ being consumed by residents in region 1. Similarly, $Q_2$ is the total consumption of local public good in region 2 where $0 \leq b \leq 1$ is a parameter determining the extent to which residents of region 2 consume each unit of $q_1$ provided in region 1. Total consumption of local public goods in the federation is $Q = Q_1 + Q_2$. Thus, the $a$ and $b$ parameters can be thought of as indicating each region's productivity in generating externalities, or alternatively, as a measure of the 'localness' of $q_1$ and $q_2$. If $a = b = 1$, the two local public goods can be seen as pure global public goods.

2. This is the model of externalities adopted in Chapters 3 and 4. Refer to that Chapter for further discussion.
The problem of region 1 becomes

\[ \text{Max } u_1 = x_1(q_1 + aq_2) \]  
(8.2)

\[ (q_1) \]

\[ \text{STo: } n_1(.)x_1 + p_1q_1 = f_1(.) \]  
(8.3)

where \( x_1 = [f_1(.) - p_1q_1(.)]/n_1(.) \).

Solving for region 1's optimal level of \( q_1 \) yields

\[ q_1(.) = \frac{f_1(.) - a}{2p_1} - \frac{a}{2} q_2^*(.) \]  
(8.4)

\( q_1(.) \), or \( q_1(p_1,p_2,a,b) \), is region 1's independent provision of \( q_1 \) in the presence of local public good externalities. It is made up of the level of provision defined by equation (7.5) in Chapter 7, that is, \( f_1(.)/2p_1 \), less \( a/2 \) of region 2's provision of \( q_2 \). Note that \( q_1(.) \) is now also a function of the parameters \( a \) and \( b \). Similarly, region 2's optimal demand for its local public good is

\[ q_2(.) = \frac{f_2(.) - b}{2p_2} - \frac{b}{2} q_1^*(.) \]  
(8.5)

There are now two forms of interdependence between the decisions of regional governments 1 and 2. The first relates to the fact that provision in each region is linked via the free migration equilibrium condition. This is the interdependence appearing in the standard free migration models. The second type of interdependence arises from the presence of local public good externalities. One region's provision of local public goods directly affects welfare in the other region. This second form of interdependence can be modelled using game theory.

Assuming Nash behaviour, region 1 is assumed to take \( q_2(.) \) as fixed, so that \( q_2(.) \) in (4) is written as \( q_2^* \). Similarly, region 2 is assumed to take \( q_1(.) \) fixed at its optimal Nash level, and hence \( q_1(.) \) is written as
ql* in (5). Accordingly, equation (4) can be thought of as region 1’s ‘subscription function’ since it shows region 1’s provision of q1 for given parameter values in the presence of local public good externalities. Similarly, (5) can be thought of as region 2’s subscription function.

8.3 Nash Equilibrium With Free Migration

Equations (4) and (5) yield the Nash equilibrium levels of q1 and q2 as

\[
q_1^*(.) = \left( \frac{f_1(.)}{2p_1} - \frac{a}{2} \right) / D \tag{8.6}
\]

\[
q_2^*(.) = \left( \frac{f_2(.)}{2p_2} - \frac{b}{2} \right) / D \tag{8.7}
\]

where (i) \( D = 1 - ab/4; \)

(ii) \( 0.75 \leq D \leq 1, \) since \( 0 \leq a, b \leq 1 \) by assumption;

(iii) \( q_1^*(.), q_2^*(.) \geq 0 \)

Note that equations (6) and (7) are analogous to equations (4.11) and (4.12), except that here \( n_1 \) and \( n_2 \) are determined from a free migration equilibrium condition and regional endowments are a function of regional populations (which can vary). In the model of Chapter 4, \( n_1 \) and \( n_2 \) were exogenously fixed, as were regional endowments. Thus, the fixed population model of Chapter 4 can be thought of as a special case of the present model with free migration.

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3. One can show existence of a Nash equilibrium. However, unlike the fixed population version of this model in Chapters 3 and 4, it has not been possible to demonstrate uniqueness and stability.
The superscript * has been added to $q_1(.)$ and $q_2(.)$ to signify that they are Nash levels of provision to differentiate them from $q_1(.)$ and $q_2(.)$, the levels of provision from the standard model with no local public good externalities in Chapter 7.\(^{(4)}\) Note however, that the first term on the right hand side of (6) is simply $q_1(.) = f_1(.)/2p_1$. Thus, $q_1^*(.)$ can be thought of as $q_1(.)$ from the standard model, adjusted by the local public good externality and the interdependence this introduces. When $a = 0$, $q_1^*(.) = q_1(.)$ and similarly for region 2, when $b = 0$, $q_2^*(.) = q_2(.)$. One can show that in general $q_1^*(.) < q_1(.)$ and $q_2^*(.) < q_2(.)$. It is also possible to show that, generally $q_1^*(.)$ and $q_2^*(.) > 0$. Hence, the Nash levels of provision are positive and less than the levels of provision in the absence of positive local public good externalities (the standard model).\(^{(5)}\)

Substituting $q_1^*(.)$ and $q_2^*(.)$ into $x_1 = [f_1(.) - p_1q_1^*(.)]/n_1(.)$ and $x_2 = [f_2(.) - p_2q_2^*(.)]/n_2(.)$ and rearranging yields the optimal level of private good consumption in each region as

4. When $a = b = 0$, each region has a dominant strategy which will be played regardless of the other region's level of provision. Thus, when $a = b = 0$ we can think of (6) and (7) as defining a dominant strategy equilibrium (DSE). By implication, quantities of $q_1(.)$ and $q_2(.)$ supplied in an equilibrium in the standard migration model can be thought of as resulting from a DSE where $a = b = 0$. Hence, the standard model of Chapter 7 can be seen as a DSE of the present model where $a = b = 0$.

5. Establishing this algebraically is problematic. However, numerical solution of the model shows this to be the case for a large range of assumed values of $p_1$ and $p_2$, although if extreme differences in $p_1$ and $p_2$ are allowed, or if the regional production functions are allowed to be very different, it is possible to generate solutions where Nash levels of provision exceed the levels of provision without local public good externalities. These cases are ruled out by assumption.
One can show that generally $x_1^*(.) > x_1(.)$ and $x_2^*(.) > x_2(.)$. Thus, when there are local public good externalities, per-capita consumption of the private good is higher than in the absence of such externalities. Note that (8) and (9) are analogous to (4.13) and (4.14), except that here total regional endowment is determined from a free migration equilibrium condition. In addition, it is possible to show that, as might be expected, the Nash levels of provision are not Pareto optimal as $q_1(.)$ and $q_2(.)$ were in the standard model of Chapter 7. In this regard, the first order conditions from (2) and (3) yield the MRS condition for provision of the local public good by region 1 as

$$n_1(.)MRS_{Q1} = p_1$$

where $MRS_{Q1}$ is the marginal rate of substitution between $x$ and $Q$ in region 1 as a function of $p_1$, $p_2$, $a$ and $b$. A similar condition can be derived for region 2. Note that (10) is also the MRS condition adopted by region 1 under independent provision in the standard model [see equation (7.8)]. However, this provision rule no longer leads to Pareto optimal provision because region 1 ignores the benefit received by region 2 from the positive local public good externality. The Pareto optimal MRS condition for provision of $q_1$ in the presence of local public good externalities is (6)

6. Obtained by solving the central government problem

$$\max u = x_1Q_1 + x_2Q_2$$

subject to:

(i) $n_1x_1 + p_1q_1 = f_1(.)$ and (ii) $n_2x_2 + p_2q_2 = f_2(.)$
and similarly for region 2. Comparison of (11) with (10) indicates that the Pareto optimal condition includes an additional term, $b_{n2}(.)MRS^2Q(.)$, which is region 2's valuation of units of externality generated by region 1. This term is not taken into account by region 1 when adopting (10). Moreover:

$$n_1(.)MRS^1Q(.) < n_1(.)MRS^1Q(.) + b_{n2}(.)MRS^2Q(.)$$

and hence independent provision with local public good externalities leads region 1 to under-provide $q_1$ relative to the Pareto optimal quantity, and similarly for region 2. (7)

### 8.4 Optimal Regional Population

Substituting $q_1^*(.)$ and $x_1^*(.)$ into the utility function for region 1 yields per-capita utility in region 1 as

$$u_1^*(p_1,p_2,a,b) = x_1^*(q_1^* + aq_2^*)$$

where $x_1^*$, $q_1^*$ and $q_2^*$ are defined by equations (8), (6) and (7) respectively. $u_1^*(.)$ is the level of per-capita utility in region 1, which is a function of $p_1$ and $p_2$ as in the standard model, but also now of $a$ and $b$, the externality parameters. $u_1^*(.)$ from (13) is analogous to $u_1(.)$ from equation (7.9). However, as will be seen later, the graphs of $u_1^*(.)$ and $u_1(.)$ differ, and hence so do the migration equilibria they yield.

As previously, one can find region 1's optimum population by taking the optimum optimorum of (13), or by appealing to the envelope condition to obtain

$$MP_1 = x_1^*(.)$$

7. This is analogous to the result obtained in Chapter 3.
Equation (14) is analogous to equation (7.10), the condition for optimal population for the standard model, except that marginal product is now equated with the per-capita consumption of private good in the presence of Nash levels of provision of local public good. Moreover, the Henry George condition for region $i$ is now

$$p q^*(.) - f^*(.) - l^*(.) - R^*(.)$$

(8.15)

where $f^*(.)$, $l^*(.)$, and $R^*(.)$ are total regional endowment, labour income and total rent respectively at the optimal population. The implications of local public good externalities for optimal population, rents and provision of public goods are shown diagrammatically in Figure 1, which is an extension of Figure 7.1.

**Figure 8.1: Optimal Population with Local Public Good Externalities**
The $f(.) - pq(.)$ and $f(.)$ curves are from Figure 7.1 in Chapter 7. With positive local public good externalities, the $f(.) - pq^*(.)$ curve lies above the $f(.) - pq(.)$ curve, since as shown above, in general $q^*(.) < q(.)$ for a given $n(.)$. A number of conclusions follow. First, the optimal population without local public good externalities is, as before, at $n^*(.)$ with $pq(.) = DE = OC = R(.)$ and $MP = x(.)$. Second, however, the local public good externalities result in a lower optimal population at $n_e^*(.)$ where the slope of $OD' = x^*(.)$ which is in turn equal to the slope of $G'E' = MP$. Thus, at $n_e^*(.)$ we have $x^*(.) = MP$, the optimality condition given by equation (14), but the optimum occurs at a higher level of per-capita consumption of private good and a higher marginal product, because the optimal population is lower. Third, provision of the local public good has fallen from $pq(.) = DE$ to $pq^*(.) = D'E'$, as shown in the discussion of (6) and (7). Fourth, the Henry George condition still holds at $n_e^*(.)$ where $D'E' = pq^*(.) = OG' = R^*(.)$. However, the condition holds at a lower level of rents and local public good provision.

8.5 Free Migration Equilibrium

The free migration equilibrium condition with local public good externalities is

$$x_1^*(q_1^* + aq_2^*) - x_2^*(q_2^* + bq_1^*) = 0 \quad (8.16)$$

where again, $x_1^*$, $x_2^*$, $q_1^*$ and $q_2^*$ are as defined by equations (8), (9), (6) and (7) respectively. Once the parameters $p_1$, $p_2$, $a$, and $b$ have been specified, (16) can be solved for $n_1$ (as in Chapter 7), and hence $n_2$ since $N^*$ is fixed. These equilibrium regional populations can then be substituted into (6) and (7) to derive $q_1^*(.)$ and $q_2^*(.)$ and into (8) and (9) to derive $x_1^*(.)$ and $x_2^*(.)$. Finally, substitution into the utility functions, solves for $u_1^*(.)$ and $u_2^*(.)$, the equal per capita utilities in the presence of local public good externalities. Numerical solution
of (16) indicates that \( n_1 \) is an increasing function of \( p_2 \) \( (\frac{\partial n_1}{\partial p_2} > 0) \) and decreasing in \( p_1 \) \( (\frac{\partial n_1}{\partial p_1} < 0) \) and similarly for region 2. (8)

A free migration equilibrium with local public good externalities is characterised in Figure 2 using the graph of \( u_1^*(.) \) from equation (13), and the equivalent graph of \( u_2^*(.) \) for region 2.

Figure 8.2: Free Migration Equilibrium With Local Public Good Externalities

8. There is now a system of equations which can be solved for various parameter values. Nash equilibrium levels of local public good provision are linked directly with the free migration equilibrium condition and cannot be determined or changed independently of it since \( q_1^*(.) \) and \( q_2^*(.) \) are functions of the parameters in (16). To each free migration equilibrium there is associated a Nash equilibrium in local public goods.
The graphs of $u_1^*(.)$ and $u_2^*(.)$ are single peaked, an equilibrium occurs at point $A'$ (hence, equation (16) is an algebraic characterisation of $A'$) and $n_1^*$ and $n_2^*$ are the regional populations at $A'$. The $u_1(.)$ and $u_2(.)$ curves in Figure 2 are the per-capita utility curves from the standard model without local public good externalities and $A$ is the equilibrium from Figure 7.2. Note that $u_1(.)$ and $u_2(.)$ everywhere lie above the $u_1^*(.)$ and $u_2^*(.)$ curves and that $u_1^*(.)$ and $u_2^*(.)$ reach their single peaks at lower levels of population than the $u_1(.)$ and $u_2(.)$ curves. This can be gleaned from Figure 1 by seeing what happens to $f(.)$ and hence $u(.)$ as $n$ rises for the standard case, and the case with local public good externalities. In general, $A'$ does not coincide with $A$ and hence the presence of public good externalities yields a different migration equilibrium and distribution of population.

### 8.6 Location Efficiency

The net marginal benefit to region 1 at point $A'$ in Figure 2 from having an additional resident is

$$NMB_1^R = \left( \frac{p_1 q_1^*(.)}{n_1(.)} \right) \frac{R_1(.)}{n_1(.)}$$

(8.17)

where an n superscript has been added to $NMB_1$ to denote net benefit in the presence of local public good externalities, distinguishing it from $NMB_1$ in the standard model of Chapter 7. $p_1 q_1^*(.)/n_1(.)$ is the positive fiscal externality generated by the addition of a person to the population of region 1 (with Nash levels of provision) and $R_1/n_1$ is per-capita rent in region 1.

Since in general $q_1^*(.) \neq q_1(.)$, except if $a = 0$, then the fiscal externality generated by a migrant to region 1 in the presence of positive local public good externalities will not coincide with the fiscal externality generated in the absence of public good externalities. Indeed, the fiscal externality in the standard model implicitly assumes that $a = 0$. 
8.7 Fiscal Equalisation

The net benefit to the federation from reallocating a resident from region 2 to 1 at point $A'$ in Figure 2 is

$$NB_n = \frac{P_1q_1^*(.)}{n_1(.)} - \frac{P_2q_2^*(.)}{n_2(.)} - \frac{R_1(.)}{n_1(.)} - \frac{R_2(.)}{n_1(.)}$$  \hspace{1cm} (8.18)

Comparing (18) with (7.17), the analogous condition from the standard model, it can be seen that $NB_n$ is a function of differences in per-capita fiscal externalities and per-capita regional rents (as in the standard model of Chapter 7) and also of the difference in per-capita local public good externalities generated at the free migration equilibrium. Because the local public good externalities influence the determination of the Nash levels of $q_1^*(.)$ and $q_2^*(.)$, via (6) and (7), and $q_1^*(.)$ and $q_2^*(.)$ affect the size of the fiscal externalities generated by migration from region 2 to region 1, then they also help determine the value of $NB_n$. Thus, $NB_n$ is a function of the parameters $a$ and $b$, as well as $p_1$ and $p_2$ as in the standard model. This can be seen a little more clearly by breaking up the positive fiscal externality term for region 1. Substituting for $q_1^*(.)$ from (6) into (17), and recalling that $f_1(.)/2p_1 = q_1$ and $f_2(.)/2p_2 = q_2(.)$ one can write $NMB_1^n$ as

$$NMB_1^n = \left( -\frac{P_1q_1(.)}{n_1(.)} - \frac{p_1aq_1(.)/2p_2}{n_1(.)} \right) /D - \frac{R_1(.)}{n_1(.)}$$  \hspace{1cm} (8.19)

The first term in brackets on the right hand side is the fiscal externality from equation (7.16), less per-capita local public good externalities received by region 1 from region 2, divided by $D$. Hence, per-capita local public good externalities enter $NMB_1^n$ explicitly because they determine the level of provision via the reaction function for region 1.
The optimal equalising transfer in the presence of Nash levels of local public good provision, denoted as $t^*_n$, is

$$
t^*_n = \frac{n_1 n_2}{N^*} \left( \frac{p_2 q_2^* \left( \cdot \right)}{n_2 \left( \cdot \right)} - \frac{p_1 q_1^* \left( \cdot \right)}{n_1 \left( \cdot \right)} \right) + \frac{R_1 \left( \cdot \right) - R_2 \left( \cdot \right)}{n_1 \left( \cdot \right) - n_2 \left( \cdot \right)} \right) (8.20)
$$

Comparing $t^*_n$ from (20) with $t^*$ from the standard model [equation (7.20)] it can be seen that the equalising transfer is now a function of differences in per-capita fiscal, rent and local public good externalities, whereas in the standard model it is a function of differences in fiscal and rent externalities only. In the terminology of Chapter 7, $t^*_n$ is the transfer that ensures that the sum of per-capita residence-based tax payments for Nash levels of local public good provision, determined partly by the magnitude of local public good externalities and partly by source-based per-capita taxes, equals zero. Only when $a - b = 0$ will $t^*_n = t^*$, and in general the two differ.

However, $t^*_n$ corrects only for the fiscal and rent externalities, and the local public good externalities to the extent that they influence $NB^n$, but does not correct for the under-provision of local public goods resulting from the local public good externality. As shown in Chapter 3, matching grants to regional governments would be required to correct for inefficiencies associated with under-provision in the presence of public good externalities. Therefore, even with $t^*_n$ implemented and the inefficiency associated with migration corrected, we still do not have a social optimum in this model. However, the model can be extended to incorporate matching grants and a social optimum characterised in which there are optimal matching grants to correct for underprovision and optimal equalising transfers to correct for migration inefficiencies.
8.8 Fiscal Equalisation, Matching Grants and Policy Interdependence

Suppose that a central government (not modelled explicitly here) imposes a lump-sum tax, $L_1$ in region 1 and $L_2$ in region 2, to pay for a matching grant to each region, defined to be $g_1$ for region 1 and $g_2$ for region 2. Also assume that the central government implements fiscal equalisation to correct for migration inefficiencies. The matching rates can be found from each region's optimisation problem. In this regard, with the matching and equalising grants in place, the problem of region 1 is:

Max $u_1 = x_1(q_1 + aq_2^*)$ 

$\text{(q1)}$

STo: $nx_1 + p_1(1 - g_1^*)q_1 = f_1(n_1) - L_1 - t_n^*$ \hspace{1cm} (8.21)

where $t_n^*$ is the optimal equalising grant (assumed, as previously, to be a redistribution from region 1 to 2), $L_1$ is the transfer from region 1 to pay for the matching grant, $g_1^*$ is the optimal matching rate, and it is assumed that $L_1 = p_1g_1^*q_1$: that is, an amount exactly equal to the lump-sum tax $L_1$ is given back to region 1 as a matching grant.\(^{(9)}\) The first order necessary condition for provision of $q_1$ in region 1 yields

$n_1(.MRS^1Q(.)) = p_1(1-g_1^*)$ \hspace{1cm} (8.22)

Region 1 now adopts (22) as its decision rule for provision of $q_1$ instead of (10). Region 1 equates the total marginal benefit of local public goods with a price or MRT which is adjusted downward by the matching subsidy rate and hence expands provision. The optimal $g_1$ can be found by substituting the right hand side of (22) into the left hand side of (11) and solving for $g_1^*$ to obtain

---

9. As shown in Boadway, Pestieau and Wildasin (1989a), such a matching grant regime causes region 1 to increase provision. When the lump-sum income taken away from the region is returned to it via the matching grant, there is a substitution effect as the price faced by region 1 for the local public good falls.
\( g^*(P_1, P_2, a, b, t_n^*) = b n_2(\cdot) MRS_2^2 Q(\cdot)/P_1 \) (8.23)

\( g^*(P_1, P_2, a, b, t_n^*) \), or simply \( g^*(\cdot) \) for convenience, is the optimal matching grant and similarly for region 2. Notice that since \( g^*(\cdot) \) is dependent on an MRS condition and the population of region 2, it is itself a function of the parameters of the model \( P_1, P_2, a, b \) and \( t_n^* \), the equalising transfer chosen to correct for migration inefficiencies. The Nash equilibrium levels of provision chosen by regions with the optimal matching and equalising grants in place are

\[
q_{1, m}^* = \left( \frac{\hat{f}_1(\cdot)}{2p_1(1-g_1^*)} - \frac{a}{2} \frac{\hat{f}_2(\cdot)}{2p_2(1-g_2^*)} \right) / D \tag{8.24}
\]

\[
q_{2, m}^* = \left( \frac{\hat{f}_2(\cdot)}{2p_2(1-g_2^*)} - \frac{b}{2} \frac{\hat{f}_1(\cdot)}{2p_1(1-g_1^*)} \right) / D \tag{8.25}
\]

where (i) \( \hat{f}_1(\cdot) = f_1(\cdot) - L_1 - t_n^* \)

(ii) \( \hat{f}_2(\cdot) = f_2(\cdot) - L_2 + t_n^* \)

We now have \( q_{1, m}^*(\cdot) = g(P_1, P_2, a, b, \xi_1^*, \xi_2^*, t_n^*) \) and similarly for \( q_{2, m}^*(\cdot) \). Note that an \( m \) superscript has been added to \( q_{1, m}^*(\cdot) \) and \( q_{2, m}^*(\cdot) \) to denote Nash levels of provision with optimal matching and equalising grants and hence Pareto optimal levels of provision.

---

10. Apart from dependence on the model's parameters, equation (23) is analogous to equation (3.32).
Finally, private good demands, with the optimal equalising and matching grants in place, become:

\[
x_1^*, m = \frac{f_1(.)}{n_1} \left( 1 - \frac{1}{2D} \right) + \frac{ap_1(1-g_1^*)f_2(.)}{4Dn_1p_2(1-g_2^*)}
\]  

\[
x_2^*, m = \frac{f_2(.)}{n_2} \left( 1 - \frac{1}{2D} \right) + \frac{bp_2(1-g_2^*)f_1(.)}{4Dn_2p_1(1-g_1^*)}
\]

Using the methodology adopted to derive equation (20), it can be shown that the optimal fiscal equalisation grant is now:

\[
t_n^*, m = \frac{n_1n_2}{N^*} \left( \frac{p_2q_2^*}{n_2(.)} - \frac{p_1q_1^*}{n_1(.)} \right) + \left( \frac{R_1(.)}{n_1(.)} - \frac{R_2(.)}{n_2(.)} \right)
\]

\[
+ \left( \frac{L_1}{n_1(.)} - \frac{L_2}{n_2(.)} \right)
\]

The novel feature of equation (28) is that the equalising transfer is now not only a function of the parameters \( p_1, p_2, a, \) and \( b, \) but also of the two policy instruments, \( g_1^* \) and \( g_2^*, \) which enter the \( q_1^*(.) \) and \( q_2^*(.) \) terms, and hence help determine the fiscal externalities, and also differences in the per-capita lump-sum transfers required to pay for the matching grants. Hence, the equalising transfer formula must take account not only of the local public good, fiscal and rent externalities, but also of the difference in per-capita lump-sum taxes in each region to pay for the matching grant, and the matching rate itself. Thus, there is policy interdependence: the matching grant cannot be determined independently of the fiscal equalisation transfer, and vice versa.

Action by the central government to correct for migration inefficiencies must also account for the action taken to correct for public good externalities.
Therefore, achieving Pareto optimality in the federal economy modelled here with free migration and local public good externalities, requires fiscal equalisation grants to correct for migration inefficiencies and matching grants to correct for under-provision: two policy instruments for two sources of inefficiency. Moreover, the optimal grants must be determined simultaneously.

8.9 Australian Practice: The Inclusion Approach To Specific Purpose Payments

The policy implication of equation (28) from the point of view of optimal policy intervention on efficiency grounds is clear, though perhaps not terribly helpful in practice. Nevertheless, some insights can be obtained which have something very general to say about Australia's current approach to determining equalising grants and specific purpose payments (hereafter referred to as SPPs) to the states.

The theoretical implication of the above is that in determining the optimal equalising grant, the central government must take explicit account of the matching grants it implements to correct for underprovision. First, the central government must account for the differential effect of the matching rate on the fiscal externalities ($g_1^*$ and $g_2^*$ enter the fiscal externality terms). Second, it must take account of the differential per-capita taxes paid by each region toward the matching grants. Similarly, the central government must take account of the fact that optimal matching grants are a function of the equalising transfer.

In an Australian context, SPPs are similar to matching grants, at least in the sense that they have matching conditions. Responsibility for determining these grants lies largely with Commonwealth Treasury and the relevant state departments. As noted before, responsibility for equalisation lies with the Commonwealth Grants Commission, or CGC. These analogies are not strictly correct, first, because fiscal equalisation in Australia is not conducted according to any efficiency principles, and second, because SPPs are not exactly equivalent to matching grants.
Nevertheless, the results here suggest that the CGC and Treasury should each take the other's policies into account. In this respect, in its approach to grant setting the CGC does actually take account of SPPs received by the States. The Commission uses what is called the 'inclusion approach' in its consideration of SPPs whereby it effectively includes any SPP received by a State in that State's budgetary position before determining the equalising grant. The States have argued against this approach, and hold the view that instead the Commission should adopt instead an 'exclusion approach' whereby SPP's are excluded from consideration by the Commission.\(^{(11)}\)

Indeed, what the analysis here suggests, is that in an ideal world of optimal policy intervention on efficiency grounds, the CGC should take account of SPP's in two ways: (i) the differential effect, via any matching requirements, on provision of local public goods across states (any differential effect of SPPs between states will affect relative fiscal externalities, and hence migration patterns, which will in turn influence population distribution and optimality); and (ii) the differential impact between states of the taxes used to finance SPPs. This is suggestive of an inclusion approach (although almost certainly not the inclusion approach actually used by the Commission) to equalising grants: that is, they should include the effects of other policies which influence fiscal, rent and public good externalities, because anything which affects these variables, will also influence migration, population distribution and optimality, and, therefore, should be accounted for by the equalising formula.

Thus, although equalisation in Australia is not based on efficiency and SPPs are not exactly like matching grants, the analysis here does offer broad support for the notion that the CGC should take account of SPPs in determining its equalising grants, at least on efficiency grounds, simply because SPPs influence migration and hence efficiency and welfare. Similarly, the Commonwealth Treasury should take into account fiscal equalisation grants in determining its levels of SPPs.

\(^{(11)}\) For example, see Inquiry into Grants Commission Methodology (1990).
8.10 Socially Optimal Migration Equilibria

The free migration equilibrium condition, following the implementation of optimal matching and equalising grants, is

\[ x_1^*(m) q_1^*(m) + a q_2^*(m) - x_2^*(m) q_2^*(m) + b q_1^*(m) = 0 \]  

(8.29)

where \( x_1^*(m) \), \( x_2^*(m) \), \( q_1^*(m) \), and \( q_2^*(m) \) are as defined by equations (26), (27), (24), and (25) respectively. The socially optimal free migration equilibrium following implementation of the optimal equalising and matching grants by the central government is characterised in Figure 3.

**Figure 8.3: Socially Optimal Free Migration Equilibrium**

The arbitrary initial equilibrium is assumed to be at point A', as in Figure 2, where there is under-provision and \( NMB_1 < NMB_2 \). The equilibrium following implementation of optimal interdependent matching and equalising transfers is at point P'. This equilibrium is
characterised algebraically by equation (29). $P'$ can be considered to be socially optimal in the sense that the distribution of population is optimal (fiscal, rent and local public good externalities have been equalised) and social losses due to under-provision have been corrected.

8.11 Mobility and the Break-Down of Neutrality

In Chapter 4 it was shown that neutrality would, in general, not hold once units of own-provision were no longer perfect substitutes for units of externality, regions had different populations, or marginal costs of producing units of local public good differed. Moreover, the Boadway, Pestieau and Wildasin (1989b), or BPW for convenience, neutrality result was shown to hold fortuitously, or when $p_1 = p_2$, $I_1 = I_2$, $n_1 = n_2$ and $a = b = 1$ (all of which were assumed by BPW). In this Section, neutrality is examined when there is also population mobility between regions. It is assumed that there are no matching grants in place to correct for under-provision, so that $L_1 - L_2 = g_1^* - g_2^* = 0$. Recalling from (1) that $Q_1 = q_1 + aq_2$ and $Q_2 = q_2 + bql$, the response of $Q_1$ and $Q_2$ to a small transfer of income from region 1 to region 2 is given by

$$\frac{\partial Q_1^*}{\partial t} = \frac{\partial q_1^*(\cdot)}{\partial t} + a \frac{\partial q_2^*(\cdot)}{\partial t} = 0$$

(8.30)

$$\frac{\partial Q_2^*}{\partial t} = \frac{\partial q_2^*(\cdot)}{\partial t} + b \frac{\partial q_1^*(\cdot)}{\partial t} = 0$$

(8.31)
Deriving $\partial q_1^*/(\cdot)/\partial t$ and $\partial q_2^*/(\cdot)/\partial t$ from (24) and (25), substituting into (30) and (31) and rearranging yields (for region 1 only: region 2 is analogous):

$$dQ_1^* = \frac{f_{1t-1}}{2p_1} \frac{a}{2} + \frac{f_{2t+1}}{2p_2} \frac{b}{2} + a \frac{f_{1t-1}}{2p_2} \frac{b}{2}$$

where (i) $f_{1t} = \frac{\delta f_1}{\delta n_1} \frac{\delta n_1}{\partial t}$

(ii) $f_{2t} = \frac{\delta f_2}{\delta n_2} \frac{\delta n_2}{\partial t}$

It is clear that (32) will only equal zero fortuitously (as with equation 4.21) and the general effect of the redistribution of income from region 1 to 2 will depend upon: (i) $f_{1t}$ and $f_{2t}$ (the changes in regional endowment as a consequence of the redistribution-and hence regional marginal products); and (ii) the parameters $a$, $b$, $p_1$ and $p_2$. Now consider the case examined in Chapter 4 where $a = b = 1$ and $p_1 = p_2$ (essentially the BPW case of neutrality). In this case, (32) simplifies to:

$$dQ_1^* = \frac{f_{1t} + f_{2t}}{3}$$

(8.33)

Clearly, (33) equals zero only when

$$f_{1t} + f_{2t} = 0$$

(8.34)

(34) would only hold fortuitously. Even if $\delta n_1/\partial t = \delta n_2/\partial t$, then for neutrality we would need $\delta f_1/\delta n_1 + \delta f_2/\delta n_2 = 0$ or $\delta f_1/\delta n_1 = -\delta f_2/\delta n_2$: that is, the fall in regional endowment in region 1 as one resident migrates is equal to the rise in regional endowment in region 2 as one resident enters that region. In other words, the marginal migrant would need to have the same marginal product in region 1 as in region 2.
However, recall from Chapter 7, that because of the presence of fiscal and rent externalities, labour migrates to equate average rather than marginal product between regions. Therefore, in general, marginal products are unlikely to be equated in equilibrium.

Thus, even if \( p_1 = p_2 \), \( a - b = 1 \) and \( n_1 = n_2 \) (recall these assumptions were sufficient to yield neutrality in the fixed population model of Chapter 4), population mobility, another important feature of federations, is likely to result in a break-down of neutrality. In general, the real effects of lump-sum transfers will depend upon public good externality parameters, regional populations, marginal costs of producing local public goods and differences in the marginal product of labour between regions. (12)

8.12 The Fly-Paper Effect with Externalities and Mobility

In Chapter 4, the fly-paper effect was explained as a consequence of the fact that the recipient region was linked to the donor region via a public good externality. This interdependence resulted in a boost to the recipient's expenditure response to a transfer from the donor over and above what might be expected as the result of an exogenous increase in the recipient's endowment. In this Section, it is shown that mobility responses to income transfers further enhance the fly-paper effect.

This can be seen by considering two comparative static responses by region 2 to a redistribution of lump-sum income from region 1: a short-run and long-run response.

8.12.1 Short-Run Response to a Grant

Consider the effects of a small increase in \( t \), the lump-sum transfer. From (24) and (25) this will result in a redistribution of income from

12. Cornes (1992b), in a public good model with Nash behaviour and voluntary contributions, also emphasises the importance of different marginal products in the break-down of neutrality or invariance results.
region 1 to 2. Also assume that, in the short run, the migration response to this transfer occurs with a lag so that one can take regional populations as given. Finally, let $L_1 - L_2 = q_1 - q_2 = 0$ as in the neutrality discussion. The short-run effect of this redistribution on $q_2^*$ can be found by differentiating (25) with respect to $t$ while holding $f_1(.)$ and $f_2(.)$ fixed, to obtain:

$$\frac{\partial q_2^*}{\partial t} = \left(\frac{1}{2p_2} + \frac{b}{2} \frac{1}{2p_1}\right) > 0$$

(8.35)

(35) describes region 2's response to the transfer given that the migration responses are held fixed. This equation is comparable to equation (4.18) from the fixed population model of Chapter 4. Therefore, it captures the fly-paper effect caused by the local public good externality interdependence identified in Chapter 4.

8.12.2 Long-Run Response: The Effect of Mobility

Consider the effect of an increase in $t$, but now allowing for the migration responses to the transfer. Differentiating (25) with respect to $t$, and allowing $f_1(.)$ and $f_2(.)$ to vary, yields the change in $q_2^*$ as:

$$\frac{\partial q_2^*}{\partial t} = \frac{f_{2t} + 1}{2p_2} + \frac{b}{2} \frac{f_{1t} + 1}{2p_1}$$

(8.36)

(36) describes the change in provision in region 2 as a result of an increase in its transfer, taking into account its direct interdependence with region 1 as a result of the local public good externality and the fact that people migrate from region 1 to region 2 as a result of the transfer (the migration response). It is clear that:

$$\left(\frac{f_{2t} + 1}{2p_2} + \frac{b}{2} \frac{f_{1t} + 1}{2p_1}\right) > \left(\frac{1}{2p_2} + \frac{b}{2} \frac{1}{2p_1}\right)$$

(8.37)
implying that the response of the recipient region is greater once migration responses to the transfer are taken into account. Thus, there is a 'double' fly-paper effect. First, reaction function interdependence (because of public good externalities) boosts the recipient's response to a transfer (as shown above and in Chapter 4) over and above what would occur as the result of an exogenous increase in region 2's endowment. Second, region 2 (the recipient) also responds to the migration effect of the transfer in its favour. Since the recipient is assumed to determine local public good provision by summing MRSs, the increased population leads to a further increase in provision. (13)

8.13 Conclusion

The contribution of this chapter to our understanding of migration in federal economies has been to extend and generalise the fiscal externality and regional rent literatures by explicitly modelling local public good externalities in a free migration setting. A number of conclusions have been reached.

First, local public good externalities influence the magnitude of the fiscal externalities generated by free inter-regional migration, since they affect, through regional reaction functions, the level of provision of local public goods, and hence per-capita tax payments. Second, provision of local public goods is not optimal, in contrast to the standard model where independent provision by regions leads to optimal provision. In particular, there is underprovision of local public goods because each region fails to internalise its neighbour's positive valuation of local public good externalities. Hence, there are three distortions associated with free migration equilibria: fiscal, rent and local public good externalities.

13. A fly-paper effect can be obtained from the model of Chapter 7, except that in that case, the effect of the reaction function interdependence through local public good externalities will be absent and only the migration effect will be present.
Third, the optimal fiscal equalisation transfer designed to correct for free migration inefficiencies must take account of fiscal externalities and regional rents as identified in the standard model, but also of local public good externalities since they influence the fiscal externality generated by migration. Fourth, the optimal equalising transfer corrects only for the inefficiency of free migration equilibria and not under-provision of local public goods. The latter distortion needs to be corrected by matching grants to regions. Moreover, the optimal equalising grant is a function of the optimal matching rates and the lump-sum taxes used to finance the matching grants. Conversely, the optimal matching rates are functions of the equalising transfer. What the analysis has shown, therefore, is that two of the more important grants analysed in the literature are interdependent and that two policy instruments are needed to achieve a social optimum in a federation with free migration and local public good externalities: fiscal equalisation transfers to correct for migration inefficiencies, and matching grants to correct for under-provision.

Fifth, population mobility introduces an additional way in which neutrality can break-down in federal economies: that is, if there are different marginal products of labour across regions. It was argued that in general marginal products would not be equated between regions in a free migration equilibrium. In general, therefore, the real effects of lump-sum transfers will depend upon migration responses, relative marginal products, public good externalities, regional populations, regional endowments and marginal costs of producing local public goods.

Finally, mobility introduces an additional fly-paper effect: the impact on provision of the increased population which flows into the recipient region (along with the grant). Indeed, when there are mobility and local public good externalities, there are two fly-paper effects at work: the one identified in Chapter 4 related to reaction function interdependence and local public good externalities, and the second related to population mobility (modelled in this Chapter).
Overall, the Chapter has brought together two features of federal economies which derive from the openness of regions, and which have been major themes in this Thesis: local public good externalities and free migration between regions. One can think of the model in this Chapter as having, therefore, two varieties of competition: Nash competition associated with the public good externalities and Tiebout-type competition resulting from migration.


9.1 Introduction

Apart for the specific conclusions contained in the concluding sections of each chapter, there are a number of major ideas or themes which emerge from the Thesis considered as a whole, including: (i) general theoretical conclusions; and (ii) conclusions that have particular relevance to Australian federalism. These ideas are summarised below.

9.2 Theoretical Conclusions

Theoretical conclusions relate to: (i) the inducement for cooperative behaviour; (ii) the role of diversity of preferences as a limit on cooperative behaviour; (iii) the role of transfers and institutional structures in facilitating cooperative behaviour in the face of diversity; (iv) fiscal, rent and public good externalities and free migration; and (v) neutrality and the fly-paper effect. Each is discussed below.

9.2.1 Cooperative Behaviour

A theme throughout this Thesis is that independent political entities may face strong inducements to engage in cooperative behaviour of one form or another, even when different assumptions are adopted about government behaviour. It was shown in Chapter 3, using a community preference model, that cooperative behaviour could internalise positive externalities and result in a social welfare gain. In Chapter 5, using a median voter model, it was argued that separate political entities may face inducements to federate in order to secure a social surplus, depending upon diversity of preferences. In Chapter 6 it was argued that regions within a federation may have strong incentives to relinquish
control over local taxes to a central government to minimise tax competition because of concerns over revenue sufficiency and federal unity, depending on diversity of preferences and the presence of other constraints on central government powers. Finally, in Chapter 8 regions were shown to face an incentive to cooperate to internalise local public good externalities in a free migration context.

However, while there may be incentives to cooperate in these different models of government behaviour, the welfare implications of cooperative behaviour are less clear. Cooperation in the models of Chapters 3 and 5 was shown to create a social welfare gain under some circumstances because governments cared about citizen-voters. However, in Chapter 6, where revenue maximising governments were modelled, all that one can say is that cooperation leads to higher total revenues being extracted from citizens: that is, cooperation allows governments to obtain higher revenues (depending on the operation of other Constitutional provisions such as Section 99) relative to competitive levels. Whether this results in a social loss or gain depends upon where the competitive and cooperative tax rates and revenues are in relation to the socially optimal rates and revenues, and this was not analysed.

Thus, while there may be significant inducements for cooperative behaviour to emerge, one cannot say generally whether cooperation is welfare enhancing or otherwise, relative to competitive outcomes. Indeed, much seems to depend upon how one specifies government behaviour.

9.2.2 Diversity as a Constraint on Cooperation and the Role of Income Transfers and Federal Institutions

Another theme to emerge from Chapters 5 and 6 is that one might expect there to be diversity of preferences between independent political entities. When these entities cooperate, either by agreeing to central provision of public good (as in Chapter 5) or centralisation of a tax base (as in Chapter 6), then there may be a 'uniformity cost' imposed on them. This can be thought of as a loss of welfare because, with centralised provision or taxation, local preferences are no longer
satisfied as closely as they were in the non-cooperative situation. For example, uniformity in Chapter 5 emerged because the median voter mechanism picked out the median demand for local public goods in each coalition, imposing a welfare cost on participants in the coalition who do not have median demand. On the other hand, in Chapter 6 uniformity was imposed by a Constitutional Clause (Section 99 of the Australian Constitution), reducing the gains from cooperative behaviour, and in some instances, making non-cooperation more attractive.

Further, the uniformity cost rises as diversity of preferences increases. Indeed, it was shown in both Chapters 5 and 6 that autarky or independence is preferable to cooperation when diversity of preferences is extreme. Cooperative outcomes were dominated by non-cooperative outcomes. When regions were assumed to be less dissimilar, it was shown that cooperation may be attractive, but only if accompanied by lump-sum transfers in favour of regions suffering more than others from the cost of uniformity. When regions were assumed to be identical, cooperation always dominated independent non-cooperative outcomes because uniformity constraints in such cases are not binding.

Thus, although there may be incentives to cooperate as suggested earlier, the presence of diversity between the parties to cooperation provides a 'natural' constraint on the degree to which cooperation is attractive, because it results in cost of cooperation: the welfare loss from uniformity. One might expect, therefore, cooperation to be stronger between political entities which have similar preferences.

The idea that diversity constrains cooperative behaviour also appears in Oates (1972), although not in exactly the same context. In his decentralisation theorem, the 'costs' of a uniformity constraint associated with central government provision are used to rationalise federalism, or some degree of decentralisation of provision (discussed in the Literature Review Chapter, Chapter 2). The role of uniformity in imposing costs of cooperation, or centralisation, were also neatly summarised by Tocqueville when he said:
'In great civilised nations the legislator is obliged to give a character of uniformity to the laws, which does not always suit the diversity of customs and of district; as he takes no cognizance of special cases, he can only proceed on general principles; and the population are obliged to conform to the requirements of the laws, since legislation cannot adapt itself to the exigencies and the customs of the population, which is a great cause of trouble and misery. This disadvantage does not exist in confederations.'

Therefore, while there might be strong inducements to cooperate, diversity of preferences places a limit on the degree to which cooperation will occur, and ensures that the right to some independent action will be retained by the parties to cooperation.

Following on from the above is the idea that, since diversity and uniformity place limits on the attractiveness of cooperative behaviour, lump-sum transfers, and the institutional mechanisms to facilitate them, are arrangements designed to redistribute the uniformity costs between the potential parties to cooperation, ensuring that each gains and thus has an incentive to cooperate.

These arrangements exist in federal systems because of the need to share the costs of cooperation to secure some kind of net cooperative benefit. They improve the trade-off between the benefits of cooperative behaviour on the one hand, and the costs which can arise from uniformity in the face of diversity on the other.

9.2.3 Public Good Externalities and Free Migration

The analysis in Chapters 3, 4, 7 and 8 shows that there is merit in extending the Boadway and Flatters (1982b) model of mobility to introduce explicitly local public good externalities. The first insight this yields is that local public good externalities introduce an additional distortion to free migration equilibria, implying that free migration equilibria can be inefficient for three reasons: (i) fiscal externalities; (ii) rents; and (iii) local public good externalities.

1. Tocqueville (1835/1945).
The first two sources of inefficiency were identified by Boadway and Flatters (1982b). The last source of inefficiency is analysed here.

In addition, the magnitude of the local public good externality influences directly the size of the other two distortions (the fiscal externality and per-capita rents). For example, positive local public good externalities reduce the magnitude of the fiscal externality caused by migration. The intuition for this is that it is now the (lower) Nash levels of provision, influenced by the explicit public good externality, which determine the fiscal externality created by migrants, rather than the higher Samuelson level of provision as in the Boadway and Flatters (1982b) model.

Further, the optimal fiscal equalisation transfer called for on efficiency grounds in mobility models no longer establishes a social optimum. It corrects for the distorting effects of fiscal, rent and local public good externalities on the migration equilibrium, but not for the underprovision caused by the local public good externalities. This must be corrected by matching grants. Thus, two policy instruments are required to establish a social optimum, one for the migration inefficiency and the other for underprovision.

Finally, the optimal fiscal equalisation grant required to correct for the migration inefficiency depends upon the taxes raised to finance the matching grants, and the matching rates themselves. Similarly, the matching grant required to correct for underprovision is a function of the fiscal equalisation grant. Hence, the two policies are interdependent.

9.2.4 Openness, Regional Interdependence and Externalities

As emphasised in the Introductory Chapter, because of the openness between regions in federations, interdependence is a key feature of local economies. The main insight here regarding interdependence is that it usually involves some form of externality: that is, regional interdependence can be thought of as one region influencing another in
some way without taking into account this influence. Various forms of regional interdependence, considered as externalities, have been modelled in this Thesis. Following the federalism literature, the models used have examined interdependence as special cases of more general externalities models.

For example, interdependence is modelled as local public good externalities in Chapters 3 and 4, where one region's voluntary contribution to a local public good benefits another region. In Chapter 5, there is interdependence between three federating regions which is modelled as a tax price benefit of federation. It is argued that a major benefit of union is that it internalises this tax price benefit (an externality associated with public goods) which is not internalised in autarky. In Chapter 6, interdependence of tax bases is modelled as a tax base externality in examining Section 90 of Australia's Constitution, and the issues of tax competition and tax exporting. Finally, interdependence dominates the analysis of Chapters 7 and 8 where the presence of fiscal, rent and local public good externalities introduce distortions to free migration equilibria which must be corrected using fiscal equalising grants and the standard Pigovian remedy.

9.2.5 Links with Oates' Work

In Chapter 3, it is shown that much of what Oates (1972) was concerned about in his seminal contribution can be interpreted using more recent developments in the theory of externalities, pure public goods and simple game theory, in particular the concept of static Nash and cooperative equilibria. Interpreting Oates using these techniques is useful for a number of reasons. First, it encourages us to think of public good externalities as another form of regional interdependence which can be modelled in the same way that other types of interdependence, such as tax competition, are modelled. This in turn is suggestive of the idea that public good externalities introduce a form of competition between regions in the sense that each region treats the externality generated by a neighbour as a parameter. This notion of competition is analogous to the concept of competition appearing in the tax competition literature.
Second, modelling public good externalities in this way gives some new insight into some of the standard results to be found in Oates (1972) and links those results with the modern theory of externalities and pure public goods. For example, his notion of perfect correspondence can be thought of as a special case of an externality model where \( a - b = 0 \) and each region has a Dominant Strategy Equilibrium in quantities which is Pareto optimal. As an another example, Oates identified the fact that unresolved external effects implied the existence of gains from trade. In the analysis here, this notion was interpreted as implying that externalities led to a sub-optimal Nash equilibrium dominated by cooperative equilibria. Also, as noted above, another theme in Oates (1972) is that the uniformity associated with centralised provision imposes a welfare cost. This has also been a major theme here.

### 9.2.6 Bertrand and Cournot Equilibria

In Chapters 3, 4, 6 and 8 static Nash equilibria in quantities and taxes have been characterised in various forms in order to model regional interdependence. One point to be emphasised throughout is that the Nash equilibria in quantities characterised, for example, in Chapter 3, are analogous to Cournot equilibria, and that Nash equilibria in taxes, characterised for example, in Chapter 6, are analogous to Bertrand equilibria. In the Nash equilibria in quantities we have two regions choosing levels of voluntary contribution to a local public good, whereas in Cournot equilibria, duopolists choose levels of output. Similarly, in the Nash equilibria in taxes (see Chapter 6) regions choose tax rates, whereas in Bertrand equilibria, duopolists choose prices.

Thus, models of regional interdependence in the federalism and local public economics literatures have similarities with models of interdependence used in the theory of Industrial Organisation. This is not surprising given the formal equivalence between the game theoretic models used in both literatures.
9.2.7 Neutrality of Lump-Sum Transfers

The challenge of Boadway, Pestieau and Wildasin (1989b), or BPW, to analyse the role of public good impurity in breaking-down neutrality of lump-sum transfers initiated an interest in those features of federal economies which are likely to cause, not only the break-down of neutrality, but also be the main determinants of the real effects of lump-sum transfers.

The enquiry into neutrality began in Chapter 4 where it was shown that neutrality only holds fortuitously, or if it is assumed that regions: (i) have equal populations; (ii) treat own-contributions to local public goods and units of externality as perfect substitutes; and (iii) have identical marginal costs of provision. These are the assumptions inherent in the BPW model. However, if any one of these assumptions does not hold, neutrality breaks-down and lump-sum transfers have real effects on per-capita welfare. Thus, not only is impurity in the national public good sufficient to cause non-neutrality as recognised by BPW, so too are at least two other conditions; unequal regional populations and different marginal costs.

In Chapter 8, where mobility and local public good externalities are modelled, it is argued that neutrality in the presence of population mobility requires an extra assumption; that regions have identical labour productivity. It is proposed that this is unlikely to hold in a free migration equilibrium because of the distorting effects of fiscal, rent and public good externalities which imply that in equilibrium marginal products will not be equated.

Hence, it has been argued that once some of the features of federal economies are incorporated into models of regions making voluntary contributions to a public good, the model diverges from the individual contribution-type model used in much of the neutrality literature, and neutrality is likely to break down with lump-sum transfers having real effects. An attempt has also been made to characterise some of these
real effects, for example, in the discussion on Pareto improving lump-sum transfers in Chapter 4.

9.2.8 The Fly-Paper Effect

There are two explanations for the fly-paper effect offered. The first is that it is due to a link between donor and recipient regions caused by local public good externalities. In particular, if donor and recipient regions are linked via a positive public good externality, a grant recipient boosts its expenditure response to a lump-sum grant by more than would be the case if it simply received an increase in endowment, because it must make up for the lower externality generated by the donor region. This was discussed in Chapter 4. The second explanation (see Chapter 8) arises from allowing for another form of regional interdependence; that caused by population mobility. If residents are mobile, they will migrate from the donor to recipient region giving a further boost to expenditure in the latter which reinforces the public good interdependence effect.

Thus, it is argued that two kinds of regional interdependence which link donor and recipient regions, are possible theoretical explanations of the fly-paper effect. Whether these explanations are important in reality would have to be resolved empirically.

9.3 Australian Fiscal Federalism

Conclusions of relevance in an Australian context relate to: (i) the motives behind the formation of the Commonwealth Grants Commission, or CGC, and the development of fiscal equalisation; (ii) the motives for including excise taxes in Section 90 of the Australian Constitution and role of Section 99 and the Braddon Clause; and (iii) fiscal equalisation and efficiency. The main points are summarised below.
9.3.1 The CGC and Fiscal Equalisation

It is argued in Chapter 1 that the importance of the Commonwealth Grants Commission, or CGC, and the central role of fiscal equalisation in determining general revenue grants to the states, are distinguishing features of Australia's federal arrangements. The analysis in Chapter 5 offered some economic explanations for the formation of the CGC and the motives behind the development of the equalising principle. In particular, it is argued that the CGC and equalisation are the result of a need to redistribute the net benefits from federation in the interests of federal unity.

Thus, while the CGC and the equalisation payments can be explained as the consequence of an Australian concern with egalitarian outcomes, as Gramlich (1984) suggests, the results here indicate that they have also been important ingredients in maintaining federal cohesion and have a substantial compensatory motivation behind them. They are, therefore, the 'glue' of federation.

9.3.2 Sections 90 and 99 of the Constitution and the Braddon Clause

Another distinguishing feature of Australian federalism discussed in the Introductory Chapter was the high degree of vertical imbalance, partly the result of a high degree of centralisation of taxation responsibilities. This provided the impetus for Chapter 6, which argued that a desire to minimise tax competition because of concerns over sufficiency of State revenues and federal unity, may have been strong motives behind the centralisation of at least one tax base; excise taxes (through Section 90). This is in contrast to the more usual view that excise taxes were centralised because of worries over internal free trade.

It is also shown that because of another provision in the Constitution which imposed an equal tax price constraint on the Commonwealth (Section 99), and the Braddon Clause, which was effectively
a revenue sharing rule, the inclusion of excise taxes in Section 90 may not have yielded higher revenues for all States (depending on the degree of diversity), implying a need for compensating transfers.

9.3.3 Fiscal Equalisation and Efficiency

Although fiscal equalisation in Australia has a history of being motivated by equity, and, as argued here, compensatory concerns, in recent years interest has grown in efficiency and equalisation. In Chapters 7 and 8, a contribution is made to this debate by; (i) presenting an efficiency case for fiscal equalisation (essentially the results from the Canadian literature); and (ii) highlighting the issues which must be resolved in Australia in order to assess whether there is, or is not, an efficiency case for equalisation.

9.4 Conclusion

In this Thesis, a number of specific issues in the theory of fiscal federalism and local public economics have been analysed. The Thesis has also examined issues of importance in an Australian context. The task in this concluding chapter has been to identify and draw out the main themes to complement the conclusions presented at the end of each chapter.
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