The internationalisation of the economy and its effects on regional economic policies

Frank E. O. Eich

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Abstract

This thesis studies the effects of the internationalisation of the economy on various regional economic policies and is organised as follows: Chapter 1 provides a general introduction. Chapter 2 studies the effects of industrial policy on manufacturing firms' location decisions. Industrial policy provides a productive local public good, financed by locally-raised tax revenues. Building on the 'new economic geography' literature, two new, opposing agglomeration forces are described: first, taxation reduces the market size - making a region less attractive - second, production cost fall - making a region more attractive for firms. We analyse the conditions under which a less-developed region can attract industry from a more-developed region. Chapter 3 incorporates ideas of the 'new international trade' literature into a 'fiscal federalism' framework with local public goods. In a two-region model, local public goods are underprovided if they are productive in nature and financed by domestic tax revenues. The degree of underprovision depends on the volume of trade between the two regions. This result arises as the benefit of provision has to be shared with the other region's citizens whereas the cost of provision falls entirely on the local citizens. Finally we show that delegating tax policies to a supra-regional body solves this problem. Chapter 4 analyses zoning policies on an urban level. We show that welfare under zoning is higher than in the market equilibrium if residents and monopolistically-competitive firms compete for land in a fixed-sized city with one central business district (CBD). Assuming an additional out-of-town business district (SBD), we find that the optimal size of the CBD depends crucially on whether the SBD is developed by the citizens or by an absentee land-developer: in the latter case the CBD should be expanded to minimise the outflow of rental income. Chapter 5 concludes.

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Chapter 1

Introduction

The globalisation of the world economy and major international changes in business practice such as the rise of the multinational corporation or the emergence of purpose-built business and retail parks have been some of the most striking economic developments of the postwar era. These developments have influenced and shaped the way how goods are produced and distributed, and where and by whom they are made. It is thus not surprising that all economically active agents, whether it is consumers, the workforce, capital owners or the public sector, have been affected. This thesis focuses on the public sector and analyses in which way these developments have been affecting the sector's economic policies at different levels of government. Economic policies are formalised and executed within a hierarchy of government levels. Broadly speaking, a country's political system consists of three tiers of government: the local (e.g. rural and urban municipalities), the intermediate (e.g. the counties or states), and the national level (Council of Europe, 1992). In addition, many countries have also formed 'supra-national' bodies such as the European Union in Europe. Each tier of government is responsible for a specific set of economic policies and it is thus that the general developments have been affecting different tiers of government in different ways. More precisely, we are interested in which way the appropriate tier of government has adapted the following economic policies: industrial policy, public good provision and taxation policy, and finally land use zoning. The first two theoretical chapters of this thesis analyse the effects on economic policies at a national/intermediate level of government, whereas the third theoretical chapter focuses on the local level of government.

The most obvious aspect of the internationalisation of the economy over the past forty years has been the dramatic increase in world trade: '[A] particularly important feature of the postwar period was that trade *increased more rapidly than production*, a clear indicator of the *increased internationalization* of economic activities and of a greater *interconnectedness* which have come to characterize the world economy... By 1988 total world exports were more than four times greater than in 1960; total world output was a little under three times greater than in 1960'

(Dicken, 1992, p. 16). This trend has been strongest in manufacturing exports which in the years between 1963 and 1979 grew by 281 per cent, whereas manufacturing production grew by 'only' 149 per cent (Kenwood and Lougheed, 1992). This growth of world trade has implied that economies are now much more closely integrated with each other. However, most of this trade originated from the industrialised countries: their share in 1987 was 68.2 per cent of all exports, compared with only 19.7 per cent for developing countries. Trade between industrial countries accounted for 54.6 per cent of all trade (Kenwood and Lougheed, 1992)[1]. The GATT has played a major role in this development: '[T]he growth of trade in manufactures was made possible by the gradual lowering of tariffs ... and other quantitative restrictions... This was achieved through the establishment of GATT in 1947' (Grimwade, 1989, p. 53). Only relatively recently have newly-industrialising countries (NICs) joined the developed world as exporting economies: '[T]he most noticeable change of the period from 1973 to 1985 was the increased share of world manufacturing exports accounted for by the NICs. Taiwan, South Korea, Hongkong, and Singapore all achieved a big increase in their share of world manufacturing trade' (Grimwade, 1989, p. 76).

However, many countries around the world and even many regions within otherwise developed parts of the world such as Western Europe or the United States have been 'by-passed' by this global change and have remained industrially backward and dependent on imports of most industrial goods. Given this uneven distribution of economic and especially manufacturing activity, it is not surprising to find that national and regional governments of backward regions have tried to reduce their dependency on imported goods by implementing specific policies. After the Second World War, most developing countries pursued import-substitution policies. The aim of these policies was to reduce the dependence on imports by raising tariffs and other barriers of trade and to nurture and develop domestic production. These policies were usually conducted in two phases: in the first phase simple consumption goods were

1 'Industrial countries' includes the USA, Western Europe, Canada and Japan.

substituted, in the second phase more sophisticated manufactured goods followed. However, it soon became apparent that these policies did not have the desired effects of bringing about economic development and most countries abandoned them from the late 1960s onwards[2]. The NICs were the first to embrace an outward-looking and export-oriented development strategy, demonstrating spectacular growth rates and export performances. Many other developing countries followed their lead and also switched policies (Todaro, 1994). The liberation of trade, especially in consumer goods was one of the first policies implemented[3]. This policy was meant to increase competitive pressures on domestic firms which had showed low rates of innovation and a high level of complacency (The Economist, 1997).

It is not only generally backward countries in the developing world but also the backward regions within the developed world and also formerly highly-industrialised but now declining regions which are interested in (re)establishing a domestic industrial base. Molle (1994) defines these groups as follows: '... [t]raditionally backward regions: ...these regions have developed hardly any manufacturing or service industry and are still largely oriented to agriculture...' (p. 427) and also '...[r]egions of industrial decline: ...these regions played a leading role at a certain stage of economic development, but have landed in difficulties as production conditions changed. This type of region is generally marked by inadequate infrastructure...' (p. 428). Parts of Portugal, Greece, Southern Italy and Ireland belong to the first group, whereas parts of Northern Spain and Wales for example fall into the second group (Commission of the European Communities, 1993c&d).

The study of industrial location in space has been the main theme of the 'new economic geography' literature (see for instance Krugman, 1991, and Krugman and

2 For a case study, see for example Wickramasinghe (1994) on Sri Lanka.

3 The second policy is in many cases a direct consequence of countries joining the GATT as member states.

Venables, 1996)[4]. The effects of closer economic integration due to lower transportation cost and the reduction of artificial trade barriers on the location decision of firms have received particular attention, partly spurred by the development of the single market in Europe in 1992 (Emerson, 1988). Emphasis in this literature has been put on the importance of atomistic agents such as firms and workers in shaping the economic landscape. Generally, the literature has suggested that high barriers to trade are more likely to support a more even distribution of economic activity in space as firms want to locate close to their markets. A fall in trade costs, however, would weaken this attraction, and other forces such as exploitation of economies of scale or agglomeration forces due to technological and/or pecuniary externalities would become predominant. The trend of economic activity to agglomerate in specific locations, leaving other locations underdeveloped, has been attributed to these latter forces. It has been argued that locations which enjoyed an initial advantage such as a large population size (i.e. large potential consumer market) have been able to attract all footloose industry once a self-reinforcing trend process has set in: given that firms want to locate close to their main market, they move to the location with the initially largest population size (everything else being equal). But population size is largest exactly where most industry is located (Krugman, 1991)[5]. Conversely, a location which has been at an initial disadvantage would lose out altogether and would become entirely dependent on imported manufactured goods. Given that such a location can no longer rely on its own market size to attract firms as it could when trade costs were higher, the national/intermediate government has to restore to specific economic policies to do just that.

However, most of the 'new economic geography' literature so far has not given the role of policy makers and other large scale agents in shaping the economic landscape the deserved attention: '[T]he future research agenda for economic

4 See also the Financial Times (1995b) for a survey on business locations in Europe.

5 This story requires labour mobility. Venables (1996) generates a similar story by assuming vertical linkages between firms.

geography is vast... The question of what regional integration does to industrial concentration is important, but as yet it is not well understood. Even more detailed questions such as what are the best policies in order to help disadvantaged regions are even more pressing (at least in Europe) but are even less well understood. There is much informal reasoning and 'common wisdom' (e.g. the central government should build more physical infrastructures such as roads and telecommunications systems, and promote more investment in human capital by building and improving schools). In fact these policies have failed dismally in some cases (southern Italy) but have enjoyed some success in others (Ireland and Portugal)' (Baldwin, 1994, p. 46) and also Fujita and Thisse: '[T]he question of regional convergence/divergence has at last received the attention it has long deserved... However models are still too preliminary to draw strong policy recommendations... In particular, we do not know much about the circumstances that lead a region to recover. In the real world, we observe that some regions are successful in their economic revival while others seem to decline inexorably. It is not always clear why such different evolutions arise... So far we have very few insights about what could well be a "good" infrastructure policy in the context of a spatial economy' (Fujita and Thisse, 1995, p. 41).

Several policies are feasible and are used by governments to attract firms: tax holidays (see for instance Mintz, 1989), guaranteed public demand in the form of specific government procurement programmes (Trionfetti, 1996)[6], a reduction in 'red tape' to improve government efficiency and business conditions (Gore, 1993), the creation of regional development agencies (Council of Europe, 1985)[7], and the provision of local productive public goods are just some of them. In this chapter we want to shed some light on the observations made by Baldwin: why is it that regional

[6] The Commission of the European Communities notes that public procurement is a powerful economic policy to stimulate economic activity (Commission of the European Communities, 1993a).

[7] These development agencies have been studied by Bartolome and Spiegel (1997) who find a strong positive correlation between state spending on development per worker and state manufacturing employment growth.

policies, such as the provision of physical infrastructures, succeed in attracting firms to a region in some cases but not in others?

The provision and/or updating of local public goods such as infrastructure is seen as crucial by policy makers for the development of a region and/or to keep it competitive. This view is based on many empirical studies (see for instance Biehl, 1992 and Vickerman, 1990). In Europe, policy makers at different regional levels have been engaged in improving the provision of local public goods. Consider the case of Eastern Germany: since the unification with West Germany, the German government has invested heavily into the improvement of local infrastructure such as telecommunications, roads or the railway network[8]. These investments are considered to be necessary to attract private investment into the Eastern German states and to support a local industrial base. At an urban level, London and Barcelona can both be used as examples: in the former it has been argued that improving existing infrastructure is crucial to maintain London's position as a world city. The Corporation of London and 'London First/Pride Partnership' have both argued that especially the transport network has to be upgraded to prevent London from losing business to competing cities such as Paris or Frankfurt, suggesting a £ 23 billion investment programme until the year 2010 (The London First/Pride Partnership, 1994 and Financial Times, 1995a)[9]. Barcelona is a case in which massive investments into its local public goods have helped to transform the city from a declining industrial location to one of the most dynamic regions of Southern Europe (Commission of the European Communities, 1993d). On an inner-city level, the provision of local public goods (e.g. The Docklands Light Railway, The Limehouse Link, the Jubilee Line

8 It has been estimated that DM 500 billion are necessary to bring the Eastern German infrastructure up to the West German level (Rürup, 1993). Note that the financing of these infrastructure projects can be done directly through the Federal budget or indirectly as in the case of telecommunications for which Deutsche Telekom, then a state monopoly, was in charge.

9 The Corporation of London is the administration of the City of London in which most of the financial sector is based. 'London First/Pride Partnership' is an association of London's industry which promotes London as a business location.

extension) has been fundamental to the eventual success of the London Docklands development.

It has to be noted though that the above mentioned examples have all benefited from outside financing of the projects. The states of Eastern Germany have received transfer payments from Western Germany and the European Union as a whole, Barcelona received most of its infrastructure during the preparation of the 1992 Summer Olympics which were a national event. The London Docklands Development Corporation which was in charge of the development in the Docklands area was mainly publicly funded. Generally, countries and regions within the European Union and similar political environments can rely on outside assistance in stimulating manufacturing production and growth in their location. '... [F]ollowing the signing of the Single European Act, the Treaty of Rome was amended to include a ... section devoted to 'Economic and Social Cohesion' (EEC Title V). The objective of the EC in regional policy terms are made clear:
'In order to promote its overall harmonious development, the Community shall develop and pursue its actions leading to the strengthening of its economic and social cohesion.
In particular, the Community shall aim at reducing disparities between the various regions and the backwardness of the least-favoured regions (Article 130a EEC)' (Cole and Cole, 1993, p. 224). One way of achieving economic and social cohesion has been through labour mobility from the backward to the more industrialised regions. Another way has been through transfers which provide financial assistance by the more advanced regions to the more backward regions. (Cole and Cole, 1993). In addition to national policies, the 'EC Structural Funds' were one of the instruments created to achieve the goals: over 80 per cent of the Regional Development Fund were used to fund infrastructure projects (Vickerman, 1991, p. 1), with the overall transfers representing up to 3 per cent of Gross National Product of certain benefiting member states (Christopherson, 1994). In 1992, the Maastricht treaty put these Union policies on a new base: in addition to the Structural Funds which were to receive 161 Billion

Ecu between 1993 and 1999, the European Cohesion Fund was set up to cofinance projects especially in the poorest member states Spain, Greece, Portugal and Ireland (Commission of the European Communities, 1993b)[10].

We want to consider the extreme case though in which a region is self-financing its local public good provision[11]. This assumption is admittedly unrealistic as no region is fully independent of outside financial support[12]. However, the former communist countries of Central and Eastern Europe such as Poland, Bulgaria and Hungary (Baldwin ,1994), Norway and Switzerland in Western Europe, the NICs, and also countries as diverse as South Africa or Argentina might come close to meeting this assumption. However it can be argued that the forces we want to study also exist - albeit to a lesser extent - in countries and regions which do not depend entirely on self-financing. Countries and regions within that group still complement outside financial support with 'local' policies. In doing so, we follow Dicken who '...[d]emonstrate(s) some of the ways in which nation states contribute to the shaping and reshaping of the global economic system. All states are engaged in a broad variety of trade, investment and industry polices; only the *degree* of involvement varies from one nation to another' (Dicken, 1992, p. 186). Note that throughout the discussion the main objective of a regional government is the 'industrialisation' of its economy, i.e. raising the fraction of the labour force employed in the industrial sector. We thus interpret industrialisation as the main characteristic of development. This economic policy is called 'smokestack chasing' in the literature (see for instance Bartik, 1994), the prime goal being to induce manufacturing firms from *outside* the region to *relocate in* the region (Bartolome and Spiegel, 1997). Other - and equally valid -

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10 For a very detailed country by country survey on regional incentives available for industrial and business relocation in Europe see Yuill et al. (1994).

11 We relax this extreme assumption in the last section of Chapter two.

12 Every country/region receives some form of outside financial support. It is either integrated into a trading bloc (e.g. the EU), part of a country (e.g. the states of the United States), or they receive financial support from other international institutions such as the World Bank.

interpretations can be based on the increase in gross domestic product (GDP) per capita, the reduction of underemployment or unemployment, and the reduction of income disparities in regions etc. However, the framework developed rules out these interpretations and focuses entirely on the industrialisation aspect.

Given that the above mentioned economic policies have to be financed in some way, the question of the optimal size of the public sector arises[13]. The UK government, for example, has promised to reduce its public sector share to below 40 per cent of Gross Domestic Product - claiming that this is necessary for a dynamic economy. '[T]he UK is unique in having attributed a magical significance to the 40 per cent figure. But the equation of good government with small government is a global phenomenon... To focus on the sheer size of government is to ignore ... what matters about a given chunk of public spending is not its size, but the way it is spent' (Financial Times, 1997). This implies that a government could justify a large public sector *as long as* it is efficient in the way it spends its tax revenues: '[E]ven in those sectors which have remained largely under state control, the government ... believes that ... reforms have made them more competitive. It follows ... that the 11 ½ per cent of GDP spent on public education and health next year will have a very different impact on national economic efficiency than the 11 per cent of GDP the government spent on them in 1979' (Financial Times, 1997). These general observations are likely to be valid also for the more specific policies designed to attract firms. What matters are not only the benefits offered to the firms (in the form of a high quality and efficient local public provision) but also the cost involved. And these costs depend on the efficiency level within the public sector.

[13] Rodrik (1996) tests the hypothesis that the size of the public sector in a country depends positively on the degree of the economy's openness to trade. He finds supportive evidence from a large cross-section of countries. As a possible explanation, he proposes the following: '[M]ore open economies have greater exposure to the risks emanating from turbulences in world markets. We can view large government spending in such countries as performing an insulation function, insofar as the government sector is the "safe" sector ... relative to other activities' (Rodrik, 1996, p. 13).

Chapter two of this thesis analyses in which way economic policies can affect the distribution of firms in space - as seen from the viewpoint of a backward region which tries to attract firms from a more developed region. Do well formulated and executed policies always succeed in attracting firms? If not, what are the causes for failure? Has deeper economic integration made it easier or more difficult for a backward region to construct successful policies? In order to answer these questions, we introduce a public sector into a standard economic geography model of the type advocated by Krugman and Venables (1995) and Venables (1996). Surprisingly few models have attempted to incorporate public sectors into these economic geography models. Martin and Rogers (1995), Trionfetti (1996) and Spatafora (1997) are notable exceptions. However only the former are concerned with public goods provision, the other two are interested in public procurement programmes (Trionfetti) and trade policies and foreign direct investment (Spatafora). We analyse which factors are likely to affect the success rate of industrial policies aimed at attracting mobile firms.

We assume that the public sector's output has a direct and cost-cutting effect on the manufacturing firms located in the region (see for instance Holtz-Eakin and Lovely, 1996)[14], i.e. the higher the quality of the public sector output (such as public transport, education or health service), the lower the production cost of the industry. Following McMillan who defines '[p]ublic intermediate goods are goods such that the whole amount supplied enters the production functions of several firms' (McMillan, 1979, p. 294), local public goods are necessary for the production of an industrial sector which produces goods for local consumption and export. Specifically, we assume 'factor-augmenting public inputs' which improve the productivity of private factors (Feehan, 1989). The provision of the local public good is financed by a tax on the immobile factor of production - labour.

[14] For empirical evidence see for example Morrison and Schwartz (1992).

We find that the size and efficiency of the public sector are two important factors determining whether the regional government can induce manufacturing firms to move to its region. However, the economic forces as discussed in the 'new economic geography literature' are also very important. We can therefore offer further theoretical support to the empirical observations made: '[T]he results of a very large number of functions estimated ... can be ... summarized as follows: ...
The estimated contribution of infrastructure to regional development declines if the other potentiality factors, location, agglomeration and sectoral structure are explicitly introduced into the production functions. Infrastructure nevertheless remains significant. This supports the theoretically derived proposition that infrastructure is one of the main determinants of regional development, but that the other determinants exert significant influence, too. Regional development, therefore, cannot be based on infrastructure policy alone' (Biehl, 1992, p. 14).

The increased 'interconnectedness' of economies in the post war era has also presented a changing framework for national and intermediate level governments in which to formalise and pursue domestic economic policies. This 'interconnectedness' can arise through several channels: first through labour mobility, second through capital mobility (e.g. firm relocation), and third through trade of goods[15]. The post war era has brought increased mobility in all three areas and it thus that policies which have been primarily targeted at the domestic economy - including the provision of local public goods - are now having stronger effects on other economies.

Consider labour mobility: the question of whether independent jurisdictions oversupply or undersupply local public goods has attracted much attention: '[P]ersuasive arguments can be given both sides of the issue. A typical argument for undersupply would run as follows: Local communities will tend to discourage expansionary projects because such projects will encourage in-migration and increase

[15] The second channel forms the basis for Chapter two of this thesis.

congestion to current residents... A contrasting argument for oversupply can be given. Communities, in attracting residents, can bid tax revenue away from others; the extra tax revenue can be used to spread the costs of a given provision of public goods more thinly over the original population...' (Starrett, 1980)[16]. Labour mobility also provided the foundations for Tiebout's (1956) famous response to Samuelson (1954). Tiebout argued that mobile citizens would reveal their preferences regarding the provision of public goods by their choice of residence from a wide selection of jurisdictions. Given that there exists a large number of jurisdictions, so that citizens would find one which offers exactly their preferred revenue and expenditure scheme, efficiency can be reestablished even with public goods[17].

The effects of capital mobility on the provision of local public goods has also been extensively studied by the tax (fiscal) competition literature. The focus of attention has been on independent jurisdictions and governments which compete against each other to attract mobile capital (i.e. footloose firms) to their respective regions. It has been shown that in such a competitive environment, tax rates on capital are set too low and that the resulting tax revenues are not high enough to finance the optimal amount of local public goods for which the government is responsible. There is thus a sub-optimal provision of local public goods: '[W]ith the economy's total capital stock assumed to be fixed, the lost investment from a higher tax in one jurisdiction represents a positive externality, because capital becomes more plentiful in other jurisdictions... A tax-induced capital outflow is a cost from the single jurisdiction's viewpoint, but not from the entire economy's viewpoint' (Wilson, 1995, p. 333). This literature is vast and includes work by Wilson (1984), Wildasin (1987, 1989), Wildasin and Wilson (1991), Oates and Schwab (1988), and Bucovetsky

16 The 'theory of local public goods' deals specifically with issues such as the determination of the allocation of the population among different communities (see for instance Stiglitz, 1977). Wildasin (1987) also offers a survey on the theory of local public economics (see also Atkinson and Stiglitz, 1980 and Myles, 1995 on that issue).

17 Samuelson (1954) claimed that citizens would have an incentive to underreport their willingness to pay for public goods so that these goods would be undersupplied in equilibrium.

(1991). Wilson (1995), for example, combines labour mobility with capital mobility, whereas Hoyt (1991) introduces taxation on immobile factors of production such as land. Policy coordination between the competing jurisdictions is seen as one way to solving this problem. Generally a higher level of government is suggested which could coordinate lower-tier economic polices. However, this approach has been criticised for not taking into account the complex interactions between the different levels of government (see for instance Keen and Kotsogiannis (1996) and Keen (1996)). It also raises the question why economic policies are not pursued by the higher-tier government in the first place.

It seems surprising that most of the theoretical literature dealing with local public goods provision and taxation issues considers the importance of capital and labour mobility, but not the trade in goods. As argued above, the volume of trade in goods between industrial countries has increased vastly in the last decades, i.e. between countries which are relatively similar in their economic structures. This fact can only be explained by intra-industry trade, which has been defined as '[t]he simultaneous export and import of goods belonging to the same industry' (Grimwade, 1989, p. 89)[18]. Indeed, the share of intra-industry trade as a proportion of total trade in manufactured goods in 1986 has been estimated to be 80.4 per cent for France, 79.1 per cent for the UK, 65.4 per cent for West Germany and 60.7 per cent for the United States (Grimwade, 1989). These observations were the motivation for the 'new international trade' literature which was established in the late 1970s (see for instance Krugman, 1979, 1980). However, its focus of attention has been towards strategic trade policies and related issues (Brander and Spencer, 1984, Eaton and Grossman, 1986, and Venables, 1987), and not so much on policies which have a distinctly domestic emphasis such as local public goods provision.

18 For an informal discussion on intra-industry trade see Grimwade (1989), pages 126-138.

Chapter three of this thesis analyses the effects of the increased volume of intra-industry trade on domestic public goods provision and taxation policies - thus bridging the two separate strands of literature which have been developed in the public economics and the international trade fields. To do so, Chapter three incorporates aspects of both strands of literature and also draws heavily on the framework developed in Chapter two such as 'factor-augmenting' local public goods and taxation on labour income in a two region setup. We find that increased economic integration (as reflected by a fall in trade costs) raises the level of potential 'spillovers' of domestic economic policies into the foreign economy. The externality studied here is quite different though to the ones mentioned above: the benefit of local public goods provision is embedded in the industry's output which is sold in both the domestic and the foreign market. Closer economic integration raises the volume of intra-industry trade and it is thus that more of the benefit is 'exported' to the foreign region. The consequences are similar to the ones described by Wilson in that '...[O]utflow is a cost from the single jurisdiction's viewpoint, but not from the entire economy's viewpoint' (Wilson, 1994, p. 333). Noting that the tax burden on the domestic citizens does not vary with changes in economic integration, we can find that a regional government has an incentive to underprovide the local public good - a tendency which becomes the stronger, the deeper the level of economic integration. Wildasin (1993) is closest in spirit to the model presented here: he studies the effects of tax and expenditure policies in one jurisdiction on the wages and welfare level in another jurisdiction when these are linked through inter-industry trade. We conclude that closer economic integration has to go hand in hand with closer economic and political cooperation to yield the full benefit of the former.

Chapter four of this thesis focuses on a lower tier of policy making: we study local government and its policies in the context of urban areas. Urban economics is the branch of economic theory which deals specifically with the questions and problems arising in urban areas (see for instance Henderson, 1985 and Fujita, 1989). Much of the basic theory of urban economics is based on the pioneering work of

Alonso (1964) who introduced the concept of 'bid-rent functions' into an urban framework: assuming the existence of only one business district (generally located in the urban centre and therefore called the central business district - CBD) in an otherwise featureless plain, identical citizens maximise their utility by choosing over their residential location and consumption goods. Amenities such as the distance to the centrally-located workplace are 'location-specific' and create a heterogeneity in the otherwise homogeneous plain. Citizens are prepared to bid the highest rent for the most desirable location. In the simplest model, where distance is the only 'location-specific' amenity, a location is the more desirable, the closer it is to the CBD and therefore yields the highest land rent. This is because such a location minimises the commuting cost which has to be incurred by workers (Straszheim, 1987)[19]. Firms face a similar problem within the CBD and are prepared to pay the highest rent for the most desirable location within it - generally the centre as that contains the central transportation node of the urban area. This simple setup generates a falling land rent gradient away from the centre, a result which is generally supported by empirical evidence (see for example Coulson, 1991). The spatial equilibrium configuration of the urban area thus depends on the optimising behaviour of the two types of atomistic agents: residents and firms[20].

Building on this simple framework, many modifications and extensions have been made (Henderson, 1985). Here we want to concentrate on the extensions which are of relevance to Chapter four. The first one is the introduction of land use zoning[21]. Generally it has been argued that negative externalities can arise due to 'non-conforming' land use. Technological externalities such as pollution created by the

19 An alternative interpretation is given by Beckmann (1974) and Henderson (1985) who argue that such a location would minimise the 'foregone' leisure time due to commuting.

20 Such a setup also endogenously determines the size of the CBD: firms and citizens compete for the same plots of land, and the highest bidder receives the right to use it. It can be shown that at a given distance x from the centre, citizens are willing to pay a higher land rent than firms. This distance x then marks the edge of the CBD and the beginning of the residential area (Alonso, 1964).

21 For a survey on land use zoning, see for example Pogodzinski and Sass (1990).

industrial sector in the CBD can be one of them (see for instance Stull, 1974)[22]. The racial and social mixture of a neighbourhood can also be considered to be a 'location-specific' amenity and can also lead to 'non-conforming' land use (Becker, 1957). In these cases it can be shown that land use zoning can raise the welfare level of the local citizens. Zoning, however, requires a large agent such as a local government which can act in the interest of the atomistic agents.

Second, the assumption of mono-centricity has been relaxed. By doing so, observations such as the move of manufacturing or services to the urban periphery, or the retail sector's decision to follow the suburbanisation trend of its customers have been taken care of (Straszheim, 1987)[23]. Two approaches have been taken: the first has been to *assume* the existence of a second business district (see for example Rubinfeld, 1978 and Yinger, 1990). The second approach has been to *endogenously* generate the possibility of multi-centric outcomes. Fujita and Ogawa (1982) treat the spatial configuration as the outcome of interactions between firms and residents. Firms favour agglomeration, whereas residents want to live as close as possible to their workplace in order to minimise commuting cost. The consumption of and competition for land works against agglomeration though. Fujita and Ogawa show that monocentric and non-monocentric outcomes are both possible - which one represents the equilibrium configuration depends on the parameter values chosen. Note that in both approaches, the equilibrium configuration is determined by the atomistic agents only.

Third, the literature has been extended to include a second type of large scale agent in addition to the local government: land-developers (Henderson, 1974). Building on this work, the problem for the land-developer *when* to develop land from non-urban to urban use has been studied (Arnott and Lewis, 1979), Bar-Ilan and Strange (1996) consider the effects of the uncertainty created by time lags between the

22 In that case the citizens living closest to the CBD are the most affected.

23 These two trends have, respectively, led to the creation of industrial/business parks and out-of-town shopping malls and warehouses.

application and completion of development. Anderson (1993) analyses the effects of externalities created by such developments. Henderson and Slade (1993) present a model in which land-developers give rise to non-monocentric cities.

The importance of land-developers in shaping the economic landscape has been discussed only recently. Becker and Henderson (1996) analyse the importance of land-developers in the formation process of cities. They argue that so far this formation process has been approached in two different ways in the literature: '[A]t one extreme (Henderson, 1974), there are large agents in national land markets ... who can orchestrate large scale movements of people. At the other extreme ... (Krugman, 1993), large agents are non-existent and cities form through "self-organisation"' (Becker and Henderson, 1996, p. 3). Rauch (1993) argues that business park developers are under specific circumstances necessary to encourage firms to move from an old and high-cost site to a new and low-cost site. Due to agglomeration forces within the industry, firms can be locked-in at the old site, preventing an individual firm from moving. By differentiating the rental price of land *over time*, the land-developer can create incentives for individual firms to break away from the industrial cluster and move to the new location. Once one firm has moved, more firms will follow, eventually leading to the complete shift of economic activity to the new site. It is thus that the land-developer is able to influence the spatial distribution of economic activity. On an even larger scale, Henderson and Mitra (1996) consider the creation of 'edge cities' by land-developers. These edge cities are self-contained towns with business districts, residential areas etc. They study the optimal location and capacity choice faced by the developer, assuming that the traditional city's capacity remains fixed.

The model presented in Chapter four builds on some of the extensions mentioned above. In the first section of the model, we present a fixed sized and closed (i.e. there is no migration) urban area with one central business district in which residents and monopolistically competitive firms compete for land. It is shown that land use zoning is welfare improving over the market outcome not because of the problem of 'non-conforming' land use but because of the pecuniary externality created by the monopolistically competitive firms.

In the following section we *assume* the existence of a second business district which is located out-of-town. This extension enables us to analyse another economic development of international importance: in addition to the above mentioned global changes which have affected the location of economic activity *across countries or regions*, there have also been changes which have affected the location of economic activity *within urban areas*. Historically, most economic activities have been based within the urban area but the post war era has seen major relocations. Manufacturing industry, for example, has shifted production out of urban areas to peripheral locations[24]. Retailing has also undergone major changes, and the 1960s and 1970s have witnessed the 'retail revolution'. Retailing, for example, was characterised by small, family-owned shops which were located in the town or city centres. These traditional centres were the dominant if not the only shopping location. The rise of car ownership and changing demographic patterns have led to a fundamental restructuring of the retail trade: previously unattractive out-of-town sites have become attractive retailing locations, competing with the traditional town centres for shops and costumers. This development started in the 1950s in the United States, establishing itself as a major economic trend in other industrialised countries such as France and Germany by the early 1970s (Walker, 1996).

The relocation of industry to peripheral locations and the shift of retailing activity has been helped and encouraged by the development of appropriate sites in the form of industrial/business parks and out-of-town shopping centres and warehouses. It is through these sites that land-developers have been involved in shaping the economic landscape of urban areas (see for instance The Financial Times,

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24 It is best here to think of light industrial production. Changes in production techniques, logistics and improved telecommunications infrastructure have encouraged many firms to relocate.

1996). Chapter four of this thesis argues that the rise of land-developers (i.e. a large scale agent) has affected the framework in which local governments - previously the only large scale agent - pursue their local economic policies. Specifically we ask in which way land use zoning policies have been affected. To answer this question we consider the dual-centric urban area and initially assume that all land is owned and developed by the local residents. This assumption implies that all land rents are fed back into the local economy. Even though extreme, it can be argued that this assumption is appropriate for small to medium sized towns and cities in which absentee landlords play a minor role. We derive the optimal land use policy to be followed by the local government. This case is compared with a scenario in which the out-of-town site is developed and managed by an outside land-developer which transfers the rental income to its absentee headquarters[25]. Undeniably even small to medium sized towns and cities have been affected by the above mentioned changes, with many of these out-of-town developments being huge compared to the size of the traditional town centre. We show in which way optimal local economic policies are affected by the existence of absentee landlords and the resulting outflow of rental income.

Chapter five of this thesis provides a brief summary of the conclusions drawn in the individual chapters.

[25] As argued above, many land developers operate nationally or even internationally, e.g. Arlington as a business park developer in the UK (see The Financial Times, 1996). On the retail side, the big retail chains such as Tesco, Sainsbury etc come to mind in a UK context.

Chapter 2

The effects of industrial policy on the location decisions of firms

1. Introduction

One striking phenomenon observed in the world is the uneven spatial distribution of economic activity. Industrial production tends to agglomerate in particular regions, leaving other parts of a country or continent relatively less developed. In Europe, for example, most economic activity is located in the so-called 'European banana' which stretches from England's southeast to the plains of northern Italy via France, Germany and the Benelux countries (Cole and Cole, 1993). A similar observation can be made for the United States where industrial production used to be and still is concentrated in the 'manufacturing belt' of the northeast (Krugman, 1991a).

The early 1990s witnessed the revival of interest into that phenomenon. Krugman (1991) demonstrates how a country (or more generally a region) could endogenously become differentiated into an industrialised 'core' and an agricultural 'periphery'. Assuming economies of scale in production, manufacturing firms try to minimise the number of production sites they have and tend to locate these in the region with the highest consumer demand in order to minimise transportation costs. However, consumer demand is highest where the most manufacturing workers (and hence firms) are located. This circular causation argument is then the main force behind the agglomeration trend of firms. Krugman's initial model requires inter-regional labour mobility to generate these results. Venables (1996) argues that vertically-linked industries could generate similar outcomes: vertically-linked industrial clusters generate their own demand as downstream firms demand intermediate inputs from upstream firms - establishing a market independent of the final consumer market. Upstream firms thus want to be close to the downstream firms, a market access effect. Moreover, the more upstream firms are located in one region, the lower would be the price index for intermediate inputs for the downstream firms in that region, a cost effect. Venables concludes that vertically-linked industries could fully agglomerate in one region and serve the other region by exporting to it, without the need of labour mobility[26].

The results derived in these models depend entirely on the decisions taken by utility-maximising consumers/workers and profit-maximising firms, i.e. atomistic agents. However, large scale agents such as local or national governments also try to influence the geographical distribution of economic activity - a fact generally ignored in this literature. Trionfetti provides one of the few exceptions: he introduces public procurement schemes into the standard core-periphery model of Krugman (1991): '[G]overnments are assumed to collect taxes and provide publicly an impure public good ... Many types of infrastructures (such as electricity networks or telecommunication) and, to some extent law and order, could be comprised within this type of public good. It is assumed that the presence of this good does not affect the production decisions' (Trionfetti, 1996, pp. 2-3). He compares an "American" style scheme with a "European" one. In the former, he assumes that the '[S]tates expenditure follows the geographical location of producers precisely as private expenditure does. Governments do not use (this scheme) as a policy instrument and therefore government procurement under this scheme does not affect location decisions'. In comparison, European governments are assumed to spend their expenditure on domestic firms: '[U]nder the "European" scheme the geographical allocation of government expenditure is dynamically independent from the location of producers' (Trionfetti, 1996, p. 10). Closer in spirit to the model presented here is a model developed by Martin and Rogers. They '...[p]ropose a new way to model different types of public infrastructure, which allows us to analyze its impact on trade patterns, industrial location, and welfare... Poor infrastructure imposes costs on trade within and between countries... We differentiate between infrastructure that facilitates domestic trade (...) and infrastructure which facilitates international trade (...)... This

26 This result depends on the underlying economic parameters, such as the degree of economies of scale, the magnitude of the linkages between industries and the size of the final consumer demand in the regions. The importance of these and other factors is discussed later in the chapter.

way of modelling public infrastructure departs from earlier models, such as Arrow and Kurz (1970) and Barro (1990) in which infrastructure is an input in the production function. These models cannot address the role played by infrastructure in regional integration because they do not capture the function of infrastructure in facilitating trade within and between countries' (Martin and Rogers, 1995b, pp. 336-339)[27].

It is generally acknowledged that governments want to have a 'fair share' of industrial production in their region and introducing policies aimed at attracting mobile industries is thus a major issue for every government[28]. Past and current UK policy, for example, has been to set up so-called regional development agencies which have successfully attracted many companies (e.g. the Welsh Development Agency)[29]. The UK generally proved to be one of the most popular destinations for capital investment in the 1980s and 1990s: over the period 1984-1992 the UK was the most attractive market for foreigners, receiving almost 43 per cent of direct investment made by foreign countries in the EU (Office for Official Publications of the European Communities, 1995). Many companies invested heavily into production facilities in the UK. One reason for doing so has been the size of the domestic UK market itself. Locating in the UK also meant that the other main European markets could be supplied at relatively low cost. In a recent study on location factors and location decisions it was argued that: '[O]f the individual factors, proximity to markets was by far the most significant ... Although access to the EC market overall is the most important factor, many companies also like to have a strong national market for their production ... Proximity to major customers is another key factor at the country level. Some companies, particularly those supplying components had invested in a country in order to increase market share ... The availability of inputs is relevant as both a

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27 See also Spatafora (1997) for another exception. He introduces multinational firms, foreign direct investment and trade policies such as tariffs into a two region core-periphery model.

28 It is expected that mobile firms create new jobs and thus help to combat the unemployment problem which exists in many regions. This issue is, however, not discussed in this model.

29 See Economists Advisory Group Ltd (1994) or Price et al. (1994) for case studies.

country and a region factor ... The development of a specialized component-producing economy also attracts new investment in the end-product industry. This reflects the industry linkages in the automotive and the electronics industry' (Commission of the European Communities, 1993, pp. 77-99). In the case of the motor industry (e.g. Nissan at Sunderland in 1986), this process has actually happened: car components manufacturers have located close to the car manufactures which in turn have reinvested into new facilities due to the close proximity of components suppliers. This is the process which has been analysed by Venables (1996).

More generally though, there is a debate among political parties on the role of governments in this context: on the one hand it is argued that a small public sector is important for a dynamic economy[30], on the other hand it is claimed that more and not less public involvement is required to attract industries, referring to improved education or public infrastructure standards (The Economist, 1995). These suggestions are in line with observations made by the European Commission: '[I]n the 1980s, public poliey to attract mobile investment was focused on the development of a favourable investment climate ... ~~As~~ ... the location choice of companies hinges upon production factors, public policy was designed to improve such operational attributes as the availability of labour ... Training schemes were initiated to enhance the quality of the work-force...' (Commission of the European Communities, 1993, p. 77).

The purpose of this chapter is to shed some light on the above mentioned debate of whether a small or a large public sector is better suited to attract firms. We want to analyse in which way the ability to attract firms is affected by the size and efficiency level (see page 18 of this thesis) of the public sector. The objective of this chapter is therefore to formalise the role of the public sector in influencing the distribution of economic activity in space, focusing on the two activities of tax raising and local public good provision. We want to concentrate on the case of a backward

30 See page 18 of this thesis' introduction.

region which tries to attract manufacturing industry into its region. We analyse which policy mix (i.e. low taxation and a low level of public good provision versus high taxation and a high level of public good provision) is most likely to succeed in attracting industries. The chapter then goes on to investigate which other economic factors determine the location of firms in space and shows that even the 'best' policy mix may not be good enough to attract firms into a region. This allows us to analyse why such policies may have failed - addressing some of the points made by Baldwin (see page 14 of the introduction).

This chapter is organised as follows: the next section formalises the regional economies and policy instruments available to the regional governments. Section 3.1 analyses the agglomeration forces within the industries as long as the governments are 'symmetrically active' in the sense that they follow the same policies with the same efficiency levels. We study the ability of a backward region's government to attract firms in such a case. Section 3.2 assumes that government activity is asymmetric in the sense that the regional governments might choose different policies or have different efficiency levels in implementing them. Once again we study whether a backward peripheral region could attract firms from an 'industrialised' core. We then go on to do some comparative statics, analysing the effects of several different parameter values on the attractiveness of the backward region. Section 4 briefly outlines the implications of relaxing several assumptions made throughout this chapter. Section 5 concludes. The appendices derive some of the results presented in this chapter.

2. A formal model with government activity

We imagine a world consisting of two regions, Home (H) and Foreign (F). In this section we describe one region's economy, noting that the same setup applies to the other region as well. The region consists of many identical citizens and a government which tries to attract firms by following a tax raising/local public good provision policy. Citizens provide the only factor of production, labour L, which is normalised to unity. We impose the restriction that labour is regionally immobile, i.e. there is no migration between the two regions, however labour can freely move between the economy's sectors. Individuals have identical endowments of one unit of labour and can either be employed in the public sector - in which case they provide the local public good - or in the private sector. The private sector consists of two industries: the first industry produces subject to constant returns to scale (CRS) a 'y-type' good which we use as the numéraire[31], the second industry produces subject to increasing returns to scale (IRS) manufactured goods - denoted by 'x' - which can be used for final consumption or as an intermediate input in the production of other manufactures. The labour force is split into these three sectors so that:

$$L_g + L_x + L_y = 1 \,, \qquad \textbf{(2.1)}$$

where L_g is the fraction of workers in the public sector, L_x is the fraction of workers in the IRS-sector and L_y is the fraction of workers in the CRS-sector.

2.1 Private demand and utility

Let us assume that all individuals have identical consumption preferences and that a representative citizen spends his/her income on the numéraire and on an aggregate X of manufactured goods with Cobb-Douglas preferences. The indirect utility V of a consumer has the following form:

$$V_s = \frac{w_s(1-t)}{P^{(1-\gamma)} p_y^{\gamma}} \,, \qquad \textbf{(2.2)}$$

where w_s is the nominal gross wage in the sectors with s = x, y and g. t is the income tax rate with $0 \leq t \leq 1$ which is imposed by the regional government to raise tax

[31] In the economic geography literature the CRS-sector is normally interpreted as the agricultural sector.

revenues, so that w_s (1 - t) is the disposable income. γ is the fraction of disposable income spent on the CRS-sector good with $0 < \gamma < 1$[32], p_y is the price of the numéraire good so that $p_y = 1$, and choosing the units of the CRS-good so that one unit of output requires exactly one unit of labour input we also have $w_y = 1$. Trade between the two regions is possible, but only at a cost: whereas the CRS-sector good can be costlessly transported between the two regions, shipment of the IRS-sector goods involves cost of the 'iceberg' type: of every unit of an x-good shipped, only a fraction $1 / \tau$ - with $\tau \geq 1$ - arrives in the other region and the rest melts away. τ represents the transportation cost of the manufactured goods between the two regions and reflects natural and/or artificial barriers to trade such as tariffs. Following Dixit and Stiglitz (1977), the price index for the aggregate of manufactured goods is given by:

$$P = \left(n p_{xi}^{(1-\sigma)} + n^* (p^*_{xi} \tau)^{(1-\sigma)} \right)^{\frac{1}{(1-\sigma)}}, \tag{2.3}$$

where the asterisk denotes the variables of the 'other region'. n and n* are the number of firms in the two regions, whereas p_{xi} and p^*_{xi} are the prices charged by an individual firm i in the two regions. Furthermore σ - which is larger than one - is the elasticity of substitution between the different varieties of the manufactured good and thus reflects the degree of economies of scale which could be exploited by a firm. It can be seen from (2.3) that a larger regional economy, as reflected by a higher n, would support a lower price index P.

2.2 The public sector

Turning to the public sector, it is assumed that its budget is always balanced and that all of the tax revenues are spent on hiring citizens. These citizens are then employed to provide some form of public good which is *productive in nature for the*

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32 This assumption guarantees that goods from both private sectors are always demanded.

IRS-manufacturing sector and required to transform 'raw' labour L into the input factor M (for Modified labour)[33]. As stated on page 19 of the introduction, we follow McMillan in assuming that '[p]ublic intermediate goods are goods such that the whole amount supplied enters the production functions of several firms' (McMillan, 1979, p. 294). It is thus that the number of firms over which the public good is spread does not affect the benefit of provision to an individual firm; what matters is the level of provision. We assume that the level of public good provision is a function of the tax revenues collected by the government. We make three simple assumptions: first, without any tax revenues, the amount of public good provided must be zero. Second, the higher the tax revenues, the more of the public good can be provided. Third, we want to rule out that the amount of modified labour M can exceed the amount of "raw" labour L - whatever the level of tax revenues. This captures the idea of transformational loss. We could, for example, imagine that the public sector provides a public transport service and that the transformational loss is due to the commuting of the labour force to the IRS-sector. The higher the tax revenues, the higher the quality of the transport service, leading to less time spent commuting. The best the transport service could achieve though would be zero commuting time. Another example could be publically financed and provided vocational training. The higher the tax revenues, the higher the quality of the courses, and hence the less time a citizen would require to gain the skills necessary to work in the IRS-sector.

The total amount of M available in the region therefore depends on the amount of tax revenues T and the amount L_x of labour to be transformed. Generally we can write $M = G(T,L_x)$, where G is assumed to be homogeneous of degree one with respect to L_x. Note that because of $L = w_s = 1$[34], total tax revenues T are identical to the tax rate t. We can therefore write:

[33] We thus assume that infrastructure enters the production function as an input factor. Note Martin and Rogers' (1995) comment on that approach, as quoted on pages 32 - 33.

[34] Due to free labour mobility between sectors, wages are equalised.

$$M = G(T, L_x) = g(T)L_x = g(t)L_x. \qquad \textbf{(2.4)}$$

The above mentioned assumptions can be stated as follows:

ASSUMPTION 2.1

(a) $g(0) = 0$

(b) $g'(t) > 0$

(c) $g(t) \leq 1 \qquad \forall\, t \in [0; 1].$

The implications of these assumptions will be analysed in the subsequent sections. Also note that, due to the free mobility of labour between sectors, the government has to pay a wage $w_g = w_y = 1$. This implies that the public sector employs $L_g = t$.

2.3 The IRS-manufacturing sector

In this section we use several modelling tricks which are generally applied in the 'new economic geography' literature. Firms in the IRS-sector produce a potentially large number of differentiated products of type 'x' and use M and a composite manufactured intermediate good I as input factors[35]. I is assumed to be identical to the composite consumption good so that the price indices of the two goods are the same. Production in this sector takes place in two distinct steps: in the first, M and I are combined with Cobb-Douglas technology to create the required final input factor Z:

$$Z = I^{\mu} M^{(1-\mu)}, \qquad \textbf{(2.5)}$$

[35] Recall that on page 36 we labelled the aggregate of 'x'-goods as X.

where μ, with $0 \leq \mu \leq 1$, represents the share of intermediate inputs in the total costs and therefore the degree of vertical linkages in this industry. It can easily be seen that for $\mu = 0$, vertical linkages would not exist and the final input factor Z would be identical to M. In the second step, which requires a fixed cost α and a constant marginal cost β, Z is used in the production of the final good:

$$Z_i = \alpha + \beta x_i , \tag{2.6}$$

where x_i is the output of an individual firm i. As argued above, I's price index is identical to X's price index and is therefore given by (2.3) as well. The cost of one unit of modified labour M is given by ω where $\omega = (g(t))^{-1}$. This follows from the fact that the nominal gross wage for labour is fixed by the CRS-sector to be unity and the assumption of labour mobility between the sectors: a citizen would only accept to work in the IRS-sector if its gross wage equalled that of the CRS-sector. Consider again the examples given above: a firm has to compensate its employee for the time lost due to commuting or to participating in the training courses. The compensation has to be higher, the more time the employee loses. Given the transformation process as described in (2.4), the IRS-sector has to offer ω for one unit of modified labour M. Using (2.5) and (2.6), we can find that the total cost TC of producing x_i is:

$$TC_i = P^{\mu} \omega^{(1-\mu)} (\alpha + \beta x_i) . \tag{2.7}$$

2.4 Solving the model

Given the demand faced by an individual firm and the cost structure from (2.7), firms in the IRS-sector charge a mark-up over marginal cost. In equilibrium they are identical and use the following pricing rule to maximise their profits[36]:

[36] This follows standard procedure, see Krugman (1991).

$$p_{ix} = p_x = \frac{\sigma}{(\sigma - 1)} \beta P^{\mu} \omega^{(1-\mu)} . \qquad \textbf{(2.8)}$$

Free entry and exit into the industry drive profits down to zero, so that the equilibrium level of output is the same for every firm:

$$x_i = x = \frac{\alpha}{\beta} (\sigma - 1) , \qquad \textbf{(2.9)}$$

which can be simplified to x = 1 by letting $\alpha = 1 / \sigma$ and $\beta = (\sigma - 1) / \sigma$. This notation also simplifies the pricing rule as given by (2.8) to $p_x = P^{\mu} \omega^{(1 - \mu)}$.

The number of firms in the region is determined from an individual firm's demand for the input factor M and the region's supply of the input factor M. Applying Shephard's lemma to equation (2.7), we can find an individual firm's demand for M. Noting that the supply of M is given by (2.4), we can derive n:

$$n = \frac{1}{(1 - \mu)} \left(\frac{\omega}{P} \right)^{\mu} M . \qquad \textbf{(2.10)}$$

Looking at (2.4) and (2.10), we can immediately see that for t = 0 - which according to Assumption 2.1 implies g(0) = 0 - the number of IRS-sector firms in the region is zero.

To close the model, we finally have to determine M. To do so, let us first of all find the region's expenditure E on IRS-sector goods. We know from (2.2) that consumers spend the fraction $(1 - \gamma)$ of their disposable income on IRS-sector goods. Given the technology as described in (2.5), IRS-sector firms themselves spend the fraction μ of their revenues on IRS-sector goods as intermediate inputs. The region's expenditure on IRS-sector goods can then be written as:

$$E = (1-\gamma)(1-t) + \mu n p_x x, \qquad \textbf{(2.11)}$$

where the first term on the right-hand side represents the final consumer expenditure and the second term on the right-hand side the IRS-sector's expenditure. Note that E does not tell us in which way it is split between domestic and imported IRS-sector goods. The next step is to derive total sales of the region's firms. Demand for an individual firm's product comes from the domestic region and from 'the other region'. In equilibrium, supply has to equal demand for every individual variety produced. This can be stated as:

$$1 = p_x^{-\sigma}\left(EP^{(\sigma-1)} + E{*}P{*}^{(\sigma-1)}\tau^{(1-\sigma)}\right). \qquad \textbf{(2.12)}$$

It follows that the value of total sales S of all IRS-sector firms equals:

$$S = np_x^{1-\sigma}\left(EP^{(\sigma-1)} + E{*}P{*}^{(\sigma-1)}\tau^{(1-\sigma)}\right). \qquad \textbf{(2.13)}$$

The last step is to notice that total income accrued to the modified labour M (i.e. ω M) in the IRS-sector is the fraction (1 - μ) of total sales. We can thus derive M to be:

$$M = (1-\mu)\omega^{-1} np_x^{1-\sigma}\left(EP^{(\sigma-1)} + E{*}P{*}^{(\sigma-1)}\tau^{(1-\sigma)}\right). \qquad \textbf{(2.14)}$$

Equilibrium in the region is then characterised by equations (2.3), (2.8), (2.10), (2.11) and (2.14) (and analogous equations for the other region). This set of simultaneous equations can be used to find equilibrium values for P, p_x, n, E and M (and P*, p_x*, n*, E* and M*). We could substitute the price p_x into (2.3), then use that expression in (2.10) to derive n. Once again the price and n have to be used to find E, which in turn is necessary to derive M. And M affects n. As can be seen from the equations, the policy variable t affects all endogenous variables: for example, the marginal cost of production and hence the price p_x are affected directly and indirectly through ω and P. Total expenditure E is a function of t directly and indirectly as it is determined by disposable income and total sales of the region's firms. Given numerical values it is possible to calculate the equilibrium configuration of the economy with two regions. However, in the following section we want to utilise this framework to address the questions raised in the introduction.

3. Agglomeration forces in a two region economy

It is a well known result of the 'new economic geography' literature that in a two-region economy of the type described in section 2, several equilibrium configurations can arise. One of these equilibria is characterised when IRS-sector firms are evenly split across the two regions. Another equilibrium can exist when all firms are located in one of the two regions, supplying their output to both regions. The intuition to this second equilibrium is as follows: suppose that there are two locations, of which one of them has a 'headstart' in the sense that it has initially a few more IRS-sector firms than the other region. This implies, from (2.3), that this region's price index for final consumer goods and also for intermediate inputs is lower than in the other region. This cost advantage (the so-called forward linkage) is one reason why IRS-sector firms would like to agglomerate in that region. The second reason is that such firms would also like to be located close to their main markets (the so-called backward linkage). Given that final consumer demand is the same across the two regions, the main criterion is the size of the IRS-sector cluster itself as that demands the x-good as an intermediate input for production. As long as the final consumer demand is not too large and can be easily reached from any production site, firms tend to agglomerate in the region with the headstart. Note that this crucially depends on the accessibility of the two regions and the size of the industrial cluster's demand relative to the final consumer demand.

Which one of these equilibria characterises the economy depends crucially on several key parameters of the model. In this section we *assume* that all firms have agglomerated in one region and want to ask under which conditions this constellation can be a stable equilibrium. The answer to this determines whether a backward or declining region can ever expect to attract industry (again).

ASSUMPTION 2.2

It is assumed that all IRS-sector firms are agglomerated in Foreign - making Foreign the industrial core of the economy - and that Home is peripheral and has to import all the IRS-sector goods.

3.1 The case of symmetric government activity

In this subsection we want to assume that both regions' governments follow symmetric policies.

DEFINITION 2.1

'Symmetric' government activity is given when both governments set the same tax rate and face the same transformation function, i.e. $t_H = t_F = t$ and $g_H(t) = g_F(t) = g(t)$.

Note that we have now replaced the asterisk to denote the 'other region' with the more precise notation of subscripts, where subscript H denotes the Home region and subscript F denotes the Foreign region. The model outlined in section 2 can be simplified in several important ways. First, let us rewrite (2.11), this time using the new notation:

$$E_k = (1-\gamma)(1-t) + \mu n_k p_{xk} x, \qquad \textbf{(2.11')}$$

where k = H, F. From Assumption 2.2 it follows that Foreign alone meets the demand for IRS-sector goods from both regions. In equilibrium it must also be true that total demand from Home and Foreign for a single variety of the manufactured good must equal the unit produced in Foreign:

$$1 = p_{xF}^{-\sigma}\left(E_F P_F^{(\sigma-1)} + E_H P_H^{(\sigma-1)}\tau^{(1-\sigma)}\right). \tag{2.15}$$

Given (2.11') and (2.15) we can now determine whether full agglomeration of IRS-sector firms in Foreign - as assumed in Assumption 2.2 - can be a stable equilibrium. Full agglomeration is a stable equilibrium, if *no* individual firm could move to Home, set up production there and break even. Given that the intermediate input factor I has to be imported from Foreign, profitability crucially depends on the gross wage ω_H paid to modified labour M[37]:

PROPOSITION 2.1 *The maximum gross wage ω_H a deviant firm can offer to its workers without making losses in the face of symmetric government activity in Home and in Foreign depends on t, g(t), τ, μ and σ is given by*[38]*:*

$$\omega_H^{\sigma(1-\mu)} = \frac{(1+\mu)\tau^{(1-\sigma)} + (1-\mu)\tau^{(\sigma-1)}}{2\tau^{\mu\sigma}(g(t))^{\sigma(1-\mu)}}. \tag{2.16}$$

Proof. See Appendix 2A. □

[37] We rule out the option of private provision of the public good. It could be argued that a deviant firm might not have to rely on government policy at all as it could provide its own public good such as vocational training and health services for its labour force. Obviously these supporting activities would require additional labour input into the production process. It follows from that observation that such a firm would be at a cost disadvantage compared to the firms in Foreign, making it less likely to break-even. For a study of private provision of public goods see Bliss and Nalebuff (1984).
However, we follow Martin and Rogers (1995b) and others that only the government can provide public infrastructure.

[38] The reader should recognise the similarity of expression (2.16) to expression (17) in Krugman and Venables (1996). The difference is that this time the gross wage ω_H varies with g(t).

Expression (2.16) merely extends the familiar criterion for agglomeration (see Krugman and Venables, 1996) to include symmetric government activity. In order to attract labour, the individual firm must offer a wage of at least $\omega_H = (g(t))^{-1}$. Home therefore succeeds in attracting firms if and only if:

$$\frac{(1+\mu)\tau^{(1-\sigma)}+(1-\mu)\tau^{(\sigma-1)}}{2\tau^{\mu\sigma}} \geq 1 . \qquad \textbf{(2.17)}$$

So for the case of symmetric government policies, the results derived by Krugman and Venables (1996a) carry directly over. This suggests that these government policies *do not affect firms' location decisions* and merely provide a 'level-playing field' for the firms. The market forces which are generally discussed in the 'new economic geography' literature remain active and unchanged: μ reflects the importance of forward and backward linkages (i.e. the market access and cost effects of clustering in one region) and therefore represents the external economies at work in the industrialised region. It can also be shown that for higher values of μ and lower values of σ, everything else being the same, Home is less able to attract industry into its region[39]. The transportation cost τ also plays a crucial part: the lower τ, which reflects a higher degree of economic integration between the two regions, the more difficult it is for Home to attract firms to its region. Firms are more likely to remain in Foreign to enjoy all the benefits of economic agglomeration and supply Home with exports[40].

39 These results can be derived analytically: see Krugman (1991).

40 This result is in line with all the models in the 'new economic geography' literature. For a more detailed discussion on the underlying economic intuition behind this result therefore see, for example, Krugman (1991) or Venables (1996) and page 43 of this thesis.

3.2 The case of asymmetric government activity

Consider now the case in which governments follow different tax rates and/or have different levels of efficiency in providing the public good. This allows us to analyse whether *different* government activity generates new locational forces besides the existing market forces which might affect the location decision of firms.

DEFINITION 2.2

'Asymmetric' government activity is given if Home and Foreign set either different tax rates and/or face different transformation functions, i.e $t_H \neq t_F$ and/or $g_H(t) \neq g_F(t)$.

Following the procedure outlined in section 3.1, we can derive Proposition 1.1' for the case of asymmetric government activity:

PROPOSITION 1.1' *The maximum gross wage* ω_H *a deviant firm can offer to its workers without making losses in the face of asymmetric government activities depends on* t_H, t_F, τ, $g(t_F)$, μ and σ is given by:

$$\omega_H^{\sigma(1-\mu)} = \frac{\left[(1-\mu)(1-t_F)+\mu(2-t_H-t_F)\right]\tau^{(1-\sigma)}+\left[(1-\mu)(1-t_H)\right]\tau^{(\sigma-1)}}{(2-t_H-t_F)\tau^{\mu\sigma}(g(t_F))^{\sigma(1-\mu)}}. \quad \textbf{(2.16')}$$

Proof. See Appendix 2B. □

Home therefore succeeds in attracting firms if and only if:

$$\frac{\left[(1-\mu)(1-t_F)+\mu(2-t_H-t_F)\right]\tau^{(1-\sigma)}+\left[(1-\mu)(1-t_H)\right]\tau^{(\sigma-1)}}{(2-t_H-t_F)\tau^{\mu\sigma}} \geq \left(\frac{g(t_F)}{g(t_H)}\right)^{\sigma(1-\mu)} . \qquad \textbf{(2.17')}$$

We can distinguish three cases: the first two obtain analytical results, whereas the third one relies on simulations to give us some insights. The economic intuition for all three cases is given below.

i) For $\tau = 1$, (2.17') simplifies to:

$$g(t_H) \geq g(t_F), \qquad \textbf{(2.18)}$$

i.e. in the case of complete integration, both regions offer the same market access and the same price index for the intermediate input factor I, leaving the price of the modified labour M as the only factor influencing a firm's location decision. Home therefore needs to provide at least the same level of public good as Foreign if it wants to succeed in attracting firms. Note that Home would attract all firms for $g(t_H) > g(t_F)$.

At this stage it is convenient to introduce a specific functional form for g(t) which meets the criteria set out in Assumption 2.1. Let us assume that $g_k(t_k) = \eta_k\, t_k^{\varepsilon}$, with $\varepsilon > 0$ and $\eta \leq 1$. ε is the elasticity of the public good provision with respect to changes in the tax rate t_k. η represents the fact that the transformation potentially involves some loss in labour and thus reflects the efficiency with which the public sector can transform L into M. (2.18) can then be rewritten as:

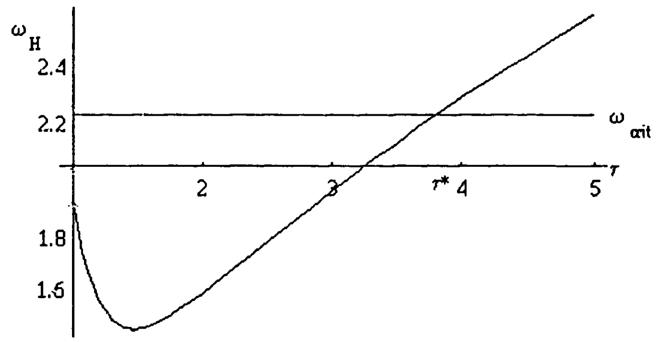
$$\eta_H t_H^{\varepsilon} \geq \eta_F t_F^{\varepsilon} \quad \forall \varepsilon, \qquad \textbf{(2.18')}$$

that is, with identical values of η, Home has to at least match Foreign's tax rate if it wants to succeed in attracting firms. However, when Home is more efficient than Foreign in providing the public good ($\eta_H > \eta_F$), then a lower tax rate in Home would suffice to attract firms.

ii) For $t_H = t_F = t$ with $\eta_H \neq \eta_F$, (2.17') can be rewritten as:

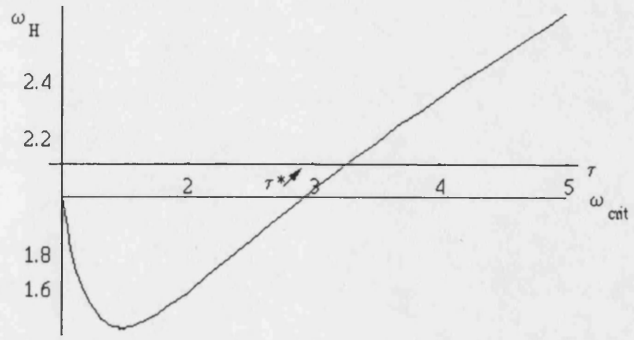
$$\frac{(1+\mu)\tau^{(1-\sigma)}+(1-\mu)\tau^{(\sigma-1)}}{2\tau^{\mu\sigma}} \geq \left(\frac{\eta_F}{\eta_H}\right)^{\sigma(1-\mu)}, \qquad \textbf{(2.19)}$$

which collapses into (2.17) for $\eta_H = \eta_F$. This result implies that a more efficient Home government (relatively to the Foreign) is more likely to attract firms than a less efficient one. Figures 2.1a/b/c represent the cases in which Home is less/equally/more efficient in providing the local public good than Foreign[41]:

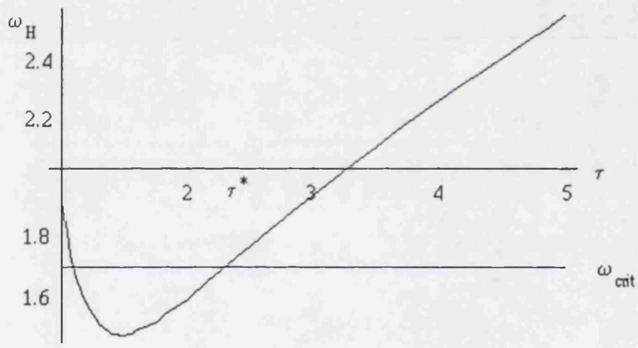


Home less efficient than Foreign ($n_H = 0.65$)
Figure 2.1a

[41] The parameter values chosen for all these diagrams, unless otherwise stated, are $\sigma = 4$, $\mu = 0.45$, $\varepsilon = 0.5$ and $\eta_H = \eta_F = 0.75$. Note that Krugman and Venables (1996a) set $\mu = 0.5$.



Home as efficient as Foreign
Figure 2.1b



Home more efficient than Foreign (n_H = 0.85)
Figure 2.1c

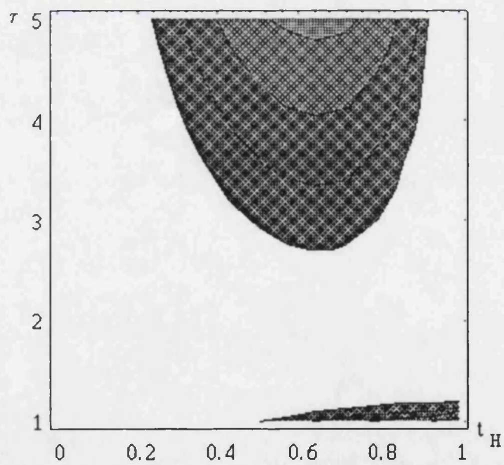
Home is able to attract firms to its region as long as ω_H is above the minimum necessary level of ω_{crit}. It can be seen that this varies with the different levels of government efficiency. The level of transportation cost above which this is the case is denoted by τ^* in the figures. Also note that Figure 2.1b is identical to the case derived in Krugman and Venables (1996a) and given by (2.16).

iii) For all the other cases, it is best to rely on simulations to gain some economic insight.

ASSUMPTION 2.3

Foreign's industrial policy is exogenous to the model, i.e. changes in Home's policy do not affect Foreign government's choice of t_F.

A more realistic setup would take into account that Foreign's policy is affected by Home's policy and vice versa. Given that we have not stated specific objective functions for the two governments, we cannot specify a unique best response function for either government. Instead we can describe a range of policy combinations which could be used by the government to achieve its objectives. In the following section, we hold Foreign's tax rate constant at $t_F = 0.5$ and analyse the Home government's range of policies, while the implications of relaxing assumption 2.3 are discussed in section 4.2 of this chapter. Figure 2.2 shows the Home government's ability to attract firms to its region as a function of t_H and τ:



Different tax rates but equal efficiency levels
Figure 2.2

In Figure 2.2 the transportation cost τ is shown along the vertical axis, whereas the Home government's policy variable t_H is represented along the horizontal axis. The shaded areas reflect all combinations of τ and t_H which would enable Home to attract firms - the case when (2.17') is satisfied. One of the shaded areas can be found at τ close to 1 and $t_H \geq t_F$ - illustrating the result given by expression (2.18). More interesting though is the interpretation of the location and expansion of the shaded area for higher transportation cost.

PROPOSITION 2.2 *Asymmetric government policies give rise to* ***two new, opposing agglomeration forces:***
on the one hand, an increase of tax rate t_H leads to lower disposable income and therefore to lower final consumer demand ***(final consumer demand effect)*** *in Home. Everything else being equal, a deviant firm would be confronted with lower consumer demand and would thus be less able to break even in Home. Home would be a less attractive location for industrial production.*
On the other hand, a higher tax rate reduces the price of the input factor M ***(input price effect)*** *and would make it easier, everything else being equal, for a deviant firm to break even[42]. This would make Home a more attractive location for industrial production[43].*

PROPOSITION 2.3 *A change in the Home government's efficiency level (as given by a change in η_H) leads to a change in the* ***relative strength of the two forces:*** *holding the tax rate constant, the final consumer demand effect would remain unaffected. However, a change in the efficiency level would affect the input price effect.*

---

42 So for the case of equal tax rates across the two regions, the two forces would be of equal strength in the two regions and would thus not affect the relative size of demand and the price index between the regions.

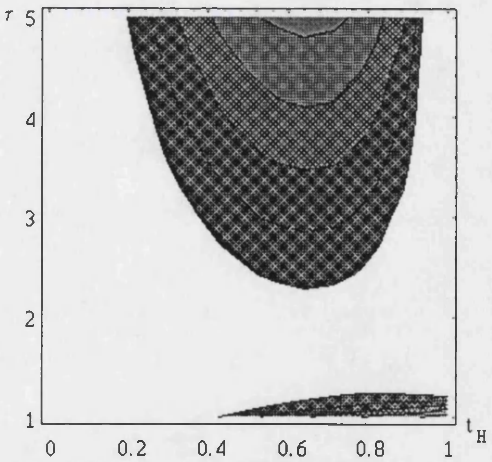
43 These two forces thus affect the two main location factors of companies: proximity to markets and the cost of labour (Commission of the European Communities, 1993, p. 77).

3.2.1 Comparative statics

In this subsection we do comparative statics to verify Proposition 2.3. We then analyse the effects of parameter changes on the expansion of the shaded area which can tell us in which way Home's ability to attract firms is affected by different degrees of agglomeration forces. We confirm the familiar results of the 'new economic geography' literature that higher degrees of agglomeration forces (as given by stronger vertical linkages and/or a higher preference for variety) are more likely to support full agglomeration of IRS-sector firms in one region as an equilibrium.

In the case of an efficiency gain (an increase in η_H), the wage to be paid to one unit of M would fall and hence the *input price effect* would become stronger. Home would thus become a more attractive location for production and a deviant firm is then more likely to break even[44]. Home's increased attractiveness as a production location is reflected by an increase in the size of the shaded area. This is shown in Figure 2.3:

[44] This effect confirms previous results: '[A]n improvement in (...) infrastructure in the home country will imply a relocation of firms to this country...' if the productivity of government expenditures is high' (Martin and Rogers, 1995b, p. 345).

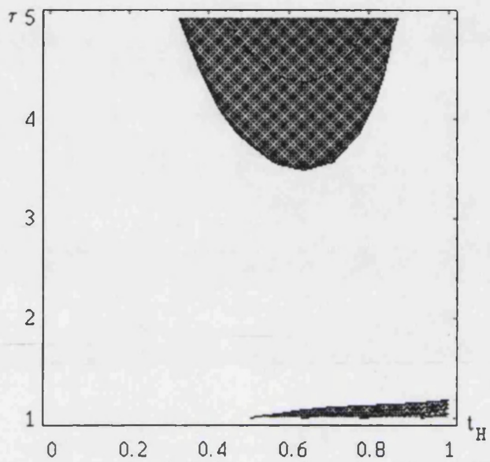


Different tax rates and efficiency levels: $\eta_H > \eta_F$

Figure 2.3

The parameter values chosen for Figure 2.3 are the same as for Figure 2.2, except that η_H = 0.85. The efficiency level of public good provision and the agglomeration forces determine the expansion of the shaded area in the horizontal plane. For a given value of η_H, the agglomeration forces vary with τ: as τ falls, the agglomeration forces become stronger as the Home region's market can now be more easily accessed by Foreign firms. Consequently, firms would like to remain in the industry cluster to take full advantage of the existing linkages. This observation is in line with the results generally obtained in the 'new economic geography' literature (see footnote (40)). It can also be seen that the range of 'successful' (in attracting firms) policies decreases with the degree of economic integration. The lower the degree of economic integration, the more attractive is the Home market for the deviant firm. In that case, a firm might want to move *even though* the Home government's policy might not be 'carefully' chosen. With a higher degree of economic integration though, a deviant firm is less attracted to the Home market and hence the Home government has to be more 'careful' in setting its policies. Home and Foreign are in stronger competition with each other for firms which are more sensitive to variations in market size and input prices.

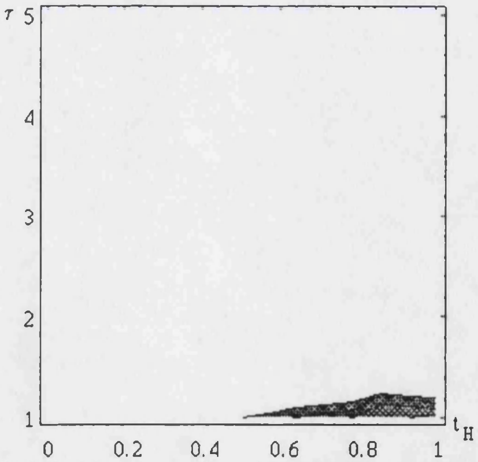
Turning to the familiar agglomeration forces as discussed in the 'new economic geography' literature themselves, we find that the stronger they are, the more difficult it is for the Home government to attract firms. One factor determining the magnitude of the agglomeration forces is the degree of vertical linkages: a higher value of μ represents stronger vertical linkages. From (2.3) and (2.5) it follows that IRS-sector firms' benefit of locating close to the manufacturing cluster is increased. As a consequence, Home faces more difficulties attracting firms. Figure 2.4 represents this situation:



Stronger vertical linkages than in Figure 2.2

Figure 2.4

The parameter values for Figure 2.4 are identical to those chosen for Figure 2.2 except for μ = 0.49. The second factor determining the magnitude of agglomeration forces is the degree of imperfect competition in the IRS-sector. The higher this degree - as represented in a lower value of σ - the stronger the incentive to exploit economies of scale and to stay in Foreign. This is shown in Figure 2.5:



A lower value of σ than in Figure 2.2

Figure 2.5

This time the only change in parameter values, compared to Figure 2.2, has been to set $\sigma = 3$. Once again, this result is in line with previous results derived in the ‘new economic geography’ literature (see, for example, Krugman and Venables, 1996).

4. Extensions

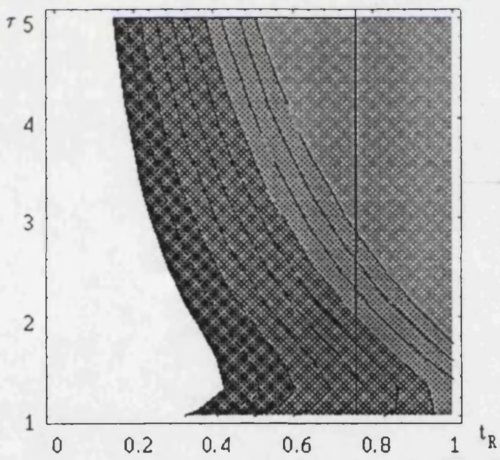
4.1 Transfer payments from Foreign to Home

The analysis so far has been based on the assumption that each region’s government has to raise its own tax revenues to finance its local public good provision. However, it is reasonable to assume that Foreign offers transfer payments to Home in order to accelerate Home’s development and, ultimately, to achieve convergence of the two regions. This would be the case as experienced in Europe - as discussed in the introduction to this thesis.

Here we briefly outline what we expect for such a setup: we should find that the mechanisms at work are still the same, in other words we still have the two new forces. During the transition period towards convergence, Foreign has to finance the public good provision in *both Foreign and Home*. Let us assume the extreme case in which Home's citizens do not contribute at all. Disposable income and hence total final consumer demand in Foreign is therefore:

$$\tilde{w}_F = (1 - t_F - t_R), \qquad \textbf{(2.20)}$$

where t_F is used to finance Foreign projects and t_R is the transfer payment to Home to finance Home projects. The implications of these transfer payments are as follows: on the one hand, Foreign's final consumer demand is reduced twice - making Foreign a less attractive production location. On the other hand, Home is becoming unambiguously more attractive as a production location: its public good provision is improved without the previously attached cost of a smaller final consumer market. Depending on the size of the transfer chosen, we can show that Home is able to attract firms for any level of transportation cost τ. This is shown in Figure 2.6:



Transfer payments from Foreign to Home

Figure 2.6

For Figure 2.6 we have set Foreign's tax rate $t_F = 0.25$. Along the horizontal line we have the level of transfer payments from Foreign to Home. Given that $t_F = 0.25$, the transfer cannot exceed 0.75 - thus the area to the right of the vertical line at 0.75 should be ignored for the interpretation[45]. It can be seen that transfer payments have to rise for lower transportation costs to overcome the stronger agglomeration tendency[46]. Notice that a policy mix which promotes a reduction of transportation cost in addition to transfer payments from Foreign to Home simultaneously (the case of the European Union again) is partly self-defeating: the former makes convergence more difficult to achieve (as long as transportation cost remain positive), the latter makes it easier to achieve[47].

4.2 The Nash equilibrium in tax rates

Throughout this chapter we have assumed that the Foreign government held its tax rate (and hence the level of public good provision in Foreign) constant, while Home could choose any value of t. The implications of relaxing this assumption can best be illustrated by analysing the case of $\tau = 1$. On page 48 we argued that in the case of complete economic integration, a firm's location decision only depends on the cost of the regionally provided modified labour M. Given this and the nature of the governments' objective functions (which do not consider utility), each government has an incentive to provide a higher level of public good provision than the other region's government. Assuming that both governments have the same level of efficiency, both governments would set $t = 1$ in the Nash equilibrium in tax rates and would provide

45 See Appendix 2C for an outline of the underlying structure for Figure 2.6.

46 Figure 2.6 has been generated in the same way as the previous figures. Analytically it also follows closely Appendices A and B, taking into account that Home doesn't have to raise any tax revenues whereas Foreign has to raise tax revenues for itself and for the transfer payments.

47 This observation is confirmed by Fujita and Mori: '[O]ur study indicates that given an economy having a core-periphery dualism, in order to promote the industrial growth in the periphery, it is not always helpful to improve the transport connections between the two regions... If the periphery region does not possess a comparative advantage in any industry, then such a transport improvement will simply help to intensify the market competition for industrial products in the periphery... In such a situation, a temporary protection of industries in the periphery by *worsening* the transport connection ... may result in a more desirable result!' (Fujita and Mori, 1996, p. 97).
See also Martin and Rogers (1995b) who analyse the effects of improving transportation networks *between* an industrialised core and a less-developed periphery on the location decision of firms.

the same amount of public goods. Firms would then be evenly distributed across the two regions. For values other than $\tau = 1$, market access and intermediate input prices would again become factors influencing a firm's location decision. The Nash equilibrium in tax rates would then crucially depend on the importance of forward and backward linkages, as given by μ.

4.3 The simultaneous move of several firms

In this chapter we stated or illustrated the condition necessary for one Foreign firm to relocate to Home. We argued that once this single firm had moved, more firms would follow as the forward and backward linkages (i.e. the market access and cost effects of clustering) would start to work in Home. Our analysis focused on the policies necessary to attract this one crucial firm and also showed under which conditions the Home government would fail to attract it. Now consider the case in which the Home government could encourage several firms to move simultaneously, maybe by coordinating their location decisions. In the context of our model we expect such a policy to increase the Home government's "success rate" of attracting industry. This is because firms within such a group would benefit from the group's backward and forward linkages, making the other location factors, such as market access or the local price of M, relatively less important. This implies that a group of firms would still move at a level of transportation cost too high for a single firm to move. It also means that the Home government, ceteris paribus, could provide a smaller amount of public good and still attract the group of firms.

5. Concluding remarks

Regional economic policies are generally seen as major factors determining the geographical distribution of economic activity and most countries have therefore witnessed public discussions on this issue. A strong industrial base is still viewed by many to be essential to support a high standard of living and politicians should therefore follow policies which increase the attractiveness of a region as an industrial location. However, there is a debate on what constitutes the 'best' regional economic policy: should a government follow a 'small government' or a 'large government' policy in order to attract industry?

This chapter addressed the above question from the point of view of an under-developed region's government which raises domestic tax revenues to finance the provision of local public goods. The chapter shed some light on this issue, arguing that such a regional government has to be aware of the fact that its policies create new forces of economic agglomeration and dispersion: on the one hand, raising tax revenues inevitably reduces the local market size, on the other hand, providing local productive goods improves the attractiveness of the location. The former effect makes the region in question less attractive as an industrial location, whereas the latter effect improves the region's attractiveness. It was argued that the magnitude of these forces (and hence the ability to attract firms) depends crucially on the public sector's efficiency level. A regional government should therefore focus less on the debate 'small public sector versus large public sector' but instead should try to increase its efficiency level. This is the potentially most successful way of attracting firms to its region.

However regional economic policies are not the only factors which determine the location of industries. This chapter demonstrated that a 'sensible' economic policy is necessary but not sufficient to successfully attract firms into a region. This implies that even the most 'attractive' policy can fail as long as the underlying economic forces of industrial agglomeration are too strong. It was shown that this is most likely to happen with either low transportation costs between the regions or strong linkages between the industries. In these cases firms would not break away from their industrial cluster in the more developed region. This shows that politicians cannot always be blamed for failed policies.

In the final section we confirmed results obtained recently by Fujita and Mori (1996). It was shown that transfer payments from a highly industrialised to a less industrialised region can always overcome the uneven distribution of firms. However, transfer payments are generally complemented by infrastructure projects *between the regions* - a policy which works in the opposite direction of the transfer payments.

Future extensions to this model could include the modelling of different tax bases. Especially interesting would be to analyse the effects of introducing a tax on firms' profits. By doing so we could provide some arguments to the generally held discussion on corporate taxation and mobile firms. For example, we could study under which conditions high tax rates on corporate profits could induce firms to relocate to another region. An answer to this question is, however, outside the scope of this chapter.

Appendix 2A

Proof of Proposition 2.1:

This section derives the maximum gross wage which a deviant firm moving from the industrialised Foreign region to the trailing Home region can offer to manufacturing workers without suffering losses. It is assumed that initially all of manufacturing takes place in Foreign and that both governments impose the same tax rate and have the same efficiency levels.

Define $\hat{E}$ as the ratio of total expenditure on the x good of the Home region to that of the Foreign region. Using (2.4), (2.8), (2.10) and the facts that $\omega = (g\ (t))^{-1}$ and $x = 1$ in (2.11'), we get:

$$\hat{E} = \frac{E_H}{E_F} = \frac{(1-\gamma)(1-t) + \frac{\mu}{(1-\mu)} L_{XH}}{(1-\gamma)(1-t) + \frac{\mu}{(1-\mu)} L_{XF}} . \tag{A2.1}$$

With no production of the x-good taking place in Home, total income of manufacturing workers in the Foreign region is a share (1-μ) of the total expenditure on the x-good by firms in Foreign and citizens in *both* regions:

$$L_{XF} = (1-\mu)\left(2(1-\gamma)(1-t) + \frac{\mu}{(1-\mu)} L_{XF}\right), \tag{A2.2}$$

which simplifies to:

$$L_{XF} = 2(1-\gamma)(1-t) . \tag{A2.3}$$

Noting that $L_{XH} = 0$ and substituting (A2.3) in (A2.1) yields:

$$\hat{E} = \frac{(1-\mu)}{(1+\mu)}. \tag{A2.4}$$

A firm only considers moving to the Home region if it is able to break even there. Hence the zero profit condition (2.12) must be satisfied in both regions:

$$1 = \hat{p}_X^{-\sigma} \frac{\left(\hat{E}\hat{P}^{(\sigma-1)} + \tau^{(1-\sigma)}\right)}{\left(1 + \hat{E}\hat{P}^{(\sigma-1)}\tau^{(1-\sigma)}\right)}, \tag{A2.5}$$

where $\hat{p}_X = p_{iXH} / p_{iXF}$ and $\hat{P} = P_H / P_F$. Using the ratio of expression (2.8) in combination with (2.3) and $\omega_F = (g(t))^{-1}$ gives:

$$\hat{p}_X = \hat{P}^{\mu} \omega_H^{(1-\mu)} (g(t))^{(1-\mu)}. \tag{A2.6}$$

Rearranging (A2.5), substituting in (A2.6) and also $\hat{P} = \tau$, we can derive:

$$(1 + \hat{E}) = \left(\tau^{\mu} \omega_H^{(1-\mu)} (g(t))^{(1-\mu)}\right)^{-\sigma} \left(\hat{E}\tau^{(\sigma-1)} + \tau^{(1-\sigma)}\right). \tag{A2.7}$$

Substituting (A2.4) into (A2.7) and solving for $\omega_H^{\sigma(1-\mu)}$ then proves Proposition 2.1.

Appendix 2B

Proof of Proposition 2.1':

This section follows the previous section closely, except that it allows for different tax rates and efficiency levels across the regions. Define $\hat{E}$ as the ratio of total expenditure on the x good of the Home region to that of the Foreign region. By (2.11'):

$$\hat{E} = \frac{E_H}{E_F} = \frac{(1-\gamma)(1-t_H) + \frac{\mu}{(1-\mu)}L_{XH}}{(1-\gamma)(1-t_F) + \frac{\mu}{(1-\mu)}L_{XF}} . \tag{B2.1}$$

With no production of the x-good taking place in Home, total income of manufacturing workers in the Foreign region is a share (1-μ) of the total expenditure on the x-good by firms in Foreign and citizens in both regions:

$$L_{XF} = (1-\mu)\left((1-\gamma)(1-t_F) + (1-\gamma)(1-t_H) + \frac{\mu}{(1-\mu)}L_{XF}\right), \tag{B2.2}$$

so that:

$$L_{XF} = (1-\gamma)(2-t_H-t_F) . \tag{B2.3}$$

With $L_{XH} = 0$ and substituting (B2.3) in (B2.1) yields:

$$\hat{E} = \frac{(1-\mu)(1-t_H)}{(1-\mu)(1-t_F) + \mu(2-t_H-t_F)} . \tag{B2.4}$$

A firm only considers moving to Home if it is able to break even there. Hence the zero profit condition (2.12) must be satisfied in both regions:

$$1 = \hat{p}_X^{-\sigma} \frac{\left(\hat{E}\hat{P}^{(\sigma-1)} + \tau^{(1-\sigma)}\right)}{\left(1 + \hat{E}\hat{P}^{(\sigma-1)}\tau^{(1-\sigma)}\right)} , \tag{B2.5}$$

where $\hat{p}_X = p_{iXH} / p_{iXF}$ and $\hat{P} = P_H / P_F$. As in proof to Proposition 2.1, it can be shown that:

$$\hat{p}_X = \hat{P}^{\mu} \omega_H^{(1-\mu)} (g(t_F))^{(1-\mu)} . \qquad \textbf{(B2.6)}$$

Solving for $\omega_H^{\sigma(1-\mu)}$ then follows exactly the same procedure as described in Appendix 2A.

Appendix 2C

Once again we follow Appendix 2A closely. This time note that the ratio Ê for the x-good is:

$$\hat{E} = \frac{(1-\gamma)}{(1-\gamma)(1-t_F-t_R) + \frac{\mu}{(1-\mu)} L_{XF}} , \qquad \textbf{(C2.1)}$$

where $L_{XF} = (1 - \gamma)(2 - t_F - t_R)$. We can then rewrite (C2.1) as:

$$\hat{E} = \frac{(1-\mu)}{1+\mu-t_F-t_R} . \qquad \textbf{(C2.2)}$$

This can then be substituted into (A2.5) to derive Figure 2.6's underlying structure.

Chapter 3

Provision of productive local public goods and intra-industry trade

1. Introduction

Local public economics has been studying the tax raising and public good provision behaviour of regional governments for a long time and several strands of the literature have developed: one branch of local public economics is the fiscal (tax) competition literature which has addressed these issues in the context of open economies such as cities, states or countries. The focus of attention has been on optimal tax rates and the efficient level of public goods provision. Most fiscal competition models have addressed this topic by making a few standard key assumptions on the form of the local public good provided, the mobility of the tax base and the type of competition between firms residing in the regions.

It has, for example, been generally assumed that the local public good (LPG) enters the utility function of consumers and does not enter the production process of firms (Wildasin, 1987). However, many examples can be given to support the latter case, e.g. education, vocational training or the provision of a legal framework[48] are all necessary for production to take place in the location and recent research has addressed this issue (see for instance Déo and Duranton, 1995)[49]. Commuting infrastructure is another LPG which is necessary for production. The British government, for example, recognises this, stating that transport is an important part of the cost structure of almost every business and of the UK economy as a whole (Department of Trade and Industry, 1994). And even though the existence of such infrastructure is generally taken for granted, it only needs one general strike to remind the public of its crucial importance in the production process of industry.

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[48] Note that the examples given are not necessarily pure public goods. However, for the following analysis it is assumed that these goods are supplied in a non-exclusionary and non-rival way, e.g. education could be done via the television (The Learning Zone on BBC).

[49] See page 19 of the introduction on public intermediate goods.

Another key assumption generally made is factor mobility between regions (Wildasin and Wilson, 1991). This has been done in the light of a more integrated world in which factors of production such as capital or labour have become increasingly more mobile. Most models also assume that regional governments levy a tax on these mobile factors, especially capital, even though this distorts investment location decisions. Models of this type generate one of the key results of the fiscal competition literature, namely the 'inefficiency in regional tax policies.' To quote Bucovetsky and Wilson: '[T]he explanation given for inefficiently low tax rates in the tax competition literature is that each government treats as a cost the capital outflow that occurs when it taxes capital to finance additional public good provision, whereas the outflow is not a cost from the viewpoint of the entire economy, since other regions benefit from the resulting capital outflows' (Bucovetsky and Wilson, 1991, p. 342).

This result does not hold, however, when the tax is levied on regionally immobile factors and it has therefore been argued that '...[o]ther forms of taxation are clearly preferable ... In particular, taxes on labor income ... are nondistortionary' as '[t]he assumed fixity of each region's labor supply insures that ... a wage income is lump-sum. Wilson (1986) observes that the introduction of lump-sum taxes restores efficiency in regional government behaviour.' (Bucovetsky and Wilson, 1991, p.333).

Another branch of the literature is represented by, for example, Scotchmer (1986). She studies the effects of imperfectly competitive jurisdictions on the amount of LPGs provision when consumers are mobile and the objective of the regional government is to maximise the land value within its jurisdiction (i.e. the LPGs are provided to enrich landowners). She provides the following intuition why local public goods are underprovided in her model: '[I]n equilibrium, the marginal unit of LPG causes the rental value of land to rise by exactly the cost of the LPG. Since the cost of LPGs gets taxed away from landowners the net increment to land value is zero. Suppose now that the marginal unit of LPG in jurisdiction j caused land prices elsewhere to fall as emigration occurred ... Since other jurisdictions are then more attractive ..., the fall in prices elsewhere dampens the increase in demand for land in jurisdiction j ... Thus the response on rental price ... is dampened also. This makes LPGs less lucrative to landowners, and hence LPGs may be underprovided'. It is this '... [p]ecuniary externality of one jurisdiction's policy on prices elsewhere ...' which matters (Scotchmer, 1986, pp. 465-466).

So far, most of the models within this literature have only studied the implications of factor mobility on the tax raising behaviour of local governments[50]. However, closer economic integration between regions has not only fostered factor mobility between regions but also increased product mobility (Emerson, 1988), especially in intra-industry goods: 'The European Commission (1990a, p.142) ...argue(d) that the (European) Community is increasingly characterised by intra-industry trade based on the exploitation of economies of scale, rather than inter-industry trade based on the specialisation through comparative advantage. They calculate that in 1987, between 57 per cent and 83 per cent of trade between the EC countries was intra-industry (European Commission, 1990b, p.41)...' (Bean, 1992, p. 7).

The main purpose of this chapter is therefore to analyse the implications of product mobility on regional government behaviour with respect to tax raising and local public good provision, especially when these local public goods are productive in nature. The questions raised here are similar to Gordon's: '...[a]ssuming that each unit of government does in fact act in the best interests of its own citizens, will the collection of units of governments together act in the best interests of all their citizens. Stated differently, what types of problems can arise from decentralised decision-making?' (Gordon, 1983, p. 567).

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50 For an exception, see Wildasin (1993) who analyses the consequences of inter-industry trade between one upstream supplier located in one region and a downstream industry located in the other region on tax setting policies by regional governments.

In order to address this issue, this chapter merges aspects of public economics and international trade theory. To do so, it is convenient to build on the framework of Chapter 2 of this thesis and to use techniques developed in the 'new international trade literature' such as in Krugman (1979, 1980), and especially Venables (1987). In contrast to the models used in the fiscal competition literature, these models assume monopolistically-competitive firms which can give rise to intra-industry trade as observed in the real world.

This chapter is organised as follows: the next section formalises the general setup of the model and analyses the optimal government policy under autarky. This is used as a reference for later comparison. Section 3 extends the model to two regions so that we can analyse the issue of optimal taxation in a fiscal federation. The Nash equilibrium in tax rates for the symmetric two region case is derived. Section 4 shows that by delegating the tax-raising power to an economy-wide central planner, both regions could raise their utility levels. Section 5 concludes.

2. The Home region under autarky

For simplicity and to have a reference for later purposes, we start by analysing the optimal government tax policy in a single region which is necessary to maximise the utility of its citizens. The region consists of many identical citizens so that the central planner - here the regional government - can rely on an individual's welfare implications when comparing different policies. Note that the basic structure is closely related to that of Chapter 2 - the main difference being the absence of vertical linkages in the economy. Citizens provide the only factor of production - labour L, which we normalise to unity. Identity of all citizens also implies identical endowments of one unit of labour and identical consumption preferences. Workers can either be employed in the public sector - which is discussed in section 2.2 - or in the private sector, in which case they are either employed in a constant returns to scale (CRS) industry or in an industry subject to increasing returns (IRS). The industry producing under constant returns to scale manufactures a good which we label "y", whereas the industry producing under increasing returns manufactures a range of products of the "x"-type. The labour force is split into these three activities so that:

$$L_g + L_x + L_y = 1\ , \tag{3.1}$$

where L_g is the fraction of workers in the public sector, L_x is the fraction of workers in the IRS-sector and L_y is the fraction of workers in the CRS-sector.

2.1 Private demand and utility

A representative consumer receives income only from work and spends it on an aggregate X of the "x" good and "y" goods with Cobb-Douglas preferences. The indirect utility V of such a consumer depends on the net wage and is given by:

$$V_s = \frac{w_s(1-t)}{P^{(1-\gamma)}p_y^{\gamma}}\ , \tag{3.2}$$

where w_s is the nominal wage in the sectors with s = x, y, g, P is the price index for the aggregate X of a potentially large number of manufactured goods and p_y is the price of the CRS good. We also have $0 \leq \gamma \leq 1$. The above exponents imply that the consumer spends the fraction $(1 - \gamma)$ of his disposable income on the IRS-sector's differentiated products and the fraction γ on the CRS-sector good. Let us choose the CRS-sector good as the numéraire so that $p_y = 1$. Furthermore, choosing the units of the CRS good in such a way that one unit of output requires exactly one unit of labour input, we also have $w_y = 1$. t is the tax rate imposed by the government on labour income with $0 \leq t \leq 1$ so that disposable income is given by $w_s\ (1 - t)$. As in Dixit and Stiglitz (1977), the price index P of the aggregate X of manufactured goods is given by[51]:

$$P = \left(\sum_{i=1}^{n} p_{xi}^{(1-\sigma)} \right)^{\frac{1}{(1-\sigma)}}, \tag{3.3}$$

where n is the number of firms producing in the region[52] and p_{xi} is the price charged by a single firm i. σ - which is larger than one - is the elasticity of substitution between the varieties and thus reflects the degree of economies of scale which could be exploited by a firm. It can be shown that in equilibrium[53], all n varieties are sold at the same price and therefore:

$$P = n^{\frac{1}{(1-\sigma)}} p_x . \tag{3.4}$$

2.2 The public sector

Following Chapter 2 of this thesis, we assume that the regional government always balances its budget and spends all of its tax revenues on hiring citizens. These citizens are employed to provide some form of public good. In order to employ a citizen in the public sector, the government has to offer the same wage as the industries in the private sector, i.e. $w_g = w_y = 1$. Crucially let us assume that the

51 The dual to this price index is given by:

$$X = \left(\sum_{i=1}^{n} x_i^{\frac{(\sigma-1)}{\sigma}} \right)^{\frac{\sigma}{(\sigma-1)}}.$$

52 It is shown later that each firm produces exactly one variety and hence the number of firms reflects the number of varieties produced.

53 See Krugman (1980) for that.

public good is productive in nature and is required by the firms in the IRS-industry to transform "raw" labour L into the necessary intermediate input factor M (M for modified). This transformation can be in the form of publicly-funded and provided vocational training or education, communication networks or public health service for the workforce etc[54]. How much of a given amount of labour is transformed into the input factor M depends on the level of public good provision g(T), where T is the tax revenue raised. Note that T = t w L = t and hence g(T) = g(t)[55]. Assumption 3.1 is motivated in the same way as Assumption 2.1 in Chapter 2. The reader is refered to page 39 of this thesis for a discussion of Assumption 3.1.

ASSUMPTION 3.1

(a)	$g(0) = 0$	
(b)	$g'(t) > 0$	
(c)	$g(t) \leq 1$	$\forall\ t \in [0;1]$.

The total amount of M available to the IRS-sector depends on g(t) and the initial amount L_x of "raw" labour to be transformed:

$$M = G(t, L_x) = g(t)\, L_x\,, \tag{3.5}$$

where M is homogenous of degree one with respect to L_x.

2.3 The IRS-sector

Let us now turn to the structure of the IRS-sector. Firms in this sector produce a potentially large number of differentiated products of type x and require the

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54 For a more detailed discussion, see Chapter 2, section 2.2. Note that we once again rule out any kind of congestion cost.

55 We once again rule out private provision of the public good. Hence a firm could not transform labour L into M for itself. For a longer discussion on that issue, also see footnote 37 of this thesis.

intermediate input factor M for production. The production of an individual good x by firm i involves a fixed cost α and a constant marginal cost β:

$$m_i = \alpha + \beta x_i , \qquad (3.6)$$

where m_i is the amount of M required by a single firm to produce its output x_i. An IRS-sector firm has to pay a wage $\omega = (g(t))^{-1}$ to one unit of M. The total cost c of producing x units of output for an individual firm is:

$$c_i = \omega(\alpha + \beta x_i) . \qquad (3.7)$$

We see from equations (3.5) and (3.7), everything else being equal, that a higher level of public good provision would reduce the total cost of production for an individual firm. Each individual firm maximises its profit against the demand function as given by footnote (51). It can be shown that in equilibrium firms are identical and set the following mark-up over marginal cost to maximises profits:

$$p_x = p_{xi} = \frac{\sigma}{(\sigma - 1)} \frac{1}{g(t)} \beta . \qquad (3.8)$$

Free entry into and exit out of this industry ensure that profits are driven down to zero. With zero profits in equilibrium, the output level can be derived to be equal for every firm and is given by:

$$x = x_i = \frac{\alpha}{\beta}(\sigma - 1) . \qquad (3.9)$$

In order to save notation, by choice of units, let $\alpha = 1 / \sigma$ and $\beta = (\sigma - 1) / \sigma$, so that $x = 1$ and $p_x = \omega$. A higher level of public good provision thus leads to lower marginal production cost and hence to a lower price charged by an individual firm. From (3.4) it follows that the price level P falls as p_x drops. Using the above notation, it follows directly from x = 1 and (3.6) that each individual firm demands m = 1 units of intermediate input. The number of firms n is therefore given by:

$$n = M = g(t) L_x . \qquad \textbf{(3.10)}$$

L_x can be found by noting that the total income of workers in the IRS-sector must equal the total expenditure E on the aggregate of x goods in the economy. Total expenditure E, however, equals the fraction (1 - γ) of disposable income in the economy (see (3.2)). Hence:

$$L_x = (1 - \gamma)(1 - t) . \qquad \textbf{(3.11a)}$$

We also know that the number of workers in the public sector is $L_g = t$. The number of workers in the CRS-sector can be determined by the adding-up constraint of equation (3.1) in the labour market:

$$L_y = 1 - t - L_x = \gamma (1 - t) . \qquad \textbf{(3.11b)}$$

It is thus that a fraction (1 - γ) of the private sector's labour force works in the IRS-sector, whereas the fraction γ works in the CRS-sector. This reflects the consumer preferences as given in equation (3.2).

2.4 The optimal tax rate t* in the autarky case

It is straightforward to determine the utility maximising tax rate in the region: the regional government chooses t, taking into account t's effects on disposable income and on the price index. The latter effect can be found from (3.4), (3.5), (3.8), (3.10) and (3.11a).

PROPOSITION 3.1 *The utility maximising tax rate t* depends on the underlying parameters* γ *and* σ *of the region and the transformation function g(t) and is given by:*

$$t* = 1 + \frac{(\gamma - \sigma)}{(1 - \gamma)\sigma} \frac{g(t*)}{g'(t*)} . \qquad \textbf{(3.12)}$$

Proof. See Appendix 3A. □

For the sake of concreteness, let us here introduce the same functional form as in Chapter 2 so that $g(t) = \eta\ t^{\varepsilon}$, with $\varepsilon > 0$ and $\eta \leq 1$. ε is the elasticity of the public good provision with respect to changes in the tax rate t. η is a scale factor which reflects the "internal" efficiency of the regional government and it is assumed that the transformation always involves some loss. In that case we can rewrite (3.12) as:

$$t* = \frac{\varepsilon(1 - \gamma)}{\varepsilon(1 - \gamma) - \frac{\gamma}{\sigma} + 1} . \qquad \textbf{(3.12')}$$

In the following we interpret t* for the extreme values of the parameters:

i) For $\sigma \rightarrow \infty$, the IRS-sector becomes perfectly competitive. Equation (3.12') then simplifies to $t^* = \varepsilon (1 - \gamma) / (\varepsilon (1 - \gamma) + 1)$. It can be shown that t* achieves product-mix efficiency, i.e. the economy produces on its production-possibility frontier, while at the same time maximising citizens' utility. Following McMillan (1979) and Feehan (1989), the efficiency condition is given generally when $\sum (\partial F_i/\partial R)/(\partial F_i/\partial V_i) = 1/(\partial F_R/\partial V_i)$, where F_i is the production function of firm i, R is the public good, V_i is the amount of factor input required and F_R is the production function of the public good. In our particular case, it can be shown that the left hand side is equal to $L_X/g(t)$, whereas the right hand side equals $1/g'(t)$. Equating these two sides and solving for t yields the above expression for t*. We can also derive the effect of a change of σ on the optimal tax rate:

$$\frac{\partial t*}{\partial \sigma} = \frac{\epsilon\gamma(\gamma-1)}{\sigma^2}\left(\epsilon(\gamma-1)+\frac{\gamma}{\sigma}-1\right)^{-2} < 0, \tag{3.13}$$

i.e. a higher degree of competition between firms in the IRS-sector (as reflected by an increase in σ) leads to a fall in t*: tougher competition forces firms to lower their mark-up $\sigma / (\sigma - 1)$ over marginal cost. A (slightly) higher marginal cost can thus be accepted, especially as this can be achieved with a lower tax rate.

ii) For $\gamma = 1$, indirect utility as given by (3.2) simplifies to $V = w\ (1 - t)\ p_y^{-\gamma}$. Setting t = 0 implies that no public good is provided and consequently no good of the "x" -type can be manufactured. The entire labour force is then employed in the CRS-industry, so that total output is y = L =1. It can be shown that t = 0 achieves product-mix efficiency.

iii) For $\gamma = 0$, citizens derive utility only from consuming the "x" -type good and therefore spent all their income on it. As in ii), product-mix efficiency is achieved when the economy produces on its production possibility frontier, while at the same time maximising citizens' utility. Given that citizens do not wish to consume the "y" -type good, the entire labour force should be employed to produce the "x" -type good. It can be shown that $t^* = \varepsilon / (\varepsilon + 1)$ maximises the amount of M available for use in the IRS-industry, therefore achieving product-mix efficiency.

Both ii) and iii) can be derived by equating the marginal rate of substitution with the marginal rate of transformation. These can be found from the utility (3.2) and production functions.

3. A two-region model with intra-industry trade

Having formalised the setup for a single region in the previous section and having established the optimum tax rate t* for such a case as a reference, we can now apply the framework to address the key issue of this paper: can product mobility in the form of intra-industry trade give cause to inefficiently low public good provision, even when the regional governments receive their tax revenues from an immobile factor? Taking the autarky case as the reference, what are the consequences of opening up the region to trade with another, identical region? Does the optimal tax policy lead to the same or to a different welfare level as under autarky?

In order to answer this question, let us assume the existence of two regions, Home and Foreign (denoted by H and F), which have identical endowments, technology and consumer preferences. Both economies also have their own representative governments which can set tax rates between 0 and 1. Transportation costs between the two regions play an important role in this setup: let us assume that the CRS-sector good can be costlessly transported from one region to the other, so that the price of it remains the same across the whole economy[56]. The x-good though is costly to ship from one region to the other. We follow the economic geography literature in assuming "Samuelson" type transportation costs τ: of every unit of an x-good shipped, only a fraction $1 / \tau$ arrives in the other region - the rest melts away. Note that $\tau > 1$.

3.1 Utility in the two-region case

Consumers can purchase their goods from Home and Foreign suppliers. The price index as given by equation (3.3) must be modified to take into account the transportation costs and the potentially different industry sizes in the two regions. In

[56] This again follows Krugman (1980).

the following *let us focus on the Home region, but note that similar expressions exist for the Foreign region.* The price index for Home is given by:

$$P_H = \left(n_H p_H^{(1-\sigma)} + n_F (p_F \tau)^{(1-\sigma)}\right)^{\frac{1}{(1-\sigma)}}, \tag{3.14}$$

where n_H and n_F are the number of IRS-sector firms in Home and Foreign respectively, while p_H and p_F are the prices charged by individual firms in Home and Foreign. The prices are given by expressions analogous to (3.8).

To find the welfare-maximising price index, we have to note that in the open economy case, total demand from *Home and Foreign* for a single variety produced in Home has to be equal to its supply. This condition is given by the following expression:

$$1 = p_H^{-\sigma}\left(E_H P_H^{(\sigma-1)} + E_F P_F^{(\sigma-1)} \tau^{(1-\sigma)}\right). \tag{3.15}$$

The expenditure on the IRS-sector E_j - with j = H, F - is given by the fraction (1 - γ) of disposable income in the two regions:

$$E_j = (1-\gamma)(1-t_j). \tag{3.16}$$

Given that (3.15) represents total demand for the output of one firm in Home, the value of total sales S_H of all varieties in Home is given by:

$$S_H = n_H p_H^{(1-\sigma)}\left(E_H P_H^{(\sigma-1)} + E_F P_F^{(\sigma-1)} \tau^{(1-\sigma)}\right). \tag{3.17}$$

With the available technology as given by (3.6), firms in the IRS-sector spend all their revenues on modified labour. We can thus derive the number of workers employed in the IRS-sector:

$$\omega_H M_H = L_{XH} = n_H p_H^{(1-\sigma)} \left(E_H P_H^{(\sigma-1)} + E_F P_F^{(\sigma-1)} \tau^{(1-\sigma)} \right). \qquad \textbf{(3.18)}$$

Recalling from (3.10) that $n_H = g(t_H)\, L_{XH}$, we can substitute (3.10) into (3.18) and solve for P_H:

$$P_H = \left(\frac{1}{E_H} \left(\frac{1}{g(t_H) p_H^{(1-\sigma)}} - E_F P_F^{(\sigma-1)} \tau^{(1-\sigma)} \right) \right)^{\frac{-1}{(1-\sigma)}}. \qquad \textbf{(3.19)}$$

With the analogous expression for P_F, we have a simultaneous equation system with two equations and two unknowns. Using the expression for P_F in (3.19) and rearranging, we can finally yield:

$$P_H = \left(\frac{1}{(1-\tau^{2(1-\sigma)}) E_H} \left(\frac{1}{g(t_H) p_H^{(1-\sigma)}} - \frac{\tau^{(1-\sigma)}}{g(t_F) p_F^{(1-\sigma)}} \right) \right)^{\frac{-1}{(1-\sigma)}}. \qquad \textbf{(3.20)}$$

It can be easily seen that the price index P_H depends on σ, the transportation cost τ, expenditure level E_H, the price levels of individual varieties in Home and Foreign and the transformation function g(t) in the two regions. These in turn, except for σ and τ, depend on the tax rate t_H. The Home government can now maximise its citizens' utility, as given by (3.2), by choosing the optimal tax rate.

3.2 The Nash equilibrium in tax rates

In contrast to the autarky case, the Home government in the two-region case has to take into account the strategic interaction with the government in the identical Foreign region when setting its optimal tax rate. This strategic interaction can be modelled as a single stage game with the players being the governments in the two identical regions. The strategy space for each government is the tax rate $t_j \in [0\ ;\ 1]$. The pay-off for the Home government is given by the indirect utility level (expression

(3.2) and (3.20)), and similarly for the Foreign region. Substituting the relevant expressions for the individual prices in Home and Foreign - which are analogous to expression (3.8) - and (3.16) into (3.20) and partially differentiating V_H with respect to t_H, while holding everything else constant, we can derive *the best response function* for Home:

$$g(t_H)^{-\sigma} = -\frac{\sigma(1-\gamma)}{(\gamma-\sigma)}(1-t_H)g(t_H)^{(-\sigma-1)}g'(t_H) + g(t_F)^{-\sigma}\tau^{(1-\sigma)}, \qquad \textbf{(3.21)}$$

i.e. Home's government chooses its tax rate, while taking Foreign's tax rate as parametric.

In a symmetric Nash equilibrium, a similar expression must also hold for Foreign. We once again have a system of simultaneous equations with two equations and two unknowns (the tax rates). Using the expression for Foreign in (3.21) and noting that tax rates have to be equal in the two regions, we can derive Proposition 3.2:

PROPOSITION 3.2 *At the symmetric Nash equilibrium in pure strategies, both governments set the same tax rate t_T* which is given by*[57]*:*

$$t_T* = 1 + \frac{(\gamma-\sigma)}{\sigma(1-\gamma)}\frac{g(t_T*)}{g'(t_T*)}\frac{(1-\tau^{2(1-\sigma)})}{(1-\tau^{(1-\sigma)})}, \qquad \textbf{(3.22)}$$

where the subscript T denotes the two-region case. It can easily be seen that the autarky case of (3.12) can be derived from (3.22) by setting $\tau \rightarrow \infty$.

57 Computer simulations suggest that the symmetric Nash equilibrium is also unique as other tax rate combinations do not satisfy the second-order conditions for a welfare maximum.

Once again, using the specific functional form as given by $g(t) = \eta\, t^{\varepsilon}$, we can derive an explicit expression for t_T*:

$$t_T* = \frac{\varepsilon(1-\gamma)(1-\tau^{(1-\sigma)})}{\varepsilon(1-\gamma)(1-\tau^{(1-\sigma)})+(1-\gamma/\sigma)(1-\tau^{2(1-\sigma)})}, \qquad (3.22')$$

which simplifies to expression (3.12') for $\tau \to \infty$.

3.3 The effects of changes in τ

In this subsection we want to analyse the effects of closer economic integration on the optimal tax rate in the two-region case. Differentiating (3.22') with respect to τ yields:

$$\frac{\partial t_T*}{\partial \tau} = \frac{\sigma(1-\gamma)\varepsilon(1-\sigma)(\gamma-\sigma)\tau^{-\sigma}\left[(1-\tau^{2(1-\sigma)})-2\tau^{(1-\sigma)}(1-\tau^{(1-\sigma)})\right]}{\left(\sigma(1-\gamma)\varepsilon(1-\tau^{(1-\sigma)})-(\gamma-\sigma)(1-\tau^{2(1-\sigma)})\right)^2} >/< 0. \qquad (3.23)$$

The sign of expression (3.23) depends on the value of the term within the square brackets. It can be shown that this term is positive except for the extreme cases of $\tau \to 1$ and/or $\sigma \to 1$. For all other parameter values the expression is unambiguously positive. We can therefore state:

PROPOSITION 3.3 *Except for the extreme parameter values of $\tau \to 1$ and/or $\sigma \to 1$, closer economic integration leads to a lower equilibrium value of the tax rate t_T*.*

It is thus that closer economic integration - due to a fall in transportation cost - leads generally to lower tax rates in equilibrium, giving rise to inefficiently low public good provision. Numerical values for the two cases of autarky and two-region scenario are provided in the following two tables. Using $\varepsilon = 1$ and $\gamma = 0.5$, we list in Table 3.1 the optimal tax rate as a function of σ for the autarky case. In Table 3.2, we then list the optimal tax rates as a function of σ and τ for the two-region scenario.

Autarky case	$\sigma = 3$	$\sigma = 4$	$\sigma = 5$	$\sigma \to \infty$
t*	0.375	0.364	0.357	0.334

Optimal tax rates in the autarky case
Table 3.1

Two-region case		$\sigma = 3$	$\sigma = 4$	$\sigma = 5$	$\sigma \to \infty$
for $\tau = 1.05$:	t_T*	0.240	0.235	0.234	0.334
for $\tau = 2$:	t_T*	0.343	0.337	0.343	0.334
for $\tau \to \infty$:	t_T*	0.375	0.364	0.357	0.334

Optimal tax rates in the two-region case
Table 3.2

It can be seen that the values in Table 3.2 are lower than the ones in Table 3.1 except for $\tau \to \infty$ and for $\sigma \to \infty$. In the latter case (3.22) also simplifies to the autarky expression with $\sigma \to \infty$. In that case intra-industry trade would not arise as the goods produced are perceived to be perfect substitutes and consumers would not improve their welfare by consuming imported goods. Also note the effects of an increase in σ on t*: in (3.13) we showed that an increase in σ leads to a fall in t* in the autarky case. For the two-region case, there are now two opposing effects: on the one hand, the effect as described in (3.13) still exists, on the other hand it also leads to a fall in intra-industry trade and thus would lead to an increase in t_T*.

This model generates the same 'inefficiency in regional tax policies' result as generally obtained by the local public goods literature. However, the mechanism at work is quite different. Intuitively the following is happening: regional governments finance the provision of the local public good by levying a tax on domestic workers' income. The cost of providing the regional public good therefore fully falls on the domestic citizens. The benefit of provision, however, does not fall on the domestic citizens alone: as the regional public good is productive in nature, it is necessary and beneficial to the IRS-sector. The benefit of provision therefore is embedded in the tradeable x-good. In the autarky case this does not matter as trade does not occur - so that the benefit can be fully enjoyed by the domestic citizens. The tax rate is then efficiently set by the regional government. With trade foreign consumers also enjoy the benefit of domestic public good provision (the lower production cost) and hence the benefit to the domestic consumers is lower than in the autarky case: Foreign free-rides on the domestically provided public good. This "outflow of benefit" is higher, the higher the volume of trade between the two regions. We can thus provide another reason why decentralised decision-making itself can lead to an underprovision of public goods. Gordon argues that this '...[l]ess efficient ... outcome ... arises because one community's decisions affects in many ways the utility levels of residents of other communities, yet these effects are ignored in the decision-making. The types of externalities ... were as follows:

(1) Nonresidents may pay some of the taxes.

(2) Nonresidents may receive some of the benefits from public services...' (Gordon, 1983, p. 580).

3.4 The 'degree of ineffectiveness'

The effect of lower trade costs on the 'degree of ineffectiveness' in public good provision can be analyzed by looking at the ratio of the optimal tax rate under trade conditions to the optimal tax rate under autarky. Define $\hat{t} = t^*_T \; / \; t^*$ so that:

$$\hat{t} = \frac{t_T^*}{t^*} = \frac{\left(\varepsilon(1-\gamma)+1-\gamma/\sigma\right)(1-\tau^{(1-\sigma)})}{\left(\varepsilon(1-\gamma)(1-\tau^{(1-\sigma)})+(1-\gamma/\sigma)(1-\tau^{2(1-\sigma)})\right)} \qquad \textbf{(3.24)}$$

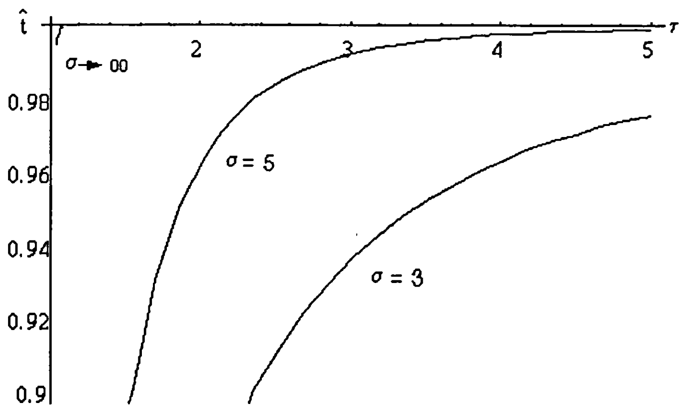
Analytically, we can find that:

$$\frac{\partial\hat{t}}{\partial\tau} = -\frac{(1-\sigma)(1-\gamma/\sigma)(\varepsilon(1-\gamma)+1-\gamma/\sigma)\tau^{-\sigma}[(1-\tau^{2(1-\sigma)})-2\tau^{(1-\sigma)}(1-\tau^{(1-\sigma)})]}{\left(\varepsilon(1-\gamma)(1-\tau^{(1-\sigma)})+(1-\gamma/\sigma)(1-\tau^{2(1-\sigma)})\right)^2} >/< 0 .$$

(3.25)

The sign of expression (3.25) depends on the value of the term in the square brackets. As in the case of Proposition 3.3, it can be shown that the term is positive except for the parameter values of $\tau \rightarrow 1$ and/or $\sigma \rightarrow 1$. We can therefore say that in general, the higher the transportation cost τ, the closer is the optimal tax rate in the two-region case to the autarky tax rate. The ratio approaches one from below for $\tau \rightarrow \infty$.

Figure 3.1 illustrates the ratio as defined in (3.24) as a function of transportation cost τ for $\varepsilon = 1$, $\gamma = 0.5$, and three values of σ ($\sigma = 3$, $\sigma = 5$ and $\sigma \rightarrow \infty$). Note that for $\sigma \rightarrow \infty$ trade does not exist between the two regions, so that efficient tax rates are set regardless of the transportation cost.



Degree of ineffectiveness
Figure 3.1

The two governments are "locked into" a coordination problem: both regions would be better off with higher tax rates as the inputs are not efficiently used, however a regional government would not unilaterally raise its tax rate to the efficient level. The Nash equilibrium in tax rates supports inefficiently low tax rates.

4. Welfare effects of economic integration and tax coordination

The above discussion suggests that regional governments have an incentive to provide the local public good inefficiently as regions open up to trade with other, identical regions. This incentive therefore reduces or even offsets any direct benefit from closer economic integration. To reap the full benefit of trade liberalisation, both governments should agree to delegate the policy making to a central planner who would take into account the "outflow of benefit"[58] on the two-region level. To see this, let us assume the existence of an organisation which sets a uniform, welfare-

[58] The line of reasoning is similar the one suggested by Bucovetsky and Wilson (1991) - see page 69.

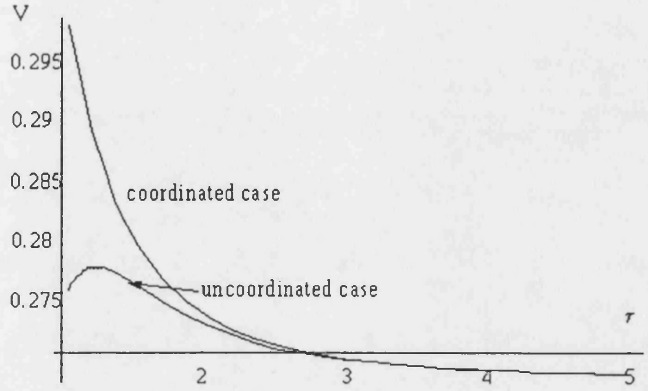
maximising tax rate across both regions[59]. Tax revenues are then evenly split between the regions to provide the local public goods. Everything else remains the same.

PROPOSITION 3.4 *Welfare levels in the regions are maximised when the two regions delegate their policy-making power to a central planner. This policy regime avoids the problem of under-provision and therefore always offers higher welfare levels than if the regional governments were responsible for the policy themselves. Also, the difference in welfare levels is the larger the lower the transportation costs between the two regions.*

Proof. See Appendix 3B. □

Figure 3.2 illustrates the above argument for the parameter values $\varepsilon = 1$, $\gamma = 0.5$, $\sigma = 4$ and $\eta = 1$.

[59] Admittedly, this setup is open to criticism: "The first ... purpose ... is to argue for a more substantive analytical role for the federal government ...: for a recognition that the federal government is best treated as a player in its own right, not introduced as a mechanical device for tidying the loose ends left by horizontal interactions between the states." and furthermore "...[t]he federal government has often been seen as having two fiscal roles: redistribution across the states of the federation ,,,, and internalising fiscal externalities ... between the states... The federal government might achieve this internalisation by a variety of means. It might coordinate the decisions of the states... The essence of all these schemes, ..., is the same. In attempting to undo the consequences of horizontal externalities, the federal government seeks to bring the economy as close as possible to the (constrained) optimal unitary outcome" (Keen, 1996, pp.1-3).



Utility in uncoordinated and coordinated cases
Figure 3.2

Both regions would therefore be better off by delegating the decision making to the central planner. The gains from coordination become bigger the larger the volume of trade between the two regions. Furthermore, it can be seen that for low values of τ, the welfare level in the "uncoordinated" case can actually decline despite the reduction in trade costs, i.e. the incentive to under-provide the public good *more than offsets* the direct gains from lower transportation costs.

5. Concluding remarks

This chapter focused on the effects of intra-industry trade on the tax raising and local public good provision behaviour of regional governments. Using methods developed in the 'new international' trade literature in a fiscal competition style framework, it was shown that product mobility can give rise to the same 'inefficiency in regional tax policies' result as generally derived in the local public goods literature. In contrast to that literature however, we did not require taxation on mobile factors to derive the result - the existence of local public goods which affect the production process of monopolistically-competitive firms sufficed.

As long as trade takes place, the benefit of the local public good provision - which is embedded in the traded goods - would have to be shared with foreign consumers, whereas the full burden of financing the provision would be on the domestic citizens. This outflow of benefit would then give rise to the inefficiency in regional tax policies. This result would not hold if we followed the fiscal competition literature in assuming that the local public good enters the utility function of domestic consumers directly. In that case, the whole benefit of provision would remain in the tax-raising region and regional governments would always choose the efficient tax rate. The result would also not arise within the framework of perfectly-competitive firms as trade would not arise between identical countries.

Another result of this chapter was that tax coordination, e.g. delegating the tax-setting policy to a central planner, unambiguously raises welfare levels in the regions as it avoids the problem of local public good underprovision. It was also shown that the incentive for a regional government to underprovide the local public good is higher, the higher the volume of trade between the two regions. Holding everything else constant, a reduction in transport costs between the two regions could thus even lead to a fall in welfare level. This observation has clear policy implications: in a European Union context, for instance, along with closer economic integration, regional policies should become more coordinated. And the need to coordinate continues to rise as the benefit from coordination become the larger, the more integrated the regions become.

However, could a regional government increase its citizens' welfare without relying on policy coordination with another government or delegating responsibility to a supra-national organisation? From Figure 3.2 it can be seen that a regional government could increase its citizens' welfare by *artificially* increasing the transport costs between the regions as long as the degree of economic integration is very high. Such a policy could, for example, require imposing tariffs on the imported goods. This would not only reduce the demand for imported goods, but it would also generate additional government revenues which could be used to provide the public good. This opens new possibilities for a regional government. For example, we could imagine that the government generates its revenues entirely from tariffs and not from levying taxes on its citizens. This policy would then not only reduce the degree of economic integration, but would also raise the disposable income of the citizens. An analysis of these alternative policies is, however, outside the scope of this chapter.

Appendix 3A

Proof of Proposition 3.1:

Recalling that w = 1 and using equations (3.2), (3.4), (3.8), (3.10) and (3.11a), we are able to derive the key expression for indirect utility in this economy:

$$V=(1-t)^{\frac{\gamma-\sigma}{(1-\sigma)}} g(t)^{\frac{-(1-\gamma)\sigma}{(1-\sigma)}} (1-\gamma)^{\frac{-(1-\gamma)}{(1-\sigma)}} . \qquad \textbf{(A3.1)}$$

Differentiating V with respect to t yields the welfare maximising tax rate t* as given by expression (3.12) in the text. The second order condition is given by:

$$\frac{\partial^2 V}{\partial t^2} = \eta^{a\sigma}(1-\gamma)^a(\gamma-1)(1-t)^{\frac{(\gamma-\sigma)}{(1-\sigma)}} t^{a\varepsilon\sigma}(1-\sigma)^{-2} \left(\frac{(\gamma-\sigma)(t-2\varepsilon\sigma(1-t))}{(1-t)^2 t} + ((\varepsilon\sigma(\gamma-1)+\sigma-1)\varepsilon\sigma t^{-2} \right), \qquad \textbf{(A3.2)}$$

where a = $(\gamma - 1) / (1 - \sigma)$. It can be shown that the above expression for t = t* and all appropriate parameter values is negative, i.e. it satisfies the condition for a maximum.

Appendix 3B

Proof of Proposition 3.4:

To prove Proposition 3.4, we first of all have to find the optimal tax rate in the coordinated case. Given the assumption that taxes are set at the same rates across both regions, we have $E_H = E_F$, and the same transformation functions and prices by individual firms. We also know that in such a case $P_H = P_F$ so that (3.18) in combination with (3.10) can be rewritten as:

$$1 = g(t)p^{(1-\sigma)}\left(EP^{(\sigma-1)}(1+\tau^{(1-\sigma)})\right). \qquad \textbf{(B3.1)}$$

(B3.1) can be solved for P:

$$P = \left(\frac{1}{g(t)^{\sigma}E(1+\tau^{(1-\sigma)})}\right)^{\frac{-1}{(1-\sigma)}}. \qquad \textbf{(B3.2)}$$

Substituting (B3.2) into (3.2) in the main text, we can find the indirect utility under the coordinated scheme. We can easily show that the optimal tax rate of the autarky case as given by (3.12) and (3.12') also maximises utility for the coordinated scheme. This utility level has to be compared with the uncoordinated case in which every region is maximising its own utility, ignoring the other region's policies. The utility level in that case can be found by substituting (3.22) and the analogous expression for Foreign into (3.20) and then using that expression in (3.2). We could compare the resulting utility levels analytically but it is more illuminating to represent the utility levels in Figure 3.2.

Chapter 4

Urban zoning, imperfect competition and land-developers

1. Introduction

The theory of land zoning analyses the motivations for government intervention in the land market of cities or regions: '[F]our motivations have been advanced as determinants of zoning decisions. The traditional view, known as externality zoning, is that zoning regulations, particularly land-use regulations, serve to reduce the external costs that may be generated when incompatible uses are in proximity to one another. Additionally, zoning may be used to attract residents whose contributions to tax revenues exceed their consumption of public services... This rationale is called fiscal zoning. Another motivation for promulgating zoning regulations, known as exclusionary zoning, is a desire to bar certain ethnic groups or social classes from occupying a jurisdiction. Finally, the value of land in alternative uses may guide zoning decisions' (Pogodzinski and Sass, 1994, pp. 602-603). In an excellent survey Pogodzinski and Sass continue to analyse zoning and '...[d]ivide the effects of zoning on economic agents into six broad categories: supply-side effects, demand-side effects, Tiebout effects, externality effects, endogenous zoning, and rent-seeking behaviour...' (Pogodzinski and Sass, 1990, p. 294). They stress that externalities are the usual raison d'être for zoning regulation and that these support zoning policies on welfare grounds. Much of the literature thus deals with the question under which circumstances zoning is welfare-improving when compared to the market equilibrium.

This chapter contributes to the theory of zoning in several ways. In the first section we look at market imperfections created by monopolistically-competitive firms. This setup has been used, for example, extensively in the 'new international trade theory' (Krugman, 1979) but not generally in the context of urban zoning. Does monopolistic competition create another reason why policy makers should intervene in the allocation of land? We answer this question by looking at a fixed-size urban region with only one production/retailing site in which monopolistically-competitive firms and households compete for the use of land. Comparing the welfare level obtained by a central planner (e.g. the local government) with the one attained in the market equilibrium, we find that there is indeed a role for government intervention.

In the second section we use the basic structure of the one-site economy such as consumer preferences and production technologies and extend it to the case with one centrally located and one out-of-town site. By doing so, we introduce 'distance' and different levels of accessibility of the central market from the two sites due to transportation cost into the model. This setup is used to study several models of urban land-use zoning. The first question we address is where and how much land the local government should zone for production/retailing use, taking into account the different levels of accessibility of the central market from the two sites. We assume initially that the local government is the only large-scale agent involved and has sole control over the two business districts.

In this context, a particular industry to think about is retailing and especially 'comparison shopping'. Shopping can be split into two subgroups, the first is 'convenience shopping' which includes essentials such as bread, milk or newspapers and is normally done locally, the second is 'comparison shopping' for which consumers are prepared to travel some distance. This includes shopping for consumer durables such as computers, household appliances, furniture or other bulky goods (LPAC, 1994a). The last two decades have seen a revolution in consumption and retailing behaviour: '[I]ncreasing affluence has been associated with a rise in car ownership and much greater mobility. Given the improvement in roads, people are now able and willing to travel far greater distances for their shopping' (Bromley and Thomas, 1993, p. 3). Consequently, many retail parks have opened on the city fringes, redirecting consumption away from the established town centre shopping facilities. The opening of out-of-town facilities frequently has effects on the traditional centres: '[A]lthough larger city centres endure much new competition, further down the retail hierarchy there are high vacancy rates, store losses, smaller units and pressure to alter uses...' (Westlake, 1993, p. 175). This 'pressure to alter uses' has led to the redevelopment of formerly production/retailing sites into residential space in may central locations (LPAC, 1994b).

On the positive side though, it has been argued that the developments have increased the supply of land and hence reduced the rental price of land; this potentially has led to a fall in the price level in general. Furthermore planners must also see the potential advantages such as more choice for shoppers (McGoldrick, 1992). Finally, the increased competition has led to the improvement of many existing town centres - to the benefit of the consumer: '[T]he negative effects of regional out-of-town shopping centres on CBDs ... can be mitigated by the redevelopment and enhancement of traditional centres, which can be seen as important positive responses to retail change' (Bromley and Thomas, 1993, p. 145).

It has to be remembered though that local governments rarely play an *active* role in the *physical development* of business or retail parks; their role is generally limited to granting the planning permission for the development and trying to participate in the potential planning gain. The active role is normally performed by profit-maximising absentee land-developers. This observation forms the basis for the following sections of this chapter. We study ~~in~~ which way urban land zoning can be affected by the existence of absentee land-developers. In this context the many retail parks and shopping centres which have been developed outside towns come to mind (Lakeside (Thurrock) and Meadowhall (Sheffield) in the early 1990s are two prime examples in England).

Surprisingly, not much attention has been given to the importance of land-developers in the process of city development and the location decisions of firms so far: Henderson and Slade (1992) and Henderson and Mitra (1995) have focused on related issues. The former use simulation results to analyse whether competing land-developers develop land adjacent to (a monocentric outcome) or distant from each other (a duocentric outcome). The latter study the optimal behaviour of a land-developer (its optimal location decision and capacity choice) when maximising against an established and passive Central Business District (CBD) in which the capacity is fixed.

This chapter is more closely related to the latter. However, the capacity of the CBD is not taken to be fixed. We ask how a local government should respond to the emergence of absentee land-developers which transfer their profits out of the local economy when the local government is still in charge of zoning of the CBD. Does this outflow of profits justify a different zoning policy for the CBD to the case in which the government was in charge of zoning in both business districts? We argue that this depends crucially on the location of the out-of-town development. If it is within the city's jurisdiction, the government can levy a tax on profits and thus recoup some or all of the outflow. If it is outside the jurisdiction though, then the local government has no legislative power to levy taxes on profits and has to resume to other polices. In the context of the model we suggest that zoning could be an appropriate policy instrument. The local government could act as a second land-developer and compete with the out-of-town developer in the supply of land. Admittedly our case is specific in that we assume only one market place for goods - the city residents themselves. This implies that the land supply within the city ultimately determines the rental price of land within and outside the city. This might not be too unrealistic to assume though: out-of-town developments are frequently built to serve just one market place - the town it is attached to.

The chapter is organised as follows: section 2 models the city with one CBD. The optimal zoning policy is derived and compared to the market outcome which would arise without zoning. We find that the existence of monopolistically-competitive firms creates a need for land zoning in our setup. Using the framework of section 2 as a building block, we introduce in section 3 a second production site which is out-of-town and potentially less accessible than the centre. The optimal zoning policy and the corresponding distribution of firms across the two sites are derived when both sites are developed and run by the city government. It is shown which factors affect the optimal policy. Section 4 introduces a profit-maximising land-developer which develops the out-of-town site and earns the corresponding land rent. The government's optimal zoning of the CBD is derived and compared to the case in section 3. In subsection 4.4 we analyse the case in which the out-of-town site is within the city's jurisdiction. Section 5 concludes.

2. A city with one production site

2.1. Citizens' utility

Let us consider a city which is inhabited by L identical residents whose utility depends on the consumption of the goods h, x and y[60]:

$$u = h^{1-a-b} X^{a} y^{b}, \tag{4.1}$$

where h is the amount of land for residential use per capita (h for housing), X is the consumption of an aggregate of goods x produced by an increasing-returns-to-scale (IRS)-sector and y is consumption of a good produced under constant-returns-to-scale (CRS). The fraction 1 - a - b of income is spent on residential land, a is the fraction spent on the IRS-sector and b the fraction spent on the CRS-sector. It is assumed that 1 - a - b is constant, whereas the values of a and b (with a + b < 1 and constant and a, b > 0[61]) can vary, representing a shift in consumer tastes from consuming IRS-sector goods to CRS-sector goods or vice versa.

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60 This setup is loosely based on Helpman (1995).

61 This assumption implies that all three goods are always demanded and hence each sector exists.

2.2 Factor markets - the supply of labour and land

Labour and land are the only factors of production in the city. Each resident is endowed with one unit of labour and can supply the unit irrespective of the distance between residential and job location. Without loss of generality we set L = 1.

ASSUMPTION 4.1

Commuting costs in the city are zero. This implies that citizens can offer the same amount of labour supply regardless of the distance between their residential and job location.

Turning to land supply, it is assumed that the city is confined spatially to be along a line of unit length. Demand for land then has to be met by land supply from within this city. There are several reasons why the city's size could be limited. The first reason is due to topographical features. Cities in coastal regions, for example, are often faced with mountains further inland, representing a natural barrier to expansion (Barcelona is such a city). Another reason could be the political status of the city: Singapore and Hongkong, to mention just two cases, are "city states" and therefore limited in size. These natural or territorial barriers to urban sprawl have led to high population densities and relatively high land prices in these cities. A third reason why land supply could be limited is because of some political decision. In the United Kingdom, green- belts were introduced to provide an artificial barrier to urban sprawl (Hall, 1973), with governments in other countries pursuing similar policies: in the urban regions of Oslo and Amsterdam, for example, urban sprawl has been contained by the high price of obtaining an official permission to convert land from agricultural to urban use. As a consequence, the price of land with official permission for conversion is 115-times (in Oslo) and 80-times (in Amsterdam) higher than land without the official permission (HABITAT, 1996). The assumption made in this section therefore represents the extreme case in which the government refuses to grant planning permission. Another urban region in which urban sprawl has been contained is Madrid which, despite its location in a desert-like environment, is compact and densely populated. These three examples represent a whole category of cities in upper-income countries, in which land use is highly regulated to the point where house prices rise as a consequence of artificially constrained land supply (HABITAT, 1996).

It is the assumption of limited land supply which gives rise to positive land rents in a city without commuting costs. In Appendix 4A we provide an informal discussion of a setup in which these assumptions are relaxed, i.e. we introduce commuting costs to determine the equilibrium size of the city. For what follows, we argue that the features of interest can also be captured by the simplified and less realistic version presented here.

2.3 The CRS and IRS-sectors

We make several strong assumptions regarding the CRS and IRS-sectors. First, *the CRS-sector, which is perfectly competitive, is assumed to require only labour as an input factor.* In the context of a 'city economy', it is most appropriate to think of the CRS-sector as services and 'convenience shopping' (see introduction to this chapter). Many types of services and 'convenience shopping' (such as legal services, hairdressers, opticians, cornershops etc) are labour-intensive and we therefore assume that the CRS-sector does not require any land for production. We choose the CRS-sector good as the numéraire and the units of production in that sector in such a way that one unit of output requires one unit of labour input. This implies $p_y = w_y = 1$, where p_y is the price of the CRS-sector good and w_y is the wage paid to CRS-sector workers.

Turning to the IRS-sector, the consumption aggregate X as introduced in (4.1) follows Dixit and Stiglitz (1977) and is given by[62]:

$$X = \left(\sum_{i=1}^{n} x_i^{\frac{(\sigma - 1)}{\sigma}} \right)^{\frac{\sigma}{(\sigma - 1)}}, \tag{4.2}$$

where x_i denotes output of an individual firm i and n the number of different varieties consumed. According to (4.2) a large number of potential varieties enters utility in a symmetric way with $\sigma > 1$ representing the elasticity of substitution between any two varieties.

Production of the final output x_i requires two stages: in the first, an intermediate input z is produced with Cobb-Douglas technology, combining land and labour:

$$z = s_x^{1-\mu} L_x^{\mu}, \tag{4.3}$$

where s_x is the amount of land available for industrial use, L_x the number of workers in the IRS-sector and μ, such that $0 < \mu < 1$, represents the importance of labour in this stage of the production process and the share of industry revenues accrued to labour. In the second stage of production, IRS-sector firms produce x with a fixed cost α and constant marginal cost β, using z as the only input factor, so that $z_i = \alpha + \beta x_i$.

62 The price index for the differentiated products is the dual to (4.2) and is given by:

$$P_x = \left(\sum_{i=1}^{n} p_i^{1-\sigma} \right)^{\frac{1}{(1-\sigma)}}.$$

Given the demand structure described by (4.2), each individual firm i maximises its profit by setting a price as a mark-up over the marginal cost MC of production. Following standard analysis we can derive: $p_i = \sigma \beta MC_i / (\sigma - 1)$ where $MC_i = r_x^{1-\mu} w^{\mu}$.

ASSUMPTION 4.2

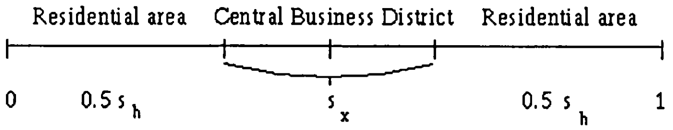
Land within the city is atomistically owned by citizens. The supply of land is therefore perfectly competitive.

Using Assumption 4.2 and assuming labour mobility between the sectors - which implies $w_y = w_x = w = 1$ - we can derive from (4.3) the price of land in the industrial zone r_x in terms of the wage w: $r_x = (1 - \mu) L_x / (\mu s_x)$. Without loss of generality let us choose $\alpha = 1 / \sigma$ and $\beta = (\sigma - 1) / \sigma$. With that simplification, we can express p_i in terms of the return on land. It can also be shown that each firm charges the same price in equilibrium. Hence:

$$p = p_i = \left(\frac{(1-\mu)}{\mu} \frac{L_x}{s_x} \right)^{1-\mu} . \quad \textbf{(4.4)}$$

Free entry and exit of firms into the IRS-sector leads to zero profits in equilibrium and determines a unique output level per firm: $x = x_i = \alpha (\sigma - 1) / \beta = 1$. In order to produce exactly one unit of final output, an individual firm requires exactly one unit of z. This implies that the number of firms is proportional to z with $n = z$.

To summarise this subsection, both the CRS and IRS-sectors need labour as an input factor, whereas only the IRS-sector requires land as an input factor. However, land is also demanded by citizens for residential purposes so that there are competing uses for both input factors. Finally, let us impose factor market clearing so that $s_x + s_h = s = 1$, where s_h is the amount of space not used by the IRS-sector and hence available for residential use. We also have $L_x + L_y = L = 1$, where L_y is the fraction of the labour force which works in the CRS-sector. Figure 4.1 depicts a *potential scenario* for this city.



A city with one (central) business district
Figure 4.1

This is a standard modelling approach as stated in Stull who, following Alonso (1964), states that '...[l]and in this economy has only two potential economic uses: as a location for residential activities or as a location for manufacturing activities' (Stull, 1974, p. 337). Note however that the scenario presented in Figure 4.1 entirely depends on the assumption of a *central* business district - denoted by CBD. Other configurations are equally possible as we do not have commuting cost in our setup.

2.4 The allocation of resources - the social planner's zoning problem

In this subsection we discuss the allocation of resources across the different uses. First, as stated above we assume that labour is perfectly mobile between the two sectors. Second, regarding the allocation of land across its uses, we make the following assumption:

ASSUMPTION 4.3

A social planner (e.g. here the local government) is in charge of allocating land between industrial and residential use - trying to maximise citizens' utility as given by (4.1). The procedure is referred to as zoning[63].

Looking at Figure 4.1 again, it is the social planner who decides on the expansion of the (central) business district, marked by the two small vertical lines defining the central business district.

2.5 Solving the model

The social planner maximises citizens' utility by choosing the optimal size of the CBD, taking the industry structures as described in section 2.3 as given. Denoting total income in the economy with E, we know that $X = a\,E\,P_x^{-1}$ and $y = b\,E$. We also have $h\,L^{-1} = h = s_h = (1 - s_x)$. We can rewrite expression (4.1) as the social planner's objective function:

$$\hat{u} = (1 - s_x)^{1-a-b}\left(aEP_x^{-1}\right)^a (bE)^b, \qquad \textbf{(4.1')}$$

where s_x is its choice variable.

To find the optimal value of s_x, we need to find E and P_x: for example, from (4.4) we see that a larger s_x would lead, ceteris paribus, to a lower individual price. Given the production function (4.3) it would also lead, once again ceteris paribus, to

[63] We use the terms 'production', 'industrial' and 'retail' land use to describe the same activity. In the context of our model we can imagine that producers sell their products on their premises. The closest form of retailing to that are factory outlets - a common form of retailing in the USA and more and more so in Europe as well: '[I]t may be too soon to positively identify a fifth wave [of retail decentralisation] but the durable goods Factory Outlet Centre is emerging as a further form of decentralisation. The factory shop, of which there are estimated to be at least 1400 scattered around Britain, sells manufacturers' products directly to the public...' (Walker, 1996, p. 165).

a larger supply of z and hence to more variety. This in turn would reduce the price index P_x. However, p also depends on L_x. In order to find L_x, we have to turn to the demand side of the economy.

First note that total income E in the city consists of labour income, rental income from the industrial sector and housing income H:

$$E = wL + r_x s_x + H, \qquad \textbf{(4.5)}$$

where from (4.1) H = (1 - a - b) E. With w L = 1 and r_x as given above, we can rewrite (4.5):

$$E = \frac{1}{(a+b)}\left(1 + \frac{(1-\mu)}{\mu}L_x\right). \qquad \textbf{(4.5')}$$

L_x can be found by noting that workers spend the fraction a of their income on IRS-sector goods so that total revenues to IRS-sector firms is a E. From (4.3) it follows that firms spend the fraction μ of their total revenues to pay their wage bill. We can easily rearrange (4.5') to get:

$$L_x = \frac{a\mu}{(b+a\mu)}. \qquad \textbf{(4.6)}$$

Expressions (4.3), (4.4) and (4.6) then give us the price index P_x (see footnote 62) as a function of s_x.

PROPOSITION 4.1 *The optimal zoning policy is a function of a, b, σ and μ and dedicates the fraction s_x* of land to industrial land use:*

$$s_x^* = \frac{-a\sigma(1-\mu)}{(1-a-b)(1-\sigma)-a\sigma(1-\mu)}. \qquad \textbf{(4.7)}$$

Proof. See Appendix 4B. □

Performing simple comparative statics, we find that the effects of changes of the different parameter values on s^*_x are given by $s^*_{xa} > 0$, $s^*_{x\sigma} < 0$ and $s^*_{x\mu} < 0$. These effects are derived in Appendix 4B. A higher value of a reflects the fact that consumers spend a larger fraction of their income on IRS-sector goods and less on the "y"-type good. To meet this increase in demand, supply should also be raised. This requires increasing s_x. The higher the value of μ, the less important is land as an input factor in the first stage of production (see (4.3)). This implies that the marginal cost of production MC - and hence the price of an individual variety - falls. Ceteris paribus, a higher value of μ thus gives rise to a lower price index. The benefits of a lower price index can then be enjoyed already with a smaller industrial site. For illustrative purposes, we present numerical values for a = 0.35, b = 0.35, μ = 0.75, and three different values of σ in Table 4.1:

σ	s_x^*	u	n
2	0.37	0.47	0.41
3	0.30	0.55	0.39
4	0.28	0.58	0.38

Optimal zoning of CBD

Table 4.1

Finally, a higher value of σ reflects a lower preference for variety by consumers. Given that variety is directly proportional to n (and therefore z) and the fact that L_x is constant, s_x* falls (see (4.3)).

Given the optimal zoning policy as stated in Proposition 4.1, we can find the corresponding land rents in the industrial and the residential areas. Using the expression for r_x, (4.6) and (4.7) we find r_x*:

$$r_x* = -\frac{((1-a-b)(1-\sigma)-a\sigma(1-\mu))}{(b+a\mu)\sigma} . \qquad \textbf{(4.8a)}$$

The price for one unit of residential land can be found by deriving s_h* = (1 - s_x*) and noting that r_h* = (1 - a - b) E / s_h*:

$$r_h* = \frac{((1-a-b)(1-\sigma)-a\sigma(1-\mu))}{(b+a\mu)(1-\sigma)} . \qquad \textbf{(4.8b)}$$

r_h* can be derived implicitly as we have not modelled the housing market explicitly. The ratio r_x* / r_h* is given by - (1 - σ) / $\sigma \leq 1$, i.e. the rental price of land should be *lower* in the industrial area than in the residential area for all values of σ except for $\sigma \rightarrow \infty$ (the case of perfect competition)[64]. The smaller σ, the more highly is variety valued by consumers. This preference can only be met by allocating more land to industrial use which leads to a fall in r_x. Less land for residential use (with fixed expenditure level on it) directly leads to an increase in r_h. In other words, the production of the IRS-sector should be indirectly subsidised.

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64 This might sound surprising but note that the general (opposite) result in the urban economics literature is driven by the commuting cost within the city. The scenario depicted in Figure 4.1 is just one example. Our industrial site could also be at the city edge or it could even be split in two sites at the city edges. What matters in this setup is the size of the business district - not its location. However we follow standard modelling techniques by assuming the Central Business District.

2.6 Utility level under zoning allocation versus market allocation of land

So far we have not shown that the optimal allocation of land by a central planner leads to a different welfare level than by market forces alone. In order to justify the central planner's intervention, we have to demonstrate that utility is higher in the case of intervention. To do so, we have to find the market allocation of land.

REMARK 4.1

The (non-zoning) spatial equilibrium in the city is characterised when all households/ firms are, respectively, equally well-off and neither households nor firms can raise their utility/ profits by moving to a different location within the city.

Remark 4.1 implies that without commuting cost and a constant wage, the land rent must be equalised across the entire city: $r_h = r_x = r$[65]. Why? Suppose that land rents were different across the two sites with $r_h > r_x$. A firm would never move: a deviant firm would face the same labour cost but r would be higher, so that its marginal cost of production would rise - leading to negative profits in the light of a given price p_x. However, citizens would relocate: spending (1 - a - b) E of total income on housing, an individual would get more space to live on in the industrial site. Note that an individual is indifferent between living in the residential or the industrial site as there are no negative externalities etc.

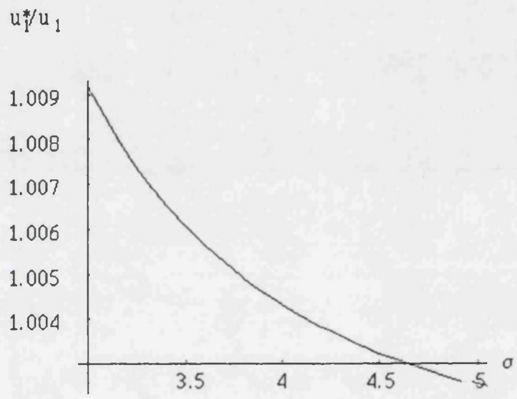
PROPOSITION 4.2 *Land use zoning policy increases the welfare level in the city when compared to the (non-zoning) spatial equilibrium outcome. This is because zoning takes into account the pecuniary externality created by the monopolistically-competitive industry.*

[65] Note that total income E remains constant throughout our discussion. Hence zoning does not affect citizens' total income.

Proof: It can easily be shown that $s_x = (1 - \mu)\, a \,/\, ((1 - a - b) + (1 - \mu)\, a)$ equalises the land rent across the residential- and industrial land. The *market allocates too little land* to industrial use. Substituting s_x* from (4.7) and s_x as above into (4.1), and taking ratios we find that:

$$\frac{u_1*}{u_1} = \left(\frac{1 - s_x*}{1 - s_x}\right)^{(1-a-b)} \left(\frac{s_x}{s_x*}\right)^{\frac{a\sigma(1-\mu)}{(1-\sigma)}}, \qquad \textbf{(4.9)}$$

where u_1* represents the utility level with zoning and u_1 without zoning. This ratio is illustrated in Figure 4.2:



Ratio of welfare levels
Figure 4.2

The ratio approaches one from above as σ goes to infinity. For $\sigma \rightarrow \infty$ (the case of perfect competition), zoning cannot improve over the market outcome. In the case of perfect competition, less land for industrial use would raise the MC and the price. A citizen would take this price increase into account when moving. With monopolistic competition though, not only does the individual price go up but also the price index as the number of firms decreases. The magnitude of this second effect depends on σ. A citizen would not take into account this effect. We have described another externality - a pecuniary rather than a technological - which gives rise to a misallocation of land by the market. There is a role for zoning.

3. A city with two potential production sites

Zoning and development done by the local government

In the following sections we want to analyse alternative factors which might affect zoning policies. We therefore ignore the effects of market imperfections in the main part of the text, however, we provide numerical examples in Appendix 4D to support the findings made in section 2 of this chapter.

Let us relax the assumption made in section 2 that land supply is limited to the urban area. Instead we assume that the city's metropolitan area extends beyond the city limits and that there is potential land to the east of the city itself[66]. *This new site can be brought into use by the local government.* All future rental income is then accrued to the city residents and channelled back into the local economy.

ASSUMPTION 4.4

The out-of-town site can only be used as an industrial/retailing site. Arbitrarily, the *maximum* size of the site is of unit length as well.

The local government has zoning power over land within and outside the city. In the following we assume that 'zoned land' is always also developed. Note that even though the maximum size is unity, the site zoned for industrial/retailing use can be anything between zero and one. Let us extend Assumption 4.1 to include the out-of-town site. This allows us to simplify the analysis without losing the aspects we are interested in analysing.

66 We can imagine that the city's expansion to the west is limited by a lake etc. Obviously the setup is symmetric and we could reverse it.

ASSUMPTION 4.1'

Commuting costs remain zero even for commuting to and from and within the out-of-town site.

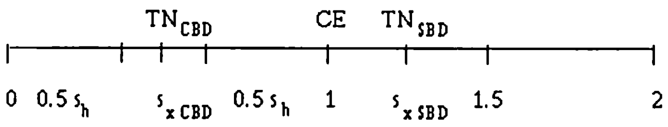
From now on let us refer to the out-of-town site as the Suburban Business District - SBD. To introduce the concept of relative accessibility to the urban market from the two different BDs, we assume that shipping final consumer goods from the SBD to the CBD is costly.

ASSUMPTION 4.5

The transportation of final consumer goods within the BDs is for free but shipment from the SBD to the CBD involves transportation cost. Furthermore, all goods produced in the SBD have to be shipped via its transportation node TN_{SBD} to the city's TN_{CBD} so that the transportation cost depends on c - the cost per unit of distance - and the total distance D between the two TNs. Finally, we assume that TN_{SBD} is always in the middle of the SBD[67].

In Figure 4.3 we show an example in which the local government has decided to zone only half of the land available for zoning outside the city:

[67] The last aspect of Assumption 4.5 obviously involves a strong assumption, however, we could imagine in the case of a production site a central railway terminal and in the case of a retailing complex a central car park or a central underground/bus station. The purpose of this assumption is to ensure that all firms face identical access to the city regardless of their location within the SBD.



An urban area with two production sites
Figure 4.3

where CE stands for city-edge. As in Figure 4.1, it is assumed that production/retailing within the city takes place at the central location, with the residential areas evenly located on both sides of it. Also note that in Figure 4.3, the area between 1.5 and 2 is left unzoned (and hence undeveloped). Why this might be the case is discussed below.

To model the transportation cost, we choose 'iceberg cost' so that for every unit of output arriving at the city's TN_{CBD}, τ units have to be shipped initially from the SBD's TN_{SBD} (with $\tau \geq 1$), the rest melts away[68]. Specifically, we follow Krugman and Venables (1995) and assume that $\tau = e^{cD}$ with $c \geq 0$ and D being the distance between TN_{CBD} and TN_{SBD}. Given that the distance from TN_{CBD} to the city edge is 0.5

68 More appropriate for the retail sector might be the following interpretation: residents purchase goods in both centres, however, transporting the goods back from the SBD is costly. In that case it is the consumers who have to pay for the transportation cost directly.

and that TN_{SBD} is in the middle of the SBD, we can easily see that $D = ½ (1 + s_{xSBD})$, where s_{xSBD} is the chosen size of the out-of-town-site[69].

The local government, when choosing the size of the SBD, has to take into account that a larger SBD would offer more land supply but would also lead to higher transportation cost as the distance between the two transportation nodes is increased. Note the difference to Henderson and Mitra (1996): even though they assume space and distance *between* business districts, the actual business districts do not take up any space (their office space capacity is stacked vertically).

3.1 The allocation of firms across the two business districts

Given Assumption 4.1', IRS-sector workers are indifferent between *working* in the CBD or SBD and hence wages are equalised across the two locations. The prices charged by the individual firms in each region therefore depend on the land rents alone and are given by:

$$p_j = \left(\frac{1-\mu}{\mu} \frac{L_{xj}}{s_{xj}} \right)^{1-\mu}, \qquad \textbf{(4.4')}$$

where subscript j = CBD, SBD. The amount of land s_{xj} allocated for industrial use and the equilibrium distribution of labour (with $L_{xCBD} + L_{xSBD} = L_x$) determine p_j.

PROPOSITION 4.3 *In equilibrium, the price charged by a firm in SBD at the factory gate must be lower than the price charged by a firm in the CBD. The relationship between the two prices is given by* $p_{SBD} = p_{CBD}\, \tau^{(1-\sigma)/\sigma}$. *Given*

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69 It is sometimes assumed that the land-developer has the size of its development (the capacity) and its location (the distance away from the city) as its choice variables (see for instance Henderson and Mitra, 1996). The latter choice variable becomes an issue once other economic factors which create forces of dispersion are modelled. In our setup, the optimal location is always adjoining the city edge.

(4.4'), this can also be written as: $L_{x\,SBD} / s_{x\,SBD} = L_{x\,CBD} / s_{x\,CBD}\, \tau^{\varepsilon}$*, where* $\varepsilon = (1 - \sigma) / ((1 - \mu)\, \sigma) < 0$.

Proof: As all varieties enter the utility function in a symmetric way (i.e. the setup is a quantity symmetry), every single firm has to sell the same quantity. Demand for each variety in the city centre can be found by applying Roy's identity to expression (4.1'). We have:

$$x_j = -\frac{(\partial \hat{u} / \partial p_j)}{(\partial \hat{u} / \partial E)} . \tag{4.13}$$

Partially differentiating (4.1') yields $x_{CBD} = a\, p_{CBD}^{-\sigma} / (P_x (a + b)(b + a\mu))$ and $x_{SBD} = a\, p_{SBD}^{-\sigma}\, \tau^{(1 - \sigma)} / (P_x (a + b)(b + a\mu))$. Noticing that we require $x_{CBD} = x_{SBD}$, we can derive Proposition 4.3.

The equilibrium allocation of firms across the two BDs is attained when the condition stated in Proposition 4.3 is satisfied[70]. Using (4.4'), (4.6) and the above condition, we can determine the equilibrium distribution of L_x:

$$L_{xCBD} = \frac{a \mu s_{xCBD}}{(b + a\mu)(s_{xCBD} + s_{xSBD}\, \tau^{\varepsilon})} \tag{4.14a}$$

and

$$L_{xSBD} = \frac{a \mu s_{xSBD}\, \tau^{\varepsilon}}{(b + a\mu)(s_{xCBD} + s_{xSBD}\, \tau^{\varepsilon})} , \tag{4.14b}$$

70 As an example, consider out-of-town retail parks which are in competition with centrally-located retailers. Consumers demand the same quantity in both locations but as they face the transportation cost, they expect a price in the out-of-town park which takes that into account.

Note that the price index for IRS-sector goods as given by footnote (62) is now:

$$P_x = p_{CBD}\left(n_{CBD} + n_{SBD}\tau^{\frac{(1-\sigma)}{\sigma}}\right)^{\frac{1}{(1-\sigma)}}. \quad \textbf{(4.15)}$$

where p_{CBD}, n_{CBD} and n_{SBD} can be found from expressions (4.3), (4.4'), (4.14a) and (4.14b) and τ as defined above.

3.2 The utility-maximising choice of s_{xCBD} and s_{xSBD}

The local government maximises utility given by (4.1') by selecting the optimal values of s_{xCBD} and s_{xSBD} (and thus D). When doing so, it has to take into account that the price index as given by (4.15) depends crucially on the per unit transportation cost c. Using (4.14a), (4.14b) in (4.15) and choosing s_{xCBD} and s_{xSBD} determines n_{CBD} and n_{SBD}. This affects $\hat{u}$. Below we analyse several cases.

PROPOSITION 4.4A *For c = 0, the optimal zoning policy is to locate all industrial production (retailing activity) in the SBD and allocate all the urban area to residential use.*

Proof: See Appendix 4C. □

This policy recommendation is obvious: without transportation cost, the local government should zone as much as possible in the SBD and as little as possible in the urban area itself. This frees land for residential use without the penalty of having to pay for the transportation of goods back into the city.

PROPOSITION 4.4B *For $c \rightarrow \infty$, the local government should ignore the potential SBD and allocate the land within the city limits as if it was the only area available for zoning.*

Proof: (4.14a) and (4.14b) simplify to $L_{xCBD} = a \mu / (b + a \mu) = L_x$, $L_{xSBD} = 0$ and $P_x = p_{CBD} (n_{CBD} + 0)^{1/(1-\sigma)}$. With $c \rightarrow \infty$, the SBD is unaccessible and no firm coul break-even in the SBD. The government should therefore the SBD: we are de facto back in the one-region case of section 2. Utility is maximised according to expression (4.7).

PROPOSITION 4.4C *For intermediate values of c, production of the IRS-sector should take place in both locations, the exact amount of which depends crucially on the level of c.*

Proof: As explicit first-order conditions to this maximisation problem cannot be found, we have to use numerical examples[71].

As can be expected, the optimal values for this case lie between the extreme values as given in Propositions 4.4a and 4.4b. In Table 4.2a the optimal values of s_{xCBD} and s_{xSBD} are given in columns 2 and 3 as functions of the transportation cost c and σ, with $\sigma = 3$. Rows 1 and 5 represent the two extreme cases as addressed in Propositions 4.4a and 4.4b (compare the values of row 5 with Table 4.1). The corresponding Tables 4.2b and 4.2c for $\sigma = 2$ and $\sigma = 4$ can be found in Appendix 4D. For illustrative purposes, the corresponding utility levels and the number of firms in each BD are also given in columns 4 to 7[72]:

[71] Nonetheless, the first-order conditions are derived in Appendix 4C.

[72] For the numerical examples we have set a = 0.35, b= 0.35 and $\mu = 0.75$.

$\sigma = 3$

c	s^*_{xCBD}	s^*_{xSBD}	u	n_{CBD}	n_{SBD}	n
0.00	0.00	1.00	0.71	0.00	0.53	0.53
0.50	0.14	1.00	0.61	0.15	0.38	0.53
0.75	0.20	1.00	0.58	0.24	0.27	0.51
1.00	0.25	0.75	0.57	0.31	0.16	0.47
10.0	0.30	0.07	0.55	0.39	0.00	0.39

Optimal zoning of CBD and SBD for $\sigma = 3$
Table 4.2a

For higher values of c, more land should be allocated to industrial use within the urban area and less in the SBD. Higher values of c force SBD firms to charge relatively lower prices. The only way this could be achieved is by having lower rental prices for land - which in turn also depends on the allocation of workers across the two BDs (see (4.4')). In equilibrium, for higher c, fewer firms can survive in the SBD. To relieve the pressure on land in the CBD, the best policy is to expand the CBD. This, ceteris paribus, reduces the prices charged by individual firms and the price index overall. Also note that as the SBD can be brought into use free of any cost (there are no development costs etc), it is obvious that the resulting utility levels are at least as high as in the single region case. In section 4.3 we interpret the values of s_{xSBD}. Comparing the values between the tables, we find that a higher value of σ should still lead to less land allocated to industrial use and hence less variety. The effect as illustrated in Table 4.1 is still relevant.

4. A city with two potential production sites

Zoning and development game with two large agents

Consider now a different setup in which the out-of-town site *has to be developed by some independent, absentee land-developer instead of the local* *government* (see page 98 for a motivation). In which way(s) is the local government's zoning policy affected by the presence of an absentee land-developer? To answer this question we assume that the local government is still in charge of zoning the CBD but has to take into account the absentee land-developer's profit-maximising behaviour. The land-developer itself also has to take into account the local government's policies when making its decisions. We assume that the decisions are taken simultaneously by the two agents. Given these assumptions, we describe the Nash equilibrium in development/zoning policies.

4.1 Total income in the city and the allocation of labour across the two districts

It is best to start this section by looking at the city residents' total income $\bar{E}$. Total income is derived from labour income, housing rent and rental income from the CBD only:

$$\bar{E} = wL + (1 - a - b)\bar{E} + r_{xCBD}\bar{s}_{xCBD}, \tag{4.16}$$

where the 'bar' is used to denote this new scenario. For a given size of the CBD (i.e. fixed capacity), a new out-of-town development leads to a fall in the rental price as the labour force is split across the two business districts. This is in line with real-life observations: new out-of-town developments frequently lead to the relocation of firms away from the old to the new district, lowering the intensity of usage of the CBD's capacity and lowering the rental price in it. Total income to citizens falls by the amount of profit taken out by the developer. Using the expression for r_{xCBD}, we can rearrange (4.16):

$$\bar{E} = \frac{1}{(a+b)}\left(1 + \frac{(1-\mu)}{\mu}\bar{L}_{xCBD}\right). \tag{4.16'}$$

Given that the fraction a of income $\bar{E}$ is spent on IRS-sector goods (see (4.1)) and that IRS-sector firms spend the fraction μ of their total revenues on labour, we find:

$$\bar{L}_x = \frac{a\mu}{(a+b)}\left(1 + \frac{(1-\mu)}{\mu}\bar{L}_{xCBD}\right). \tag{4.6'}$$

From (4.6') it can be seen that the more people are employed in the CBD, the more people are employed in the IRS-sector overall. This in turn would, ceteris paribus, raise the land rents in the two business districts. Noting that $\bar{L}_{xSBD} = \bar{L}_x - \bar{L}_{xCBD}$, we can derive from (4.6'):

$$\bar{L}_{xSBD} = \frac{a\mu}{(a+b)} - \frac{(b+a\mu)}{(a+b)}\bar{L}_{xCBD}. \tag{4.17}$$

Imposing Proposition 4.3 on (4.17), we can derive the following expression for $\bar{L}_{xCBD}$:

$$\bar{L}_{xCBD} = \frac{a\mu\bar{s}_{xCBD}}{(b+a\mu)\bar{s}_{xCBD} + (a+b)\bar{s}_{xSBD}\tau^{\varepsilon}}. \tag{4.18}$$

4.2. The profit-maximising, absentee land-developer

The land-developer tries to maximise its profit $r_{xSBD}\,\bar{s}_{xSBD}$ which is equal to the rental income of the SBD. Looking at (4.6'), (4.16') and (4.18), it can be seen that the choice of SBD affects the total income in the city, the number of people working in the IRS-sector and also the number of people working in the CBD. This in turn might affect the CBD's rental price - and thus also the SBD's rental price r_{xSBD}.

Using Proposition 4.3, we can express the rental price in the SBD as a function of the transportation cost, the number of people working in the CBD and the CBD's size:

$$r_{xSBD} = \frac{(1-\mu)}{\mu}\frac{\bar{L}_{xSBD}}{\bar{s}_{xSBD}} = \frac{(1-\mu)}{\mu}\frac{\bar{L}_{xCBD}}{\bar{s}_{xCBD}}\tau^{\varepsilon}. \tag{4.19}$$

Using (4.18) in (4.19) we can derive the land-developer's objective function, i.e. its profit π:

$$\pi = \frac{(1-\mu)a\bar{s}_{xSBD}\tau^{\varepsilon}}{(b+a\mu)\bar{s}_{xCBD}+(a+b)\bar{s}_{xSBD}\tau^{\varepsilon}}. \tag{4.20}$$

The land-developer chooses the value of $\bar{s}_{xSBD}$ which maximises (4.20) - taking $\bar{s}_{xCBD}$ as given.

PROPOSITION 4.5 *The profit-maximising value of $\bar{s}_{xSBD}$ depends on μ, σ and c. It is given by:*

$$\bar{s}*_{xSBD} = \frac{-2(1-\mu)\sigma}{c(1-\sigma)}, \tag{4.21}$$

i.e. the optimal value does not depend on the local government's choice of $\bar{s}_{xCBD}$. In other words, $\bar{s}*_{xSBD}$ represents the dominant strategy for the land-developer. It is its best response fucntion. However, it can be seen from (4.20) that a larger CBD would reduce the level of profit.

It is straightforward to derive the effects of parameter changes on $\bar{s}^*_{xSBD}$. It can be shown that $\bar{s}^*_{xSBD\,\sigma} < 0$, $\bar{s}^*_{xSBD\,c} < 0$ and $\bar{s}^*_{xSBD\,\mu} < 0$. Tables 4.3a-4.3c represent numerical values for (4.21), where Tables 4.3b and 4.3c are given in Appendix 4D[73].

$\sigma = 3$

c	$\bar{s}^*_{xSBD}$
0.00	1.00
0.50	1.00
0.75	1.00
1.00	0.75
10.0	0.07

Land-developer's SBD for $\sigma = 3$
Table 4.3a

Let us make the following comments regarding Tables 4.3a-4.3c: first, a higher value of σ leads, ceteris paribus, to a smaller business district, confirming previous results obtained in Table 4.1 and Tables 4.2a-4.2c. Second, the higher the transportation cost per unit of distance, the smaller should be the out-of-town development. This has to do with the fact that the equilibrium rental price in SBD depends crucially on c and the distance D between the two TNs. The land-developer should reduce D to counter-balance the increase in c in order to increase the attractiveness of its SBD. Third, the local government and the land-developer choose the same size for the SBD (see Tables 4.2a-4.2c). Even though this result depends crucially on the setup of this model, the economic intuition is as follows: the former is interested in maximising the citizens' utility, the latter wants to maximise its profit. Citizens face a trade-off when allocating land for residential and industrial use within the city limits. On the one hand, they would like to consume as much land as possible for residential use, on the other hand less land available for industrial use would,

73 Note that for $c = 0$ (4.21) is not defined, we have thus set $c \rightarrow 0$.

ceteris paribus, drive up the marginal cost of production and reduce the number of varieties on offer - raising the price index for IRS-sector goods. This is the trade-off they face in the case with one production site. However, in the case of two production sites they can minimise the effect on the marginal cost of production by having as few IRS-sector workers as possible in the CBD. The best policy is therefore to reduce s_{xCBD} to free land for residential use and to choose s_{xSBD} in such a way as to minimise L_{xCBD}[74]. It can be shown that $\bar{s}^*_{xSBD}$ minimises $\bar{L}_{xCBD}$ as given by (4.14a). The land-developer wants to maximise his rental income - at the cost of lost rental income to the citizens. Rental income to citizens is given by $r_{xCBD}\,\bar{s}_{xCBD} = (1 - \mu)\,\bar{L}_{xCBD} / \mu$ so that minimising $\bar{L}_{xCBD}$ also minimises their rental income.

4.3. The local government - the SBD outside the city's jurisdiction

In the previous section we analysed the land-developer's profit-maximising choice of the SBD. What is the local government's best policy? The answer to this depends on the government's control over the SBD. In this section we assume that the SBD is outside the city's jurisdiction and hence the government cannot levy a tax on the land-developer's profit. This could be the case when the SBD is in another state or county. The optimal policy is represented by the best response to the profit-maximising behaviour of the land-developer. The government's choice variable in this case is $\bar{s}_{xCBD}$, taking $\bar{s}^*_{xSBD}$ from (4.21) as given. Utility can be derived by substituting (4.3), (4.6'), (4.15), (4.16'), and (4.18') into (4.1'):

$$\hat{u} = K\left(1 - \bar{s}_{xCBD}\right)^{(1-a-b)}\left(\bar{s}_{xCBD} + \bar{s}^*_{xSBD}\tau^{\varepsilon}\right)^{(a+b)}$$
$$\left(\bar{s}_{xCBD} + \bar{s}^*_{xSBD}\tau^{2(1-\sigma)/\sigma}\right)^{(a+b)}\left((b + a\mu)\bar{s}_{xCBD} + (a+b)\bar{s}^*_{xSBD}\tau^{\varepsilon}\right)^{d}, \qquad \textbf{(4.22)}$$

[74] Note that citizens face the same price for an individual good, regardless of production location. To do so, firms in the SBD have to produce with lower cost than firms in the SBD. The marginal cost of production is much more important in determining the price index than the distribution of firms across the business districts - see (4.15).

where:

$K = a^a b^b (a\mu)^{(-a(1-\mu)(2-\sigma)/(1-\sigma)} (\mu / (1-\mu))^{a(1-\mu)}$ and

$d = (a(1-\mu)(2-\sigma) - (a+b)(1-\sigma) / (1-\sigma)$.

Effectively, choosing the optimal $\bar{s}_{xCBD}$ is a straightforward maximisation problem as there is no strategic interaction between the two agents. Numerical examples are given in Tables 4.4a-4.4c, where once again 4.4b and 4.4c are to be found in Appendix 4D. These tables can be used to compare the optimal zoning of the CBD in the present case with the case in which the local government is in charge of developing both sites. Tables 4.4a-4.4c differ only in the value of σ. In the first column, we show the five different values of transportation cost c, in columns two to seven we present the welfare-maximising size of the CBD, the resulting utility level, the corresponding profit level for the land-developer and the number of firms across the two districts respectively.

$\sigma = 3$

c	$\bar{s}^*_{xCBD}$	u	π	n_{CBD}	n_{SBD}	n
0.00	0.00	0.65	0.13	0.00	0.48	0.48
0.50	0.21	0.57	0.08	0.18	0.32	0.51
0.75	0.27	0.56	0.05	0.27	0.22	0.50
1.00	0.29	0.55	0.03	0.32	0.14	0.47
10.0	0.30	0.55	0.00	0.39	0.00	0.39

Optimal CBD with land-developer for σ = 3

Table 4.4a

First, note that the utility level and the aggregate number of firms is lower in the present case than in the case of section 3. This can be explained by the outflow of income in the form of profit, giving rise to lower disposable income for the citizens. Second and crucially, the size of the CBD is larger than in the comparable cases of Tables 4.2a-4.2c.

PROPOSITION 4.6 *The government should zone more land for industrial use in the case with the profit-maximising land-developer than without it.*

This is the best policy response when the out-of-town development is outside the city's jurisdiction. In Table 4.5 we provide the ratios which result from comparing the CBD's welfare-maximising size in the case with the land-developer with the case without the land-developer. These ratios are derived from Tables 4.2a-4.2c and 4.4a-4.4c. See Appendix 4D for Table 4.5b.

c	$\sigma = 3$
0.00	- undefined -
0.50	1.50
0.75	1.35
1.00	1.16
10.0	1.00

Ratio of CBD's size for $\sigma = 3$
Table 4.5a

This result is due to the fact that the rental price of land is determined within the CBD and depends on $\bar{s}_{xCBD}$. By zoning a larger CBD, the government can lower r_{xCBD} and therefore also r_{xSBD}. As profit is given by $r_{SBD}\ \bar{s}_{xSBD}$ and as the SBD's size is independent of $\bar{s}_{xCBD}$, profit overall falls. This can be directly seen from (4.20). The government thus has an incentive to zone more land for industrial use within the CBD just to reduce the land-developer's profit. So even though there is an opportunity cost of increasing $\bar{s}_{xCBD}$ (less land for residential use), this is more than offset by the rise in income. Finally, as the land-developer's profit is the higher the lower the per unit transportation cost c, it is not surprising that the ratio of 'over-expansion' is larger for lower values of c (see Table 4.5a).

As an example, consider the case of The City of London versus Docklands in London, England. The development of Docklands in general and of Canary Wharf in particular was based on the assumption of stable, high rental prices, determined within The City of London. The developers of the Canary Wharf complex (the Reichman brothers) detected a demand for high-quality office space in the late 1980s. They knew, however, that the rental prices in their development would have to be set below the ones demanded in The City to compensate for the lower level of accessibility. Given that the Corporation of London (the management body of The City) could not prevent the development of Canary Wharf per sé as it was outside its jurisdiction, the strategy followed was to aggressively promote the expansion of office capacity within The City - a change of policy compared to the more cautious guidelines set out previously. This - and other factors not mentioned in this model - suppressed rental prices in The City *and* in Docklands. As a consequence, the Canary Wharf development had high vacancy rates initially and its developers went into receivership in the early 1990s.

4.4. Extensions

The SBD within the city's jurisdiction

Finally, let us consider the case in which the SBD is within the city's jurisdiction. The government could then levy a tax directly on the developer's profit. Net profit is given by:

$$\hat{\pi} = (1-t)\, r_{xSBD} s_{xSBD}\,, \tag{4.20'}$$

where t is the tax rate set by the government with $0 \leq t \leq 1$. Suppose that the government sets $t = 1$, i.e. the government taxes away the whole profit. From (4.21) we know that this does not affect $\bar{s}^*_{xSBD}$. Tax revenues TR are then redistributed to the citizens. Total income E_{dt} in the city is:

$$E_{dt} = wL + (1-a-b)E_{dt} + r_{xCBD} s_{xCBD} + TR\,, \tag{4.23}$$

where the subscript stands for development *and* taxation and TR equals total profit as given by (4.20). With $r_{xSBD} = r_{xCBD}\, \tau^{\varepsilon}$:

$$E_{dt} = \frac{1}{(a+b)}\left(1 + r_{xCBD}(s_{xCBD} + s_{xSBD}\tau^{\varepsilon})\right). \qquad \textbf{(4.23')}$$

Once again we have $L_x = a\, \mu\, E_{dt}$. We can derive from $L_{xSBD} = L_x - L_{xCBD}$ that:

$$L_{xCBD} = \frac{a\mu s_{xCBD}}{(b + a\mu)(s_{xCBD} + s_{xSBD}\tau^{\varepsilon})}, \qquad \textbf{(4.14a)}$$

i.e. the government is faced with exactly the same problem as in section 3. Given that s_{xSBD}, the income level and the distribution of labour are identical to the case in section 3, the optimal zoning policy is also identical. Setting t = 1 makes 'over-expansion' of the CBD unnecessary as the outflow of income has been stopped that way. It is obvious that this policy leads to higher utility levels than the policy in section 4.3.

5. Concluding remarks

The focus of this chapter was on local economic policies, especially on land-use zoning. Starting with a closed urban area with one (central) business district, we studied the optimal allocation of land between residential and industrial/retailing use when the industry in question requires land as an input and is characterised by increasing returns to scale. We demonstrated that under these circumstances, local government intervention in the land market could indeed improve on the market allocation of land. We were thus able to provide another reason why land-use zoning is welfare-improving in addition to the reasons generally provided in the literature.

Extending the framework to include a potential out-of-town greenfield site for industry, we analysed the local government's optimal zoning policies. We showed that optimal zoning of the central business district and the greenfield site (and thus the distribution of firms/shops across the two sites) depends crucially on the level of accessibility of the latter site: for low levels of accessibility, the greenfield site is relatively unattractive and residents' welfare is maximised by having more firms/shops in the CBD - even though this implies less space for residential use. As accessibility improves though, more firms/shops should be encouraged to locate in the greenfield site, freeing space for residential use within the city itself.

The final aspect of this chapter was the introduction of a large-scale land-developer. It was argued that the rise of internationally operating and absentee land-developers has had marked effects on the economic environment in which local government is formulating and pursuing its policies. We showed that land-developers play a major role in shaping the economic landscape of urban areas. In the context of our model, this is done in two ways: first, the developer decides on the optimal size of its development, taking profit-maximisation as its main objective. Second, its existence affects the local government's zoning policies. Specifically, we found that local government should zone more land in the CBD when the greenfield site is outside the city's jurisdiction in order to minimise the outflow of rental income. This over-expansion of the CBD is not necessary when the greenfield site is within the city's jurisdiction. In that case the local government can levy a tax on the developer's profit and thus recoup its rental income.

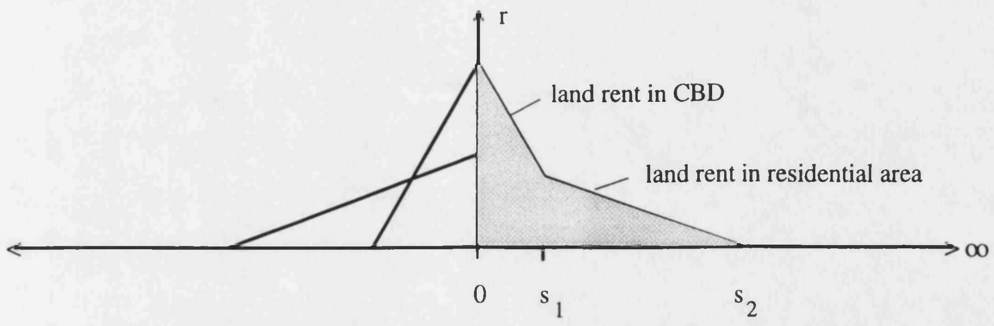
Admittedly, the chapter made several assumptions which should be relaxed in a more sophisticated setup. For example, we completely ignored commuting cost and only considered transportation cost between the two transportation nodes. Introducing them we would be able to determine the equilibrium size of the industrial sites and the city itself and additionally the land rent gradient in the industrial and residential areas.

Appendix 4A

In this appendix we discuss an alternative setup of a city. Let us assume that the city can expand along a featureless line of infinite length, where 'featureless' means the absence of distinctive natural features or man-made improvements. The exception is a transport node, which represents the centre of the city. Given the limitless amount of land available, the rental price of land would be zero and the city would expand infinitely if commuting to the city centre - for shopping or working - was for free. Let us therefore assume that residents face a commuting cost to move between different locations of the city. Given that all residents are identical, the equilibrium in the land market requires that all residents have the same utility level. This implies that a resident living further away from the centre than another resident needs to be compensated for the higher commuting cost by a lower rental price of land. The equilibrium size of the city is given when the resident living furthest away can just enjoy, despite facing a rental price of zero or some reservation price determined exogenously, the same utility level as the other residents.

While the size of the city is a function of the commuting cost, the expansion of the central business district (CBD) is determined by the competition for land between residents and firms. Suppose that firms face a transport cost to ship their production to the city centre. This implies that a firm located further away from the centre needs to produce at a lower cost to remain competitive in the centre. Assuming that commuting costs are zero once the residents are inside the CBD, the only way a firm could produce at lower cost is when faced with a lower rental price of land. The further away the firm from the centre, the lower must be the rental price.

The situation described above is shown in Figure 4.4:



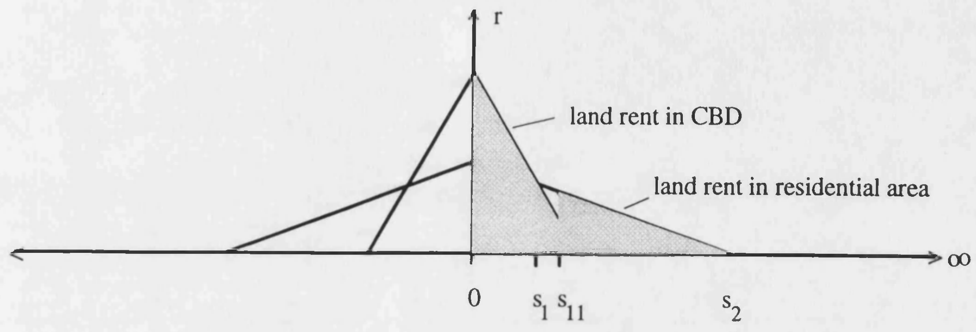
A city with commuting cost - market outcome

Figure 4.4

Due to the symmetry of the city, we can restrict the analysis to one side only. The equilibrium size of the city is s_2, with s_2 moving further out, the lower the commuting cost. Firms can pay a higher rental price for land than residents between 0 and s_1; i.e. the size of the CBD is s_1. Residents live between s_1 and s_2. This is also the equilibrium distribution of land uses in the city: a firm would not consider moving further away from the centre than s_1, as it could not compete with residents for land without making a loss. Residents would not move closer to the centre than s_1, as the higher utility due to less commuting is more than offset by the high rental prices.

Even though it should be possible to derive an analytical solution to this setup, it would be more complicated than the one presented in section 2. For example, the determination of L_x (see (4.5') and (4.6)) would be complicated by the fact that rental income to residents is now given by the shaded area in Figure 4.4. We would also have to consider the implications of having different land rents within the CBD on the profit-maximising input combinations of firms: a firm further away from the centre would substitute land for labour to take advantage of the lower rental price of land. We would lose an essential and simplifying feature of the model presented in section 2, i.e. the symmetry of firms in equilibrium.

The main insight provided by the model presented in section 2 is that zoning can lead to a higher utility level than the market equilibrium as long as residents have a preference for variety. The optimal zoning policy (i.e. over-expansion of the CBD compared to the market outcome) can be shown diagrammatically for the case with commuting and transportation costs:



A city with commuting cost - zoning outcome

Figure 4.5

The equilibrium expansion of the CBD is s_1. However, the government should zone s_{11} for industrial use to maximise residents' utility, leaving s_2 - s_{11} for residential use. The difference between s_1 and s_{11} should be the larger, the stronger the preference for variety. However, this could not be an equilibrium: a resident would be interested in moving closer to the centre than s_{11} (but not than s_1) as this would raise his/her utility level. We therefore need zoning to sustain this split of land use. In order to find s_{11}, we would have to find the total rental income, which is again represented by the shaded area in Figure 4.5.

The model presented in section 2 avoids the above-mentioned complications, while still capturing the main features of the city and *the government's role in raising utility levels*. The setup of the model presented in this appendix, while being more realistic and closer in spirit to the urban economics literature in general, would make it more difficult to derive analytical solutions without providing more insight to the role of the government. This is the main reason for choosing the model outlined in section 2 of this chapter.

Appendix 4B

Expression (4.7) can be derived by partially differentiating û with respect to s_x and equating it with zero. Suppressing some constant terms, we get:

$$\frac{\partial \hat{u}}{\partial s_x} = -(1-a-b)(1-s_x)^{-a-b} s_x^{\frac{-\alpha\sigma(1-\mu)}{(1-\sigma)}} - \frac{\alpha\sigma(1-\mu)}{(1-\sigma)}(1-s_x)^{(1-a-b)} s_x^{\frac{-\alpha\sigma(1-\mu)}{(1-\sigma)}-1} = 0. \qquad \textbf{(B4.1)}$$

Simplifying and rearranging then yields expression (4.7) in the text. We can also easily show that the second-order condition is negative for s_x*.

The optimal value s_x* is affected by changes of a, σ and μ in the following way:

$$s_{xa}* = \frac{\partial s_x*}{\partial a} = -\frac{(1-a-b)\sigma(1-\mu)(1-\sigma)}{((1-a-b)(1-\sigma)-a\sigma(1-\mu))^2} > 0. \qquad \textbf{(B4.2)}$$

$$s_{x\sigma}* = \frac{\partial s_x*}{\partial \sigma} = -\frac{(1-a-b)(1-\mu)a}{(1-\sigma)^2\left((1-a-b)-a\sigma(1-\mu)(1-\sigma)^{-1}\right)^2} < 0. \qquad \textbf{(B4.2')}$$

$$s_{x\mu}* = \frac{\partial s_x*}{\partial \mu} = \frac{(1-a-b)(1-\sigma)a\sigma}{((1-a-b)(1-\sigma)-a\sigma(1-\mu))^2} < 0. \qquad \textbf{(B4.2'')}$$

Appendix 4C

This section shows the analytical solution to Proposition 4.4a: with c = 0 we have $\tau = 1$, hence expressions (4.3), (4.4') and (4.15) can be simplified to:

$$P_x = \left(\frac{1-\mu}{\mu} \frac{L_{xCBD}}{L_{xSBD}} \right)^{1-\mu} \left(s_{xCBD}^{1-\mu} L_{xCBD}^{\mu} + s_{xSBD}^{1-\mu} L_{xSBD}^{\mu} \right)^{\frac{1}{(1-\sigma)}} . \qquad \textbf{(C4.1)}$$

With $\tau = 1$ (4.14a) and (4.14b) simplify to $L_{xCBD} = a\ \mu\ s_{xCBD} /((b + a\ \mu)\ (s_{xCBD} + s_{xSBD}))$ and $L_{xSBD} = a\ \mu\ s_{xSBD} /((b + a\ \mu)\ (s_{xCBD} + s_{xSBD}))$. Substituting these into (C4.1) and rearranging yields:

$$P_x = (1-\mu)^{(1-\mu)} \mu^{\frac{\mu}{(1-\sigma)}} \left(\frac{a}{(b+a\mu)} \right)^{\frac{1-\sigma(1-\mu)}{(1-\sigma)}} (s_{xCBD} + s_{xSBD})^{\frac{\sigma(1-\mu)}{(1-\sigma)}} . \qquad \textbf{(C4.1')}$$

Noting that E remains unchanged, we can now substitute (C4.1') into (4.1'). We have:

$$\tilde{u} = C(1 - s_{xCBD})^{(1-a-b)} (s_{xCBD} + s_{xSBD})^{\frac{-a\sigma(1-\mu)}{(1-\sigma)}} , \qquad \textbf{(C4.2)}$$

where $C = a^a\ b^b\ (b + a\ \mu)^{-(a+b)}\ (1 - \mu)^{-a(1-\mu)}\ \mu^{-a\mu/(1-\mu)}\ (a\ (b + a\ \mu)^{-1})^{-a\sigma(1-\mu)/(1-\sigma)} > 0$.

Using inequality-constrained optimisation (Lambert, 1985), the problem can be set up as follows:

$$\max C(1 - s_{xCBD})^{(1-a-b)} (s_{xCBD} + s_{xSBD})^{\frac{-a\sigma(1-\mu)}{(1-\sigma)}} , \qquad \textbf{(C4.3)}$$

subject to the four constraints $s_{xCBD} \geq 0$, $s_{xCBD} \leq 1$, $s_{xSBD} \geq 0$ and $s_{xSBD} \leq 1$, ie:

$$\mathcal{L} = K(1 - s_{xCBD})^{(1-a-b)}(s_{xCBD} + s_{xSBD})^{\frac{-a\sigma(1-\mu)}{(1-\sigma)}} + \lambda_1 s_{xCBD} - \lambda_2(s_{xCBD} - 1) + \lambda_3 s_{xSBD} - \lambda_4(s_{xSBD} - 1) \qquad \textbf{(C4.4)}$$

Taking the first-order conditions of (C4.4), we get:

$$\frac{\partial \mathcal{L}}{\partial s_{xCBD}} = \frac{-K(1 - s_{xCBD})^{-a-b}(s_{xCBD} + s_{xSBD})^{-a\sigma(1-\mu)/(1-\sigma)-1}}{(1-\sigma)}$$

$$\big((1-a-b)(1-\sigma)(s_{xCBD} + s_{xSBD}) + a\sigma(1-\mu)(1 - s_{xCBD})\big) + \lambda_1 - \lambda_2 = 0$$

(C4.5)

and:

$$\frac{\partial \mathcal{L}}{\partial s_{xSBD}} = \frac{-a\sigma(1-\mu)K(1 - s_{xCBD})^{1-a-b}(s_{xCBD} + s_{xSBD})^{-a\sigma(1-\mu)/(1-\sigma)-1}}{(1-\sigma)} + \lambda_3 - \lambda_4 = 0\,.$$

(C4.6)

We also need to satisfy the following conditions: $\lambda_j \geq 0$, $\partial \mathcal{L} / \partial \lambda_j \geq 0$ and $\lambda_j \partial \mathcal{L} / \partial l \lambda_j \geq 0$. Note immediately that $\lambda_4 > 0$, otherwise $\lambda_3 < 0$, violating one of the above conditions. Hence we have $\partial \mathcal{L} / \partial \lambda_4 = 0$, i.e. the fourth condition is binding and therefore $s_{xSBD} = 1$.

Now look at (C4.5). Suppose that $(1 - a - b)(1 - \sigma)(1 + s_{xCBD}) + a \sigma (1 - \mu)(1 - s_{xCBD}) > 0$. Setting $\lambda_2 = 0$, we would satisfy the above conditions with $\lambda_1 > 0$ and the first condition is satisfied, i.e. $s_{xCBD} = 0$.

However, now suppose that $(1 - a - b)(1 - \sigma)(1 + s_{xCBD}) + a \sigma (1 - \mu)(1 - s_{xCBD}) < 0$. Setting $\lambda_1 = 0$, we would satisfy $\lambda_2 > 0$ and the second condition would be satisfied, i.e. $s_{xCBD} = 1$.

Both results describe an optimum, however the former gives us the maximum whereas the latter gives us the minimum. This shows that the solution (0, 1) indeed describes the maximum of the above problem.

For all cases in which τ is neither 1 nor infinity (i.e. Proposition 4.4c), we cannot find analytical results. The first order conditions are nonetheless provided here. Substituting the relevant information into (4.1'), we find that:

$$\tilde{u} = B(1 - s_{xCBD})^{1-a-b} (s_{xCBD} + s_{xSBD}\tau^{\varepsilon})^{a\frac{(1-\sigma+\mu\sigma)}{(1-\sigma)}} (s_{xCBD} + s_{xSBD}\tau^{\theta})^{-\frac{a}{(1-\sigma)}}, \quad \textbf{(C4.7)}$$

where $B = ((1 - \mu) / \mu)^{-a(1-\mu)} (a \mu / (b + a \mu))^{-a(1-\sigma(1-\mu)/(1-\sigma)}$ and $\theta = (1 - \sigma + \varepsilon \sigma \mu) / \sigma$.

The first order conditions are then:

$$\frac{\partial \tilde{u}}{\partial s_{xCBD}} = (1 - a - b) + \frac{a(1 - s_{xCBD})}{(1-\sigma)} \quad \textbf{(C4.8)}$$

$$\left((s_{xCBD} + s_{xSBD}\tau^{\theta})^{-1} - (1 + \mu\sigma - \sigma)(s_{xCBD} + s_{xSBD}\tau^{\varepsilon})^{-1}\right) = 0 .$$

and also:

$$\frac{\partial \tilde{u}}{\partial s_{xSBD}} = \frac{\left(\theta\sigma(\varepsilon c s_{xSBD}+2)e^{\frac{1}{2}\varepsilon c(1+s_{xSBD})}\right)}{\left(s_{xCBD}+s_{xSBD}e^{\frac{1}{2}\varepsilon c(1+s_{xSBD})}\right)} - \frac{\left((c\theta s_{xSBD}+2)e^{\frac{c\theta}{2}(1+s_{xSBD})}\right)}{\left(s_{xCBD}+s_{xSBD}e^{\frac{c\theta}{2}(1+s_{xSBD})}\right)} = 0 .$$

(C4.9)

Appendix 4D

$\sigma = 2$

c	s^*_{xCBD}	s^*_{xSBD}	u	n_{CBD}	n_{SBD}	n
0.00	0.00	1.00	0.64	0.00	0.53	0.53
0.50	0.14	1.00	0.54	0.12	0.42	0.54
0.75	0.22	1.00	0.52	0.21	0.32	0.53
1.00	0.28	1.00	0.49	0.29	0.23	0.52
10.0	0.37	0.10	0.47	0.41	0.00	0.41

Optimal zoning for CBD and SBD for $\sigma = 2$
Table 4.2b

$\sigma = 4$

c	s^*_{xCBD}	s^*_{xSBD}	u	n_{CBD}	n_{SBD}	n
0.00	0.00	1.00	0.74	0.00	0.53	0.53
0.50	0.14	1.00	0.63	0.16	0.37	0.53
0.75	0.20	0.89	0.61	0.26	0.23	0.49
1.00	0.24	0.66	0.59	0.32	0.14	0.46
10.0	0.28	0.00	0.58	0.38	0.00	0.38

Optimal zoning of CBD and SBD for $\sigma = 4$

Table 4.2c

$\sigma = 2$

c	$\bar{s}^*_{xSBD}$
0.00	1.00
0.50	1.00
0.75	1.00
1.00	1.00
10.0	0.10

Land-developer's SBD for $\sigma = 2$

Table 4.3b

$\underline{\sigma = 4}$

$\underline{c}$	$\underline{\bar{s}^*}_{xSBD}$
0.00	1.00
0.50	1.00
0.75	0.89
1.00	0.66
10.0	0.00

Land-developer's SBD for $\sigma = 4$

Table 4.3c

$\underline{\sigma = 2}$

$\underline{c}$	$\underline{\bar{s}^*}_{xCBD}$	$\underline{u}$	$\underline{\pi}$	$\underline{n}_{CBD}$	$\underline{n}_{SBD}$	$\underline{n}$
0.00	0.00	0.57	0.13	0.00	0.48	0.48
0.50	0.21	0.51	0.08	0.16	0.35	0.51
0.75	0.30	0.49	0.06	0.25	0.27	0.51
1.00	0.33	0.48	0.04	0.30	0.20	0.50
10.0	0.37	0.47	0.00	0.41	0.00	0.41

Optimal CBD with land-developer for $\sigma = 2$

Table 4.4b

$\underline{\sigma = 4}$

$\underline{c}$	$\underline{\bar{s}^*_{xCBD}}$	$\underline{u}$	$\underline{\pi}$	$\underline{n_{CBD}}$	$\underline{n_{SBD}}$	$\underline{n}$
0.00	0.00	0.68	0.13	0.00	0.48	0.48
0.50	0.21	0.60	0.07	0.20	0.30	0.50
0.75	0.25	0.59	0.04	0.28	0.20	0.48
1.00	0.27	0.58	0.02	0.33	0.12	0.45
10.0	0.28	0.58	0.00	0.38	0.00	0.38

Optimal CBD with land-developer for $\sigma = 4$

Table 4.4c

$\underline{c}$	$\underline{\sigma = 2}$	$\underline{\sigma = 4}$
0.00	- undefined -	
0.50	1.50	1.50
0.75	1.36	1.25
1.00	1.18	1.13
10.0	1.00	1.00

Ratio of CBD's size for $\sigma = 2$ and $\sigma = 4$

Table 4.5b

Chapter 5

Concluding comments

The purpose of this thesis was to study the effects of the 'internationalisation of the world economy' on regional economic policies. Specifically we focused on two general postwar trends which have had major implications on the economic structure of cities, regions and countries. First, the increase of the volume of trade relative to manufacturing production, especially in intra-industry goods, has unquestionably been the major manifestation of the 'internationalisation of the world economy' in the postwar era. This development provided the framework in which we analysed the first two effects on regional policies in the first two theoretical chapters of this thesis. Second, closer regional economic integration has allowed new retailing and business developments to more easily spread across regions and countries. One of these international developments has been the emergence of the business/retail park on out-of-town sites. The United States was the first country to witness this trend during the 1950s-1960s, soon to be followed by other Western economies. Light manufacturing industry and the distribution sector have especially taken advantage of the new sites and have left the inner cities. The traditional central retailing district has also faced severe competition from these out-of-town developments and our modern urban structure would be unthinkable *without* out-of-town business/retail parks. In Chapter 4 of this thesis, we studied some of the possible effects this trend might have had on urban economic policies.

Studying three different models, we showed under which circumstances and in which way regional economic policies might have been affected by these developments. It should be noted again that the models presented have been based on specific assumptions and are therefore not generally applicable - however, we think that the results still offer some valuable insights into the behaviour of regional governments and other large scale agents, especially when faced with a changing economic environment. In these concluding comments we present some of the results, policy suggestions and further thoughts on the potential real-world problems of implementing these.

Turning to the first theoretical chapter - Chapter 2 - we focused on regional economic policies in a 'new economic geography' setting. Building on the models developed by Krugman, Venables and others, we studied the effects of regional economic policies on the location decisions of firms. We analysed under which conditions a less-industrialised region could attract firms from a more highly-industrialised region by using its regional economic policies. We showed that the 'internationalisation of the economy' due to closer economic integration made it generally more difficult for backward regions to attract firms from the richer regions. Given this observation, what could the government of such a backward region do to improve its chances of attracting firms? It was shown that the efficiency level of the public sector was a crucial factor determining the attractiveness of a region. It could therefore be argued that emphasis should be put on raising the efficiency level of the public sector. Furthermore, the regional government should be aware of the opposing forces it creates and should be more 'careful' when setting policies. Indeed, it could be argued that the internationalisation has put pressure on regional/national governments to improve their public sector efficiency. This is due to the fact that closer economic integration has increased the level of competition between regions for footloose firms and has provided an outside option to firms which didn't exist to the same extent in the past, i.e. to supply a region with exports rather than to create manufacturing capacity in the region itself.

One main result of the chapter was that *even if* a less-industrialised region's government improved its sector's efficiency to a reasonable extent, it might still fail to attract firms under certain circumstances. It was shown that this was the more likely to happen, the stronger the agglomeration forces as generally discussed in the 'new economic geography literature'. Given this rather sobering result, it was suggested that transfer payments from a richer region to the less-developed region could be necessary in these cases to improve the latter region's attractiveness sufficiently to attract firms and to eventually lead to economic convergence. This is indeed what the European Union is doing with the Cohesion and Structural Funds which are used to improve the infrastructure in the less-developed regions of the EU. However, it was also noted (see also Fujita and Mori, 1996) that other EU policies such as improving the quality of infrastructure *between* more developed and less developed regions should not complement the transfer payments as improved access from the rich to the poor region reduces the attractions to firms to relocate from the rich to the poor region. This result thus has strong policy implications - which ought to be considered by policy makers.

Moving on to the next chapter, Chapter 3 focused on the tax raising/public good provision policies of regional governments. In that context we were able to derive explicit policy suggestions. The model in Chapter 3 analysed the effects of an increase in the volume of trade of intra-industry goods on the optimal tax policies of regional governments when these goods require a factor-augmenting public good for production. We showed that the higher the volume of trade between two identical regions, the lower would be the equilibrium tax rate - leading to suboptimal provision of the local public goods.

We were able to make a specific policy suggestion: the delegation of tax setting/raising power to a supra-regional body which would take into account the whole economy's welfare level. Admittedly, this policy would lead to a total loss of sovereignty in the field of tax setting/raising by the regional governments and would therefore be rejected on these grounds alone by many regions. A second policy suggestion would be to encourage all participating regions to voluntarily coordinate their policies on the optimal policies. But who is going to be the coordinator? And who would be interested in following this coordinator's advice? In such a 'loose arrangement', an individual government would have an incentive to deviate from the agreed policy. Such a setup would thus not be sustainable without some kind of punishment for deviating from the agreed policy.

Whatever the problems of implementation, it remains clear that policy coordination is required to exploit all the potential benefits from closer economic integration. As was shown in Figure 3.2 on page 89, a reduction in trade costs and hence a higher volume of trade could even lead to a reduction in welfare as long as the regional policies are not coordinated. Closer economic integration should therefore go hand in hand with closer economic policy coordination - in our case the coordination of tax rates.

In the third theoretical chapter, the effects of the internationalisation of the economy on urban policies are less direct than in the previous two chapters. It was suggested that the consequences of this trend on urban policies *could* work indirectly through the creation of a new type of large-scale agent: the absentee, large-scale business/retail park developer where the important assumption was that of the *absentee* developer. Many of these developers operate nationally or even internationally nowadays and it is the effects of their presence on regional economic policies which we studied in Chapter 4.

The main aspect of this chapter was to focus on the implications of out-of-town retail/business developments by these developers on urban zoning policies. We found that if the out-of-town development was developed by an absentee land-developer, then the local government should zone more land for retail/business use within its urban area than if the out-of-town development was also developed by the government itself. 'Over-expansion' of the urban business/retail development as a response to the absentee land-developer's out-of-town development suppressed land rents in both developments and thus minimised the outflow of capital out of the urban area.

The above result depended on the assumption that the out-of-town development was outside the city's jurisdiction - making it impossible for the government to tax any of the land-developer's profit and leaving land zoning as the only policy instrument. Policy implications can be derived from this result: from the city's government point of view, it should try to negotiate merger talks with the surrounding jurisdictions which make up the urban economy. By doing so it would be able to levy taxes on the developer's profit - however this would be at the cost of the other jurisdictions' governments. This is an issue in several countries. In Germany, for example, several cities form their own separate 'Länder', surrounded by other 'Länder'. In these cases retail/business parks have been developed along the city's edge in the surrounding jurisdictions, taking advantage of the close proximity to the city's market, while at the same time generally enjoying lower land rents and lower local tax rates. This phenomenon is especially important for the city itself as it has to provide an adequate infrastructure network for the economic activities going on in the city while parts of the potential tax base are located outside its jurisdiction. It is thus not surprising that many city governments seek to cooperate with their surrounding counterparts. For instance, Berlin was recently engaged in talks with its surrounding neighbour Brandenburg to create one joint 'Land'. These talks, however, eventually failed in a referendum.

However, it is unrealistic to assume that the above suggestion of closer political and economic cooperation between jurisdictions can be implemented in many cases. Given this constraint, 'over-expansion' of the urban retail/business park is the best policy for the city government. This fact has consequences for the land-developer itself. Even though the development might be outside the city's jurisdiction, it should take into account the above response by the city government: the land-developer *cannot expect the city government to remain passive* in the light of its development, instead it should expect an active response - even if this breaks with former city policy. The case of the Corporation of London, as discussed on page 126, illustrates that point well. Admittedly, the circumstances were different to the ones modelled in Chapter 4, for example the problem of competing land uses does not arise in that real-life example. However, it is true that The City represents the reference point for land rents in Docklands so that any policy change in The City would affect the Docklands development. Relative accessibility also played and still plays a major role in that case. And the Corporation of London's decision to speed up the expansion of office space within the 'Square Mile' as a response to the Docklands development also fits the above model's predictions (obviously other factors also played a role in that decision). It seems that the developers of the Canary Wharf site did not expect the Corporation of London to respond so aggressively to their development. This response led to a fall in the rental price of office space in The City and in Docklands and consequently to a fall in the latter's developer's profits.

The above three chapters only offer a small sample of models which could be written on the issue of 'the internationalisation of the economy and its effects on regional economic policies'. Future research could start by addressing some of the assumptions made throughout this thesis. For example, based on Chapter 2, it would be worth studying the effects of corporate taxation on the agglomeration forces studied. Would we be able to replicate the results of Chapter 2? By studying such a setup we could provide useful arguments to the ongoing debate on 'corporate taxation and industrial location'. Future research could also focus on Chapter 4. So far, Chapter 4 tries to capture the 'spirit' of standard urban economics models without relying on all the standard assumptions normally made (e.g. commuting cost). This kept the setup simple and allowed us to focus on the issues of interest here. However, a more sophisticated model could try to incorporate the standard assumptions and thus could bring the model more in line with the literature. This would also open the model to further potential extensions, e.g. the endogenous determination of the city size (in a system of cities). A logical extension to this thesis would be to combine aspects of the different chapters. For example, it has been argued that urban regions are in stronger competition with each other than ever before. This is especially true for the service sector. Financial services, for example, are concentrated in New York, London and Tokyo. However, their dominance is constantly challenged by other urban areas such as Paris, Frankfurt, Singapore or Hongkong. In which way have urban policies been affected by this increased competition? We could study that by combining aspects of the 'new economic geography' literature with ideas of the urban economics literature.

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