Competition for Business Location Survey

C. Dembour*

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Part I
Introduction

Why should countries or regions compete to attract firms? Why they should enter in a "subsidy tournament" or start building costly infrastructure to boost investment in their territory? More generally, is regional competition really welfare enhancing?

These questions are rampant in the popular press, especially in Europe where the emergence of the European Market has drastically increased the mobility of both production factors and final goods. These issues have been by addressed in the economic literature from three distinct starting points: strategic trade literature, literature on capital income tax competition and the "new economic geography" in which most of the models surveyed are rooted.

In the strategic trade literature, countries compete against each other in order to attract foreign investors. The output market is characterized by increasing returns to scale and imperfectly competitive markets. In general, firms are immobile and no locational externalities are considered. Following a standard model, Helpman and Krugman (1989) among others show that governments might intervene to increase

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national welfare. Export subsidies transfer profits from foreign firms to the domestic economy. But since all the governments have the same motivations, this "subsidy war" will become uncontrollable and collectively wasteful. However the countries would increase their surplus if they were able to commit themselves not to use subsidies.

The same problem is at the heart of the literature on capital income tax competition. Firms react to capital tax differentials and relocate to the country or the region with the lowest tax. Equilibrium is characterized by excessively low levels of taxation because governments have an incentive to undercut each other taxes and because they do not take the fiscal externality into account. That is, a tax increase in a region would shift capital to the other regions but this positive externality is not considered by the self-interested government. Although the similarity with the strategic trade theory is obvious, capital tax competition rests on a different set of assumptions: firms are mobile and the output markets are generally perfectly competitive. In addition, no "clustering" effects are incorporated.

In the New Economic Geography[1], the degree of spatial agglomeration of economic activity is the result of a trade-off between agglomeration ("centripetal" forces) and dispersion forces ("centrifugal" forces, for instance congestion). Traditionally one distinguishes technological from pecuniary externalities as agglomeration factors. The first ones are linked to the exchange of information (face-to-face communication, Saxenian (1994)), or to strictly spatial dimensions (access to intermediate factors and market size). The second ones rest on interactions rooted in the market mechanisms and in the prices established therein. A second classification rests on the distinction between localization economies associated to firms of a same sector (intra-industry spillovers) and urbanization economies which apply to firms across industries (inter-industry externalities).
In all cases, the growth of an urban center rests on a cumulative growth process where various degrees of agglomeration factors combine themselves. One can illustrate this mechanism with an example related to a production externality (Ottaviano and Puga (1998)):
Suppose that a multinational wishes to set up its plant in one region. How does this affect the profitability of the local firms? The presence of one more firm will increase competition in the product and labour market of the region hosting the firm, thus tending to reduce local profits. However, the rise in the number of local varieties and the increase in labour demand and wages tend to attract more workers. This increases local expenditure (a demand linkage) and relaxes competition in the labour market, and thereby tends to rise local profits and to attract more workers. This result highly depends on the level of economic integration. The lower the transportation costs between the regions, the larger the localization externalities.
The extent, as well as the direction, of the cumulative growth mechanism suggested by the preceding scenario depends largely on the actions of public authorities. Therefore, an effective development policy must favour the development of the centripetal

[1]For a general overview of the subject, see Fujita, Krugman and Venables (2001) and Fujita and Thisse (2002). Simonis (2002) provides a survey of the literature of the New Economic Geography.

forces (for instance, developing a pool of skilled workers through an efficient education policy) while monitoring the centrifugal forces (linked for example to the congestion, to the lack of infrastructure). Local public authorities must play the role of local planners while offering the optimal "menu" of local public goods (as described by Tiebout (1956)).
Furthermore, the way agglomeration forces combine themselves differs from one case to another. Therefore, spatial agglomeration is almost universal as to its essence, but very diversified as to the form under which it realizes itself.
In most models presented in this survey, spatial externalities will play an explicit and crucial role in explaining the effects of the policies implemented by the regional governments.

The objective of this survey is to review recent papers dealing with the location of firms. They focus on the competition between national or regional governments in order to attract investment. These governments have several policy instruments at their disposal. We will examine three of those: taxes/subsidies, infrastructure and education.

But first of all, to what extent such policies really exert a significant influence on the choice of location of firms?
We review hereafter three empirical studies. They differ by the period studied and by their object of analysis, but they all try to determine the factors influencing the localization of FDI. The table below summarizes the different variables used and their proxies and indicates the sign of their impact on the location of FDI.

Variables	Proxies	Sign		
		Coughlin et al.	Head et al.	Wheeler et al.
Number of potential sites	Land area	+		
Market demand	State per capita income	+	not signif.	
	Adjacent state income		not signif.	
	Manufacturing density	+		
Agglomeration Benefits	Infrastructure quality			++
	Degree of industrialization			++
	Level of foreign investment			++
Labour market characteristics	Wage rates	-	+	+
	Unionization rate	+	+/-	
	Legislation	-		
	Unemployment	+	+	
Corporate taxes		-	-	+
Labour subsidies			+	
Capital subsidies			+	
Free trade zone			+	
Promotion expenditures		+		
Transportation facilities		+		
Risk				+
Openness				-

Coughlin, Terza and Arromdee (1991) look at the relationship between state characteristics and the location of foreign direct investment (FDI) within the United States for the period 1981-1983. They find that FDI increases with the number of host-sites available as well as with market demand, promotion expenditures and transportation facilities. Note that the positive sign of manufacturing density indicates that agglomeration economies matter for the location decision of foreign firms. The unionization rate, reflecting the productivity of workers, and unemployment, measuring workers' availability, have also a positive influence on FDI. On the contrary, high wages and taxes deter foreign investment.

Head, Ries and Swenson (1999) study Japanese investments between 1980 and 1992 to assess the effectiveness of US state promotion efforts in light of strong agglomeration effects in Japanese investments. These "national" clustering forces comprise among others, the presence of Japanese amenities, the availability of skilled workers and factors suiting their own production technology. Contrariwise to Coughlin et al. (1991), Head et al. (1999) find that higher wages attract Japanese firms, reflecting a better skill composition, and that market size effects are not statistically significant. They observe that policy instruments, namely the provision of free trade zones, lower taxes and job-creation subsidies, really exert a positive influence on the location choice. However, these state promotional policies tend to offset each other as predicted by the tax competition literature. But unilateral withdrawal of promotion would cause individual states to lose substantial amounts of investment. In summary, state governments face a prisoner's dilemma: on the one hand, multilateral

removal of promotion policies slightly decreases investment but increases welfare because of less expenses, but on the other hand, unilateral removal would induce relocation of the firms to other states.

Wheeler and Mody (1992) focus on manufacturing investments by US multinationals in the 1980's. Their results show that agglomeration economies, self-reinforcing after a certain point, are the dominant factor of the investor's locational choice. By contrast, short-run incentives seem to have a limited impact. The findings of Wheeler and Mody (1991) contrast with the two studies above because they fail to find clear evidence that high taxes reduce investment. They conclude that high-cost subsidy tournaments are unnecessary for countries or regions with good infrastructure development, specialized input suppliers and an expanding domestic market.

Corporate taxes are the one fiscal element common to most studies of investment location. In general, tax rate is shown to have a positive impact on the choice between locations (not on the choice whether to export or move production). For Devereux and Griffith (1998) an increase of 1% of the effective average tax rate decreases by 1,3% the probability of US multinationals to settle in the UK. Hines (1996) arrives to the result that a tax increase of 1% would reduce investment shares of investors who cannot claim credits in their home country by 10%.
Agglomeration economies as well as labour market characteristics seem also to play a significant role.

Recently, Cushman & Wakefield Healey & Baker (2002) conducted a survey on Europe's major business cities. The study examined the issues companies regard as important in deciding where to locate, and compared how Europe's leading business cities perform on each issue. We reproduce here the answers to the question: how important to your company is each factor when deciding where to locate?

	2002 %	2001 %
1. Availability of qualified staff	59	55
2. Easy access to markets, customers or clients	57	58
3. Transport links with other cities and internationally	51	51
4. The quality of telecommunications	46	45
5. The climate governments create for business through tax and the availability of financial incentives	34	32
6. Cost of staff	32	31
7. Value for money of office space	30	29
8. Availability of office space	27	27
9. Ease of travelling around within the city	21	22
10.Languages spoken	20	19
11.The quality of life for employees	18	15
12.Freedom for pollution	12	9

Do local governments, when achieving policies influencing these factors, actually attract business in their regions? In the remainder of the paper we will have a closer look at the theoretical answers to this question for the factors number 5; 2 and 3; and 1 respectively. Beside the fact that these factors appear at the top the table, the reason of this choice lies in the nature of the profits of the firms. Indeed, their profits, and more precisely their costs, comprises mainly three components: taxes, set-up costs (like infrastructure costs) and labour (whose productivity is affected by its education level). The objective of the regional policies is thus to make sure that these three components are competitive in order for a region to be attractive to the firms.
Notice that this survey is not meant to be exhaustive. Rather, we have selected those papers which seemed most exemplative of the various ways in which such regional policies can be approached.

The survey is organized as follows. Part 2 describes the mechanisms at work when regions compete in taxes or subsidies. In part 3 we look at the location choice of firms when the quality or the level of infrastructure varies between regions. Part 4 focuses on education and training.

Part II
Tax competition

1 The reference Model

This model will provide a benchmark to most of the studies surveyed in this part.

The environment

The economy consists of two countries labelled $i \in \{A, B\}$. There is one time period, and one foreign-owned monopolist.
The following two-stage game is played:

1. Governments simultaneously choose their tax or subsidy level, then
2. The firm chooses its location of production and production takes place. Note that the fact that the firm does not divide its production between two locations implicitly means that it faces increasing returns to scale.

We work backward to determine the Nash equilibrium[2].

[2]For an introduction to Game Theory, see Fudenberg and Tirole (1991).

The firm

Each firm makes a private profit from investing in a particular country. We denote by Π_i the multinational's profit when it decides to settle in country i . The general profit function of the firm is written $\Pi = \pi_i(\phi) - F - T_i$ where ϕ includes whatever locational externality: market size, vertical linkages, technological spillovers, transportation costs,... . When the firm builds its plant in country *i*, it incurs a fixed set-up cost *F* and pays a tax ($T > 0$) or receives a subsidy ($T < 0$) from that country. Notice that here *T* is a lump-sum tax but it could be a profit tax.
The profit-maximizing firm will be indifferent between locating in region *A* or *B* if at equilibrium $\Pi_A^* = \Pi_B^*$, that is if $T_A - T_B = \pi_A - \pi_B$. This difference in taxes is called "tax premium" and denoted by Γ. A positive tax premium means that country *A* can charge a higher tax and still leave the firm indifferent between the two locations.

Governments

Government *i*'s welfare is denoted W_i^j when the multinational chooses to locate in country *j*. We have separable utility functions of the type $W_i^i = V_i^i(\phi) + T_i$ and $W_i^j = V_i^j(\phi)$. This payoff function V_i may be quite general in character: it may involve consumer surplus, locational externalities, changes in whatever rents to existing firms that are internalized within the governments' objective function. In short, anything the governments care about. We assume that each government has sufficient resources to cover its willingness to pay for any investment profile relative to its worst profile. This will guarantee that governments will not be financially constrained in the subsidy game. However, a "fiscal race to the bottom", although financially possible, has a negative impact on the welfare of a region.

Equilibrium subsidies

The regional government will be able to offer a subsidy or charge a tax until its welfare when hosting the multinational equals its welfare when importing the firm's products from the other region, that is, until $W_i^i = W_i^j$. This gives the minimum tax (or maximum subsidy) bid, $\widehat{T}_i$, region *i* can make in order to attract the MNE. This minimum threshold gives an idea of the competitive advantage of a region relative to the other, when it lies below.
The combination of this minimum tax with the tax premium will give the equilibrium tax schemes. For instance, if Γ is positive and $\widehat{T}_A > \widehat{T}_B$, region *A* will attract the monopolist even if its tax level is above that of region *B*.

2 Tax competition between symmetric countries

In this section there is no difference per se between countries either in endowments, size, technology, or any other country-specific variable that may predetermine how

taxes are set in the Nash equilibrium. Intuitively, if regions are symmetric, there is no reason for a firm to locate in one region rather than another.

2.1 Without externalities

Janeba (1998) combines elements of strategic trade policy and capital income tax competition. That is, he builds up a model in which the output market is imperfectly competitive and firms are internationally mobile.
By contrast with our reference model, the firms are initially located, one in the home country, the other in the foreign country and they produce a homogeneous good sold in a third market. There is indivisibility in production: firms will respond to a tax differential by shifting production completely to the more favourable country.
Governments impose profit taxes on income generated in its own country (source taxation). An another assumption Janeba makes is that each firm's cost function is independent of its own and its rival firm's location decisions. That is, no externality of any kind will come to play.
The firms maximize their profits which only depends on their own and the foreigner's output: $\Pi_i(q_i, q_j) = \pi_i(q_i, q_j) - T_i R_i(q_i, q_j)$ where $\pi_i(q_i, q_j) = R_i(q_i, q_j) - C_i(q_i)$ and *R* and *C* are respectively revenue and cost functions of the firm.
The government's welfare is defined as the sum of producer surplus of the domestic firm plus tax revenues collected:

(a) $W_i^{i,i} = \pi_i(q_i, q_j) + T_i R_j(q_i, q_j)$ if $T_i < T_j$
(b) $W_i^{i,j} = \pi_i(q_i, q_j)$ if $T_i = T_j$
(c) $W_i^{j,j} = \pi_i(q_i, q_j) - T_j R_i(q_i, q_j)$ if $T_i > T_j$

Since there are no location-specific differences, the firms will always locate in the low-tax country. That is, if the home country offers a higher subsidy it will attract both firms, of which one is owned by foreigners. But this will decrease its direct tax revenue since a subsidy is given to foreigners. Hence, the usual subsidy race changes into a "subsidy-avoiding" race and no subsidy will be allowed at the equilibrium. Similarly, there is always an incentive for the governments to undercut its neighbour's tax and therefore an equilibrium with positive tax rates can never exist. As a consequence, the only subgame perfect equilibrium of the game is laissez-faire ($T_i^* = T_j^* = 0$).

2.2 With externalities

Kind, Midelfart Knarvik and Schjelderup (2000) and Haaland and Wooton (1999) analyze the effects of tax competition for internationally mobile, profit-making firms when the location of a firm causes spillover effects in the independent, potential-host countries.
In these two general equilibrium models the essential reason why governments try to attract internationally mobile firms is the existence of vertical linkages between the

production of the monopolistic firms and the producers of other goods in the host country of investment.

Kind et al. (2000) provide a general equilibrium model where capital, goods and firms are internationally mobile. The model, inspired by the new economic geography, considers two symmetric countries with transport costs on trade flows between them. Two sectors are represented, agriculture and manufacturing. The latter uses two inputs: labor which is immobile between countries, and capital. Capital exports from one country to the other implies factor movement, but not migration of purchasing power, since income from capital is assumed to be consumed in the owner's country of residence. The manufacturing sector is subject to increasing returns to scale. This will lead a firm to locate its production in only one country, from which it exports. But the migration of one single firm intensifies competition in the product and labor markets thus tending to dampen profits. This centrifugal force is however counterbalanced by the fact that the existing firms will no more have to pay transport costs on their purchase of intermediates from the new entrant. In addition, the domestic demand for intermediates in the host country will increase since the pool of firms has grown. These cost and demand linkages are self-reinforcing, and may dominate over the market competition effect and give rise to agglomeration of manufacturing. Notice that the agglomeration effect is only relevant for intermediate values of transport costs.

Kind et al. focus on two situations: capital and firms may either, ex ante, be concentrated in one single location, or they may be evenly spread between the two countries. Let us examine the first case in the spirit of our reference model. Suppose manufacturing is concentrated in country *i*. Its government compares welfare, defined as the utility of the representative consumer, $W_i^i(\eta)$ with $W_i^j(\tau, \eta)$ which depends negatively on trade costs τ and size of industry linkages η. This comparison defines the lowest tax rate ($\widehat{T}_i(\tau, \eta)$) that country *i* is willing to levy to keep its firms agglomerated. Similarly, as firms do not have to find it profitable to relocate to the other country, there is an upper bound on the tax rate ($T_i^{Max} = T_j + \Gamma(\tau, \eta)$). The optimal taxation will lie in this range depending on the parameters' values.
To conclude, if one of the countries already hosts an agglomeration advantage, it will be able to levy a positive tax on mobile firms in equilibrium, even if it benefits from the investment. This result is due to the pecuniary externality described above. Indeed, since agglomerated firms are more competitive, they are able to pay a higher price for each unit of capital without making losses. This means that even if capital can move costlessly between countries, the supply of capital is not perfectly elastic. In other words, the total amount of capital will not fly away from one country to the other in response to price differentials and this makes an agglomerated equilibrium sustainable.
In the symmetric equilibrium, the countries will equally subsidize capital.

Haaland and Wooton (1999) examine the economic justification for providing investment subsidies to foreign-owned multinationals. They argue that these provide employment opportunities and generate demand for domestic intermediate inputs

produced by domestic firms.
They use a general equilibrium model in which the monopolistically competitive domestic intermediate goods sector sells its production exclusively to the foreign-owned multinationals. The latter are perfectly competitive and they provide knowledge spillovers to the domestic firms. In addition, there is a traditional sector.
Agglomeration benefits to the multinationals because of the domestic spillovers: the higher is the domestic market size composed of immobile domestic producers and mobile multinationals, the lower are the costs of production of intermediate inputs. But agglomeration will also increase wages on the domestic labour market and this acts as a deterrent.
Formally, we solve the following two-stage game: first, governments of the two countries set simultaneously non-discriminatory subsidy levels and then, multinationals choose their location.
If spillovers are high, then multinationals will agglomerate in only one country. But the "subsidy war" will be too fierce to leave the host country with a net benefit. On the contrary, if the general equilibrium effects overcome those spillovers, then a diversified equilibrium will appear. That is, the multinationals will be evenly spread between both countries. Notice that incentives to subsidize are still present, depending on the parameters of the model.

3 Tax competition between asymmetric countries

In this literature, countries differ either by their exogenous wage level, their level of technology or their size. The main lesson is that taxes in general are non-zero in the tax competition equilibrium, and that countries may subsidize capital if there are positive externalities from attracting capital (which is not the case when the countries differ *only* by their size). Intuitively, the more a country is a priori at a disadvantage compared to the other one (in terms of technology or unemployment), the higher the positive spillovers it can gain from attracting the multinational. As a consequence, the subsidy the depressed region is willing to offer will easily outweigh the other's bid. Hence, the depressed region attracts the FDI and catches up to a certain extent.

3.1 Wage

Haaparanta (1996) looks at the effects of subsidies on the allocation of an exogenous investment level across countries. He investigates a subsidy game between two countries or regions which seek to attract inward foreign direct investment (no export possible) in order to alleviate domestic unemployment. In this model, differences in the exogenous national wage levels provide countries with unequal incentives to subsidize capital in order to lower unemployment.

The multinational must divide its production between the two locations and governments pay a subsidy which depends on the amount of capital invested. Solving backward the two-stage game implies solving first the maximization problem of the

firm:

$$Max\Pi_i = \pi_i(K_i, K_j) - T_i(K_i) - T_j(K_j) \qquad (1)$$

where $\pi_i(K_i, K_j) = \Sigma R(q_i S_i) - \Sigma w_i L_i - r(\Sigma K_i)$ and $q_i = F(K_i, L_i)$. That is, the firm's revenue depends on the investment in each country (K_i), labour (L_i) and market size (S_i).

In the first stage, governments maximize welfare which is defined as the labour income of their residents minus the subsidy ($T_i < 0$), anticipating the investment decisions of the firm:

$$W_i = w_i L_i + T_i(K_i) \qquad (2)$$

Since wages are fixed exogenously in both countries (creating unemployment), governments are only concerned with the employment effects of FDI.

Results show that subsidy competition alters the multinationals' location decision with respect to the no-subsidy case. Higher wage countries will treat FDI more favourably by adopting larger subsidies.

The model presents rather limited results due to the fact that spatial externalities are ignored. Indeed, Haaparanta (1996) treats only the impact of technology on tax competition and for FDI between two countries. FDI has no impact on other sectors of the economy. Results then depend on the nature of the technology, and in particular on the elasticity of substitution between labour and FDI.
In addition, centrifugal forces like transport costs are not incorporated into the model. Hence, differences in market size do not affect the location decision of the multijurisdictional firm and are thus inessential for the optimal tax policies.

3.2 Technology

Fumagalli (2002) investigates tax competition for multinationals between two countries which differ in terms of technology levels.
These countries or regions host one local firm, and compete to attract the manufacturing plant of a producer from a third country (the MNE). The MNE's problem is whether to build a plant in one of the two regions (and if so, in which one) or to export from its country of origin. In the former case, it has to bear trade costs which are the same for serving both regional markets, while in the latter case, it incurs a fixed set-up cost. Note that there are no transport costs between the two regions.
When locating in a region, the MNE determines a positive externality in the form of a technological spillover: the local firm gains partial or total access to the MNE's technology so that its production costs are lowered. The intensity of this positive spillover naturally depends on the level of technology in the region. That is, the larger the technological gap between the domestic and the foreign firm, the larger the efficiency of the spillover for the local producers at home.

Two cases can arise:

1. the MNE exports and its profit equals $\Pi_M^E = \pi_m^E(c_i, c_j, \tau)$ where c_i are the production costs of each local firm and τ represents transport costs.
2. the MNE invests in region *i* and its profit is $\Pi_M^{Ii} = \pi_M^{Ii}(c_i, c_j, \phi) - F - T_i$ where ϕ is the technological spillover.

For the multinational to be indifferent between country A and country B, the depressed region B must compensate its technological lag by offering a subsidy premium, $\Gamma \equiv T_A - T_B > 0$[3]. But it has also to ensure that investment is at least as profitable as exporting. That is, it has to offer an "investment tax premium", $\Omega_i = \Pi_M^E - \pi_M^{Ii}$, which is increasing in F and in ϕ.

The corresponding welfares of region *i*, are defined as

1. If the MNE exports

$$W_i^E = V_i^E(c_j, \tau) \tag{1}$$

2. If the MNE invests in region *i*

$$W_i^i = V_i^{Ii}(c_i, c_j, \phi) + T_i \qquad \text{for region } i \tag{2}$$
$$W_j^i = V_j^{Ii}(c_i, c_j, \phi) \qquad \text{for region } j \tag{3}$$

where V is defined as the sum of consumer surplus (C) and profits of the local firm (P).

When the MNE switches from exports to FDI, trade costs are saved and competition in the integrated market intensifies. All consumers, wherever resident, benefit from this via lower equilibrium prices ($C_i^{Ii} = C_j^{Ii}$). Conversely, local firms suffer from the competition effect. Given the local nature of the spillover, the firm operating in the region where the MNE invests contrasts the competition effect with the technological upgrading, while the other firm definitely suffers from a negative externality when FDI replaces exports ($P_i^{Ii} > P_j^{Ii}$).

As usual, $\widehat{T}_A$ and $\widehat{T}_B$ denote the maximum subsidy bid that each region is willing to offer to lure the multinational away from the rival location. Both are negative and decreasing in the intensity of the spillover. The depressed regions will win the auction iff it benefits so much from the FDI that the maximum subsidy it can offer exceeds the one of the other region plus the tax premium, that is, $\widehat{T}_B > \widehat{T}_A - \Gamma$.
If the technological spillover is sufficiently strong, the less advanced region always succeeds in winning the auction. Otherwise, the MNE will locate in the depressed region iff the technological gap between the two regions is sufficiently high.

[3]Recall that $T > 0$ denotes taxes.

The intuition is that the benefits from the spillover are so much higher for the depressed region than for the other region, that the subsidy offered by the depressed region can easily outweigh the other's bid.
In the no-export case, the MNE invests in the more advanced region in absence of subsidies because the reduction of the local production costs induced by the technological spillover is lower and thus the local firm becomes a less fierce competitor ($\Gamma > 0$). The introduction of subsidies will increase welfare of the technologically behind region by switching the MNE's location. The other region's welfare decreases but the net effect is not necessarily negative depending on the technological gap.
In the case where the MNE exports in the absence of subsidies, the latter will have two effects. First, they will attract the MNE in the integrated region. Second, they will intensify competition. Although this is beneficial to all consumers, the detrimental impact on local firm can offset any other positive aspects of subsidies.

3.3 Size

Haufler and Wooton (1999) discuss the case of tax competition between two countries of unequal size (i.e. population) to attract the investment of a single foreign-owned multinational (no export possible).
The existence of scale economies in production combined with transport costs will give the MNE an incentive to locate in the larger country. The latter, given its larger market ("home market bias"), is able to attract the firm with a lower subsidy and therefore always win the "subsidy tournament".

We limit our analysis to the case of exogenous transport costs, independent of the direction of trade.
Profits of the firm depend on the countries' size ($S_B = 1, S_A > 1$), level of transport costs and producer price:
$\Pi_i = \pi_i - F - T_i$ for FDI in country *i*
where $\pi_A = (p_A - w)[S_A q_A(p_A) + q_B(p_A + \tau)]$,
$\pi_B = (p_B - w)[q_B(p_B) + S_A q_A(p_B + \tau)]$ and
q_i denotes consumption of the manufactured good in country *i* .

Note that the firm can charge a higher producer price when it settles in the larger country (country *A*) because it avoids the majority of trade costs and enjoys scale economies, $\Pi_A^* > \Pi_B^*$ for $T_A = T_B$. This locational preference means that country *A* may fix a higher tax or a lower subsidy for the firm to be indifferent between the two locations ($\Gamma = T_A - T_B > 0$).
In order to maximize the welfare of its representative household, each government is prepared to offer a subsidy in order to save transportation costs. Surprisingly, country *A* will always be willing to offer a bigger subsidy than the smaller country *B* , $\widehat{T}_A < \widehat{T}_B < 0$). However the per capita costs of the subsidy are smaller. Combining these two results, country *A* only needs to slightly overcut country *B*'s subsidy to attract the multinational, that is, $T_A^* = \widehat{T}_B + \Gamma$.

When differences in country sizes are considered, the tax or subsidy competition does not change the investment profile which would have been settled in the no-subsidy case: the foreign-owned monopolist always chooses to locate in the larger market. That is, competition has no positive effects and merely results in a waste of resources.

Like Haufler and Wooton (1999), Barros and Cabral (2000) investigate the choice of location of a foreign-owned multinational between two countries of unequal size. Here, these countries also differ by their level of unemployment, that is the shadow price of labor is lower in the smaller country. As a consequence, the employment gains that this country can extract from FDI are higher than for the larger country. The "winning" country will thus result from the interaction of these two factors: relative country size and employment gains.

The foreign firm's profits in each possible location are a function of each country size (S), government's subsidies to its marginal cost ($T \leq 0$) and transportation costs (τ), that is, $\Pi_i = \pi_i(S_i, S_j, T_i, \tau) - F$. Comparing its profits in each possible location, the foreign firm will locate in country A if the tax premium defined as $T_A - T_B$ is positive, that is, if $\Gamma(\tau, \frac{S_A}{S_B}) > 0$ where both first derivatives are positive and $\frac{S_A}{S_B} > 1$ is an index of the relative size of the two countries. In other words, Γ represents the locational advantage that country A has over country B. This advantage rises with the relative size: the larger country A relative to B, the more country B 's subsidy will have to compensate for this locational "bias". Also higher transportation costs favor the larger country.
Each country's objective function is total domestic welfare. Specifically, the welfare of country i when the monopolist locates in country j is simply given by its consumers' surplus, $W_i^j(S_i, T_j, \tau)$. If the multinational chooses to locate in country i, welfare is given by consumers' surplus minus total subsidies plus (if any) gains from employment creation, $W_i^i(S_i, T_i, \beta)$. β represents the difference between the nominal and the shadow wage and reflects total employment gains. The best-response functions of each country are given by:
$T_A^*(T_B) = T_B + \Gamma + \epsilon$ and $T_B^*(T_A) = T_A - \Gamma + \epsilon$.

Three equilibria can arise:

1. If $\widehat{T}_A < T_A^*(\widehat{T}_B)$, then country A is willing to subsidize up to higher levels than country B. In equilibrium, the firm locates in country A and receives a subsidy $T_A^*(\widehat{T}_B)$;

2. If $\widehat{T}_B < T_B^*(\widehat{T}_A)$, then country B is willing to subsidize up to higher levels than country A. In equilibrium, the firm locates in country B and receives a subsidy $T_B^*(\widehat{T}_A)$;

3. If $\widehat{T}_B$ is very low, the foreign firm would locate in country A even if it were to offer no subsidy (even put a tax). This occurs when employment benefits are low, transportation costs are high and markets very different in size.

In summary, as in Haufler and Wooton (1999), the larger country attracts the firm

more easily because it saves transportation costs. However, the higher the employment gains, the more a country is willing to subsidize the multinational. The final result will thus depend on the interaction between relative size, transport costs and employment gains. Typically, the foreign firm locates in country B iff $\beta > \Gamma$.

The principal difference between the two models lies in the welfare analysis. First, compared to the no-subsidy case, total welfare may be higher in equilibrium when subsidies are allowed. The condition is that the employment gains exceed the losses from subsidies granted to the foreign firm. Second, the equilibrium welfare of the smaller country cannot be lower. Without subsidies, the firm will locate in the larger country because of the home market bias. When subsidies are allowed, the large country will always subsidize the multinational firm thereby reducing the price of imports for the other country. From the point of view of welfare of the large country, subsidies are always negative. Indeed, either it pays a subsidy to attract the monopolist, or the latter locates in the smaller country. In this case, the subsidy granted is not sufficiently high to compensate for the transportation costs it has to pay now.

4 Competition versus Cooperation

Until now we have only considered the case of tax competition between countries. But what happens if regions can coordinate their fiscal policies in order to attract a foreign firm?
There are two main reasons for regions to be willing to coordinate their fiscal policies. The first one is to dampen the negative effects of fiscal competition. Indeed, competition in taxes (or subsidies) can be wasteful and leave both regions with a lower welfare compared to coordinated fiscal policies. Second, cooperation allows also regions to pool their resources in order to be stronger in face of an external competitor[4]. In this case, the objective of fiscal coordination is not only to avoid a waste of resources but also to present a united front in order to induce a multinational to enter an economic region (composed of several "political" regions[5]).

In Haufler and Wooton (2001), regional tax coordination may lead to two types of welfare gains. First, for investments that would take place in the union (consisting of two countries) in the absence of coordination, eliminating tax competition within the union allows an increase in the equilibrium tax. This leads to a transfer of location rents from the firm to the regional governments. Second, in situations where the firm has no strong preference between locating within the union or in the outside country, a coordinated reduction in the tax offered to the firm will attract additional, welfare-enhancing investments.

[4]United we stand, divided we fall!

[5]In their book *Co-opetition*, Brandenburger and Nalebuff (1996) considered examples of examples of environments where individuals, firms, institutions, countries can be fierce competitors while engaging in various aspects of cooperation.

Haufler and Wooton (2001) consider unilateral and regional tax policy for a region of two countries (*A* and *B*) that competes with a third potential-host country (*C*) for the location of a monopolistic firm.
First, countries differ by their size: countries *A* and *B* are of equal size which is different from the one of country *C*. Second, transportation costs between *A* and *B* are lower than between the region and country *C* due to geographical proximity, administrative similarity, or other. The combination of these two factors provides a locational preference for the firm (see Haufler and Wooton (1999)). The sign of the tax premium that the firm is willing to pay for locating in country *A* (or *B* by symmetry) versus country *C* is ambiguous. It will be positive if the market of the third country is not larger than the regional market and intra-regional transport costs are low relative to inter-regional transport costs.

Comparing W_A^A with W_A^B and with W_A^C, the government of country *A* is in both cases willing to subsidize the firm in order to attract the investment, that is $\widehat{T}_{AB} < 0$ and $\widehat{T}_{AC} < 0$ respectively. For country C, equating W_C^C with W_A^C gives this country's minimum tax $\widehat{T}_{CA} = \widehat{T}_{CB} < 0$.

Tax competition
Focusing first on the tax competition between country *A* and *C*, the critical tax that is required to get the investment in *A* is denoted by $\kappa \equiv \Gamma + \widehat{T}_{CA}$. This critical tax will be positive for low levels of S_C and τ, in which case the firm has a strong incentive to settle in the union. In addition, for country *A* to attract the firm, this critical tax has to be higher than the minimum tax ($\kappa - \widehat{T}_{AC} > 0$). If this is the case, then offering a tax marginally below κ will be enough to outbid country *C*. But this does not take account of tax competition within the region. Since countries *A* and *B* are symmetric, the best offers they can make to the firm are the same. Country *A* must offer at least $\widehat{T}_{AB}$ in order to prevent the firm from locating in country *B*. Hence, the equilibrium tax charged by *A* is $T_A^* = min\{\widehat{T}_{AB}, \kappa\}$. Since $\widehat{T}_{AB} < 0$, the union country that attracts the investment will always pay a subsidy in the presence of intra-regional tax competition.

Regional tax coordination
When country *A* and *B* coordinate their tax policy, they will never make a better offer than is needed to prevent the firm from locating in country *C*: $T_A^{**} = \kappa$ (by convention, if the firm invests in the region, it settles in country *A*).
Two types of welfare gains can thus arise. First, when the firm's locational preference for the region is strong ($T_A^* = \widehat{T}_{AB}$), eliminating tax competition within the region allows an increase in the equilibrium tax, transferring the locational rent from the firm to the region. Note that κ could even be positive. Second, when locational preference is weak ($T_A^* = \kappa$), countries of the region can agree on a reduction of taxation in order to attract the welfare-enhancing investments ($\kappa - \widehat{T}_U > \kappa - \widehat{T}_{AC}$).

5 Time consistency

Competition for foreign direct investment among asymmetric countries has been studied also in a dynamic framework by Besley and Seabright (1999).
The timing of their dynamic version of the reference model is as follows. First, the two countries offer bids for the location of firm *1*. Then the firm selects its location, which is fixed for the remainder of time. In the next period, the countries offer bids for the location of firm *2*, which then locates in one of the countries. At this point, payoffs are realized. Note that each firm locates where the government's willingness to pay is highest.

The payoffs received by the governments are affected by both snowball and congestion effects. That is, the payoffs to government *B* if the two firms choose to locate in his region are not the same as the payoffs received by government *A* when region *A* is selected by both firms. We will not go through the formal analysis of the menu auction approach[6] but consider the example presented:

Outcome	Governments' payoff (prior to subsidies)
(A,A)	(9,0)
(A,B)	(6,6)
(B,A)	(7,7)
(B,B)	(0,13)

The outcome *(j,i)* is when firm *1* locates in country *j* and firm *2* in country *i*.

The final outcome heavily depends on whether the regional governments can commit themselves to their future bids. Bidding with commitment will guarantee that the investment outcome is *(B,A)*. However, without commitment, the outcome *(A,B)* will maximize the joint net payoffs. To see this, consider the payoffs to the two bidding countries after firm *1*'s decision has been taken. If firm *1* locates in country *A*, the maximum subsidies that can be offered by both regions are $\widehat{T}_A = 3$ and $\widehat{T}_B = 6$. Country *B* wins the auction and pays 3. If firm *1* settles in country *B*, $\widehat{T}_A = 7$ and $\widehat{T}_B = 6$. Country *A* wins the auction and pays 6. The net payoffs taken into account for the first period's offers are now:

Outcome	Payoff
Firm 1 in A	(6,3)
Firm 1 in B	(1,7)

Firm *1* will thus locate in country *A* since this outcome *(A,B)* maximizes the joint net payoff.

This outcome is not only failing to maximize social surplus, it is also Pareto inefficient. This result has two causes: on the one hand, the failure of governments to commit their future bidding strategies and on the other hand, the presence of locational externalities between the firms. The countries' bids for the investment today

[6] See Bernheim and Whinston (1986).

are distorted by the subsidy burden expected for the future, thereby failing to reflect the intrinsic benefits yielded by the investment.

One instrument regional governments have at their disposal in order to influence the location of firms is subsidies (or taxes). Hence, regional authorities engage in a fiscal competition by offering subsidies (or reducing taxes).
The first question we can ask is whether localization externalities reinforce this fiscal competition. Without externalities, Janeba (1998) has shown that this "subsidy race" only results in a waste of resources. Indeed, as the multinational locates in the country which offers the highest subsidies, the two countries will (indefinitely?) overcut each other's subsidy. As a consequence, the "laissez-faire" equilibrium should prevail in order to maximize welfare. The story has to be somewhat modified with externalities. On the one hand, if these spatial externalities (like transport costs in Haufler and Wooton (1999)) only tend to reinforce the advantage of the region which would have attracted the firm without subsidies, then competition has no positive effects. On the other hand however, if the localization spillovers induce a higher benefit for a "depressed" region, then engaging in fiscal competition can change the investment pattern.
This leads naturally to the question of how important is the role of asymmetry between countries. When countries are asymmetric, one country can always extract a relatively larger gain (in terms of employment, technological progress, ...) from the inward FDI. Note that the larger the asymmetry, the larger the expected rewards from FDI. This will give that country the opportunity to outweigh the subsidy of the other country and attract the multinational. When countries are symmetric, agglomeration only occurs when the positive spillovers it induces exceed the negative effects of a fiercer competition on the product and labour market.
There are thus some cases where fiscal competition is beneficial in the sense that it can reduce regional disparities. However, in other cases, this competition seems quite costly and bounded. Would it not then be possible to shift it to other elements of the firms' profits? We try to answer that question for regional infrastructure and education policies.

Part III
Infrastructure

During the last decade, many new important infrastructure projects have been developed in Europe, especially for what concerns transport infrastructure (for example,

the Channel Tunnel). The European Commission devotes Structural Funds[7] to infrastructure investments because the latter are seen as playing "a key role in efforts to reduce regional and social disparities in the European Union and in the strengthening of its economic and social cohesion" (Commission of the European Communities (1999)). This view is supported by Martin (1998) which finds, using data on regional stocks of infrastructure, that the speed of convergence across regions in Europe increases for telecommunications infrastructure.
In terms of locational effects of changes in transport infrastructure, Combes and Lafourcade (2001) find that the decrease of transport costs in the last twenty years in France, partly due to improvements in transport infrastructure, has led to more agglomeration. Similarly, Duranton and Puga (2001) suggest that the resulting increase in the ability of business services and headquarters to remote locations may lead to the concentration of business services and headquarters in a few large urban centers.

Local public infrastructure is defined as any material investment, as opposed to immaterial investment such as education, made by a regional government on his territory. It has an impact on the profits of the firms (and thereby on their location) either through their operating costs if it is used as an input in the production function or through their fixed costs. In both cases, infrastructure is considered as a *local* public good in the sense that it benefits only the firms which locate in the region where the investment has been made. Hence, problems of "free-riding" are avoided, that is, a region cannot "steal" the benefits of the infrastructure policy chosen by another region. This will not be the case with education policy as it will be described in the next part.

In this second part of the survey we examine how regional authorities can influence the location of firms through the level or the quality of infrastructure they choose. First of all we provide the general structure of the models presented in this part. We do not go very far in the development of a reference model as the articles are relatively different from each other. The notation used in that section will remain throughout this part. The second section deals with models where only firms are mobile. In the last section, firms as well as labor (or households) can move.

1 The Reference Model

The environment

The economy consists of two countries labelled m=A,B, and two firms (i).
The following game is played:

1. Governments simultaneously choose their infrastructure level,

[7] Martin (1999) and Puga (2002) look at the effects of European regional policies.

2. Regional authorities choose simultaneously the fee (or subsidy) they will charge (give) the firms,

3. The firms choose their location of production and production takes place.

This second step, not present in all models, introduces fiscal competition between the regions. That is, they compete not only in infrastructures but also in taxes. In order to avoid this wasteful competition, regions will choose to differentiate at maximum their infrastructure services.
We work backward to determine the Nash equilibrium.

Notation

The superscript denotes the firm by its initial location and the subscript indicates the region.

The firms

Consider a market in which two firms operate, producing a homogeneous product for a third market. The firms are assumed to behave as Cournot oligopolists. We assume a linear inverse demand function $p = a - b(x^A + x^B)$, where x^i stands for the output of the firm initially located in the *i*th region (*i*=*A, B*) and p denotes the common price. Firms produce under constant marginal costs C_m and incur a fixed cost F_m (which can be seen as a relocation cost to be paid if so) which both vary from one region to the other (*m*=*A, B*). Hence, the cost curves are of the form $TC^i_m = F_m + C_m x^i$. Each firm maximizes its profit: $\Pi^i_m = (a - b(x^A + x^B) - C_m)x^i - F_m$.

Regional authorities

Local governments provide local public inputs to the firms which decide to settle in their region. By local public input we mean infrastructure which is built on the territory of the region and financed by the region.This local infrastructure, z_m, affects either the fixed costs or the marginal costs of the firms. In the latter case, the net marginal costs are written $C_m = c_m - z_m$.
This effort in infrastructure can be financed through local taxes which may give rise to fiscal competition between the two regions.

2 Mobile Firms

Two elements must be taken into account when two or more firms (instead of one) can settle in the same region. First, competition on the local output market is intensified, as well as competition for inputs which might be supplied inelastically. This acts as a deterrent to firms to agglomerate. Second, the presence of several firms in one region exacerbates the role of spatial externalities. For instance, infrastructure being

considered to a certain degree as a public good, the higher the number of firms which use it, the less the relative costs of this infrastructure.

2.1 One mobile firm

Dewhurst (2000) examines the possibility for a regional-development agency to attract a foreign firm by committing funds to defray the fixed costs of this firm, if it were to choose to locate in its region.
By contrast with our reference context, the homogeneous good is sold on the two regional markets by two immobile domestic firms which are initially located, one in each region. These firms face identical costs functions but transporting the product from one region to the other is costly ($t > 0$). Note also that the regions differ in terms of size, region *B* having a bigger market (scale parameter $\lambda > 1$). The profit functions are thus the following:

$\Pi_A^A = (a - b(x_A^A + x_A^B) - c)x_A^A + (a - \frac{b}{\lambda}(x_B^A + x_B^B) - (c + t))x_B^A$, and

$\Pi_B^B = (a - b(x_A^A + x_A^B) - (c + t))x_A^B + (a - \frac{b}{\lambda}(x_B^A + x_B^B) - c)x_B^B$.

Notice that the marginal costs are identical and that the firms incur no fixed costs.

The foreign firm (*f*) has fixed costs *F* but lower marginal costs, which amount to $c - d$, where *d* represents the marginal-cost advantage of the foreign firm. When considering in which region to locate, the foreign firm compares its profits in each region:

$\Pi_A^f = (a - b(x_A^A + x_A^B + x_A^f) - (c - d))x_A^f + (a - \frac{b}{\lambda}(x_B^A + x_B^B + x_B^f) - (c - d + t))x_B^f - F$, and

$\Pi_B^f = (a - b(x_A^A + x_A^B + x_A^f) - (c - d + t))x_A^f + (a - \frac{b}{\lambda}(x_B^A + x_B^B + x_B^f) - (c - d))x_B^f - F$.

Five cases can arise, going from all three firms selling in their domestic market and in the other regional market to both domestic firms ceasing to trade. The type of equilibrium that emerges depends on the marginal-cost advantage of the foreign firm: the higher this advantage, the more the domestic firms will be pushed out of the markets. But in all cases, the foreign firm chooses to locate in the biggest region (*B*).

It is now supposed that there exists a regional-development agency in region *A*, that wishes to maximize the number of jobs in its region and has finance to do so. The development agency will choose to intervene if it perceives a gain from persuading the foreign entrant to locate in *A* rather than in *B*. In order to alter the location decision of the foreign firm, it will propose a reduction of its fixed costs sufficient to counteract the loss in profits due to relocation.
Comparing the two post-entry situations (foreign firm locating in region *B* and in *A*), the agency will find it profitable to intervene when its region is relatively large and when either the cost advantages of the foreign firm are small enough not to prevent domestic firms continuing to engage in "cross-hauling" trade, or sufficiently large to drive all domestic firms from the market.

Dewhurst (2000) has thus shown under which circumstances a regional development-agency influence the location decision of a foreign firm to the benefit of the region for which it is responsible.
However, if there were development agencies in both regions, then the agency in the larger region could always outbid the agency in the smaller region. This model is thus not well suited to study competition in infrastructure between regions.

We now consider two models which take explicitly account of strategic interactions between regions.

In Walz and Wellisch (1997), two regions compete for a mobile firm (firm *B*) by providing local public inputs using the revenues from the tax (t_m) on the profits of all firms locating within their respective boundaries. The second firm, firm *A*, is immobile and the two firms face Cournot competition.

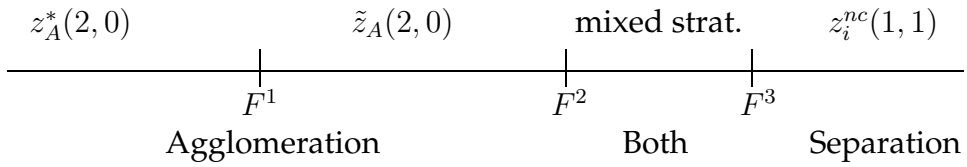
When choosing where to locate, firm *B* faces a trade-off between two opposing forces. One the one hand, the agglomeration advantage is modeled as the partial nonrivalry of local public inputs. Indeed, the costs of the local public inputs increase less than proportionally if two firms rather than one are using them:
$C_z(z_m) = (z_m)^2$ if one firm,
$C_z(z_m) = (z_m)^2(2)^\phi$ if two firms.
The congestion parameter ϕ ($0 \leq \phi \leq 1$) measures the degree of rivalry in the use of local public inputs. With $\phi = 0$ ($\phi = 1$), infrastructure is a purely public (private) good.
On the other hand, the costs a firm must bear when changing its location (F) constitute the agglomeration disadvantage.
That is, the firms maximize their profit functions:
$\Pi_m^i = \{(a - b(x_i + x_j)) - (c - z_m)x_i\}(1 - t_m)$, if $i = m$,
$\Pi_m^i = \{(a - b(x_i + x_j)) - (c - z_m)x_i\}(1 - t_m) - F$, if $i \neq m$.
The firm in *B* will choose to relocate if and only if its profits in region *A* are even higher.

Regional governments decide simultaneously on their levels of local public inputs. With both firms agglomerated in region *A*, regional welfare, which is the sum of the firms' profits, can be written as
$W_A(2,0) = \frac{(a-c+z_A)^2}{9b} - \frac{2^\phi}{2}(z_A)^2$,
$W_B(2,0) = \frac{(a-c+z_A)^2}{9b} - \frac{2^\phi}{2}(z_A)^2 - F$.
In this case, it is optimal for region *B* to choose $z_B = 0$, since positive levels of local public inputs would imply costs but no productivity gain. We denote the optimal solution for region *A* by $z_A^*(2,0)$.
If both firms are geographically separated, regional governments maximize
$W_i(1,1) = \frac{(a-c+2z_i-z_j)^2}{9b} - (z_i)^2, \quad i = A, B.$
Solving simultaneously yields the noncooperative local public input levels:
$z_i^{nc} = \frac{2(a-c)}{9b-2}$.

Depending on the value of the relocation cost (*F*) incurred by firm *B*, the equilib-

rium solution will be either agglomeration or separation.
The former case will prevail if
$\Pi_B^B(1,1,z_A^*(2,0),z_B(z_A^*)) = \Pi_A^B(2,0,z_A^*(2,0))$,
that is, if firm *B* is indifferent between locating in *A* and in *B* whenever region *A* chooses its optimal "agglomeration infrastructure". This will give a critical value of relocation costs, F^1, under which firm *B* will move to region A if it provides $z_A^*(2,0)$. Note that F^1 is negatively related to the congestion parameter ϕ. With sufficiently large crowding costs (ϕ close to 1), the agglomeration advantage is so weak that *A*'s government can never attract firm *B*.
At the other extreme, Walz and Wellisch (1997) determine a value F^3 from which the only possible solution is geographical separation. The disagglomerative force is sufficiently pronounced that firm *B* cannot be attracted by region *A*. This value is derived from the following equality: $\Pi_B^B(1,1,z_A^{nc},z_B^{nc}) = \Pi_A^B(2,0,z_A^{nc},z_B^{nc})$.

In a first interval of intermediate moving costs ($F^1 < F \leq F^2$), region *A*'s government can attract firm *B* by providing local public inputs excessively relative to the agglomeration case ($\tilde{z}_A(2,0) > z_A^*(2,0)$). For values $F^2 < F \leq F^3$, there exists only a mixed strategy equilibrium in which a (1,1) as well as a (2,0) solution takes place with positive probabilities.
In summary, the model takes the following geographical pattern:



Walz and Wellisch have thus demonstrated that an agglomeration solution can emerge. The regional government is even most likely to attract both firms the lower the relocation costs and the higher the degree of publicness of the regional infrastructure (or the lower the congestion costs).

King, McAfee and Welling (1993) present a dynamic version of intergovernmental competition for a large plant when local productivity is uncertain.
The sequence of the game is as follows. In the first stage, regional governments choose the level of infrastructure which is equally costly to build. This investment increases the expected surplus available from locating a plant in their regions. In the second stage, they participate in the following sequential auction. In the first period, governments make an offer (subsidies) based on the expected available surpluses, then the firm chooses its location and incurs a sunk cost. Finally, the actual surplus in the chosen region is revealed, production takes place and the surplus is split between the firm and the winning region. In period two, a new auction starts. If the firm does not relocate, no additional information is revealed. However, if it relocates, the surplus of the second region is revealed.

Essentially, the model shows that the region with the largest expected surplus (region *A*) will always attract the firm in the first period but it will do so as a con-

sequence of greater expenditure in infrastructure. However, given sufficient uncertainty about the available surpluses, there is a positive probability that the firm will move in the second period to the other region. Relocation is more likely the lower is the fixed cost and the smallest is the difference between the expected surpluses in the two regions. Even though region B does not attract the firm in the first period, it will choose a positive level of investment in order to raise this probability for the firm to switch location in the second period (provided that region A's investment required to drive out region B is prohibitively costly).

The possibility of relocation, coupled with the uncertainty on the regional surpluses, is thus an important determinant of equilibrium pay-offs, even when it is not actually exercised. One the one hand, it leads to both regions investing in infrastructure in order to increase their expected surpluses (and thereby attracting the plant). But on the other hand, it increases regional disparities as region A makes a greater investment.

2.2 Several mobile firms

The intensity of competition between firms when they locate in the same region plays here an essential role. Indeed, the more firms cluster together, the fiercer the competition they face on the good- and labour-market. Hence, in order to counterbalance this agglomeration disadvantage, regional governments will have to provide sufficiently high levels of infrastructure. Indeed, at a certain level, the higher supply of public inputs will outweigh the loss of profits incurred by more competition.

Martin and Rogers (1995)[8] built up a general equilibrium model with no strategic interactions between regional governments.
They consider a model with two types of "iceberg" transportation costs[9] in each region: intra-regional and inter-regional. The former has to be paid by households buying goods produced in their home region, while, when they import goods, they have to add the international transport costs (which is higher). The transportation costs are negatively related to the quality of the regional and international infrastructure respectively. These infrastructures are financed by the revenue of their residents. There exists also a market for capital which is held by wageowners. One unit of capital produces one variety of output.

The consumers of one region have thus to bear the internal transportation costs whether they consume home-made or foreign goods. Hence, the relative prices of the goods of one region do not depend on the infrastructure built by that region. However, the quantity of goods consumed by the households of one region depends on its endowment in infrastructure. The sales of each firm depend on the local revenues,

[8] We follow the analysis made by Charlot (2000).

[9] The cost of transportation of a good is measured as the fraction of this good which melts away in transit. This form of transport costs has been invented by Samuelson (1954).

on the size of the local market as in Krugman (1991), but also on the infrastructure through the transport costs. If, for instance, region A has a more developed infrastructure than region B, then its level of transportation cost is relatively low, and as a consequence, the gap between the prices of home and foreign goods in region B is reduced. Region A has thus a higher external demand in presence of infrastructure of quality. The strength of this advantage depends on the gap between the regional endowments in infrastructure. The firms will thus try to (re)locate in the region endowed with the best infrastructures. There will be an agglomeration process at hand. In addition, the lower the inter-regional transport costs, the more firms are sensitive to differentials in domestic transport costs.

Three parameters determine the choice of location of the firms: the capital-labour ratios, the endowments in infrastructure of each region and their difference in size.

Suppose the only difference between the regions resides in their endowments in infrastructures. The relative weakness of the prices in the region with the best infrastructure leads to a higher demand for home-made goods and firms will tend to localize in that region in order to benefit from increasing returns to scale. The magnitude of this process is a function of the levels and the gap between the regional transport costs and hence of the levels and the gap between the endowments in infrastructure. With a high level of infrastructure, a small gap between endowments is enough to attract the firms in the best endowed region.

If the regions only differ by their size, then the transport costs are the same in both regions. The firms will tend to locate in the region where the demand is the largest and there will be agglomeration in the biggest region.

The difference in the capital-labour ratio has an ambiguous effect on the firms' location. A small ratio in one of the regions attracts capital because of the higher returns, but the revenues of that region and hence the local demand are weaker. The net effect of these two opposing forces depends on the returns to scale, the levels of infrastructures (transport costs) and the share of revenue the households use for industrial goods. Firms will agglomerate when these three parameters are high.

Martin and Rogers (1995) showed thus that the integration process (low international transportation costs) tend to reinforce agglomeration, even more when the regions are developed. They also showed that a symmetric development of infrastructure widens the gap between regions. However, the development of infrastructure which lowers the cost of transportation within a low-industrialized region can attract firms but also increase its social welfare.

We now turn to models which take explicitly into account the strategic behaviour of the regional authorities.

The model of Maurer and Walz (2000) is closely related to the one of Walz and Wellisch (1996) described above. They both look at regional competition for mobile

oligopolistic firms but Maurer and Walz (2000) allow for the mobility of *both* firms.

Compared to our reference environment the inverse demand function is written $p^i = Max\{1 - x^i - \gamma x^j; 0\}$, where γ has an influence on the strategic interaction of firms, as well as on the market size. The lower γ, that is the more products tend to be complements, the less fierce is the competition but the lower is the overall demand.
The other difference resides in the cost function. In order to produce one unit of output, firms use one unit of labour which is supplied elastically at $w_m = \alpha L_m$. w_m denotes the local wage in region *m* when a total amount of labor L_m is supplied in that region.

The profits of firm *A* in region *A* (the case of firm *B* and region *B* is symmetric) are thus written, in the agglomeration and geographically separated case respectively,
$\Pi_A^A(2,0) = (1 - x^A - \gamma x^B - \alpha(x^A + x^B) + z_A)x^A$,
$\Pi_A^A(1,1) = (1 - x^A - \gamma x^B - \alpha x^A + z_A)x^A$.
The equilibrium output levels are denoted $x_A^A(2,0)$ and $x_A^A(1,1)$ respectively.

As usual, in the second stage firms choose their location. Given the regional input levels (z_A, z_B) the firms agglomerate in region *A* whenever their profits are higher when they locate in the same region (agglomeration constraint). The critical level of local inputs for which the $(2,0)$ case ($\Pi_A^A(2,0) \geq \Pi_B^A(1,1)$) arises is denoted $\hat{z}_A(\hat{z}_B)$.
The more inelastic the labour supply, the higher will be $\hat{z}_A$. Indeed, as α rises, the agglomeration of the two firms increases the local wages. Hence, the offer of local public inputs has to be more important in order to compensate firms for this agglomeration disadvantage.
The lower the degree of substitutability between products (γ), the looser the good-market competition and the positive effect on a firm's profits caused by higher wage costs for its rival is less pronounced. The agglomeration disadvantage becomes thus more important with γ and as above, $\hat{z}_A$ needs to be higher.

Whereas Walz and Wellisch (1996) define the maximization of the local firm's profits as the objective of regional governments, here local policy makers focus on the local labor market and local wage income.
Hence, regional authorities maximize net income: $W_m = w_m L_m - t_m$, subject to a balanced budget: $t_m = C(z_m) = n_m^\sigma z_m^2$, where σ reflects the degree of publicness of the local public input.

The analysis conducted is quite similar to the one of Walz and Wellisch (1996). A first step determines the conditions for a symmetric spatial configuration to emerge, before turning to the asymmetric equilibrium.
A symmetric equilibrium will exist whenever
$W_A(1,1,z_A^*(1,1), z_B^*(1,1)) \geq W_A(2,0,z_A^*(2,0))$.
The effect of α and γ has already been discussed: a symmetric configuration will be more likely the steeper the labor supply function and the lower the degree of competition between the firms in the output market. In addition, the less "public" the local input (σ close to 1), the more firms will tend to spread out.

We skip the asymmetric case which leads to the same interpretations.

As conclusion, Maurer and Walz (2000) showed when agglomeration can arise as a result of the infrastructure policy of the regional authorities (as well as an asymmetric equilibrium). In the absence of any infrastructure provision, firms facing the agglomeration disadvantage of an elastic labour supply would never locate in the same region. But this centrifugal force can be counterbalanced by the provision of infrastructure.

Taylor (1992) models jurisdictions that compete for an industry by building costly infrastructure more rapidly than their identical neighbours. The expected rewards (R) are the tax revenues and the value of jobs created by a new industry. On the other hand, if the region were not able to attract the firms, it would lose all the money already invested (X) in the infrastructure.

Each jurisdiction maximizes $W_m = e^{-rT}R[1-F(T)]-\int_0^T e^{-rt}X(t)[1-F(t)]dt$, where T is the limit date of completion. The expected gain of competing is the present value of the prize, $e^{-rT}R$, times the cumulative probability that the jurisdiction will win, $1-F(T)$. The expected cost of competing at time t is the present value of the amount spent on the infrastructure, $e^{-rt}X(t)$, times the probability that the race has not yet ended, $1-F(t)$.

We present here the main results of the model.
First of all, a jurisdiction may hesitate to enter the competition if the required effort is high. The bigger the deficit of that region relative to the others, the less it will spend at any time on infrastructure, and the less inclined it will be to pursue its infrastructure program.
Secondly, the higher the reward from attracting an industry, the harder the jurisdiction will compete, trying to complete its infrastructure more quickly.
At last, the impact of a variation in the probability of losing the game has an ambiguous effect. This probability is of course affected by the number of rivals but also by the discount rate which expresses the opportunity costs of infrastructure spending. If the reward is large enough, a rise in the probability of losing a lucrative race will spur the jurisdiction to spend more. However, if its deficit is relatively large, then a small rise in that probability will lead the jurisdiction to cut its investment in infrastructure because the competition looks rather bleak for the region.

3 Mobile Firms and Labor (or Households)

In the following models of Justman, Thisse and Van Ypersele (2001, 2002), the firms are heterogeneous with respect to their infrastructure needs. That is, some types of infrastructure suite better some types of firms than others. This raises the question of which firms a region is willing to attract. Depending on its development strategy, a

region will choose to invest in one particular type of infrastructure. And this leads to regional specialization.

Justman, Thisse and Van Ypersele (2001) examine how regions can attract firms by choosing different levels of infrastructure. These firms differ in their needs of infrastructure services. When regions are able to identify each firm's type, they can set a different fee or subsidy for each firm contingent on the matching cost they observe between the region's infrastructure and the firm's ideal infrastructure. In contrast, when regions cannot observe firm types, they are constrained to set a single tax or subsidy for all firms. The question of discriminatory policies will not be treated here; we focus on the incomplete information case, that is, regions cannot discriminate among firms.
There is a continuum of competitive firms of unit mass selling their output at a price normalized to one. Each firm has a type z, uniformly distributed on the interval [0,1], describing the technological infrastructure that minimizes its investment cost.
A firm of type z earns profits:
$\Pi_m(z) = Max_l\{x(l) - wl - f(z_m, z) - t_m(z, z_m)\}$ where

- $x(l) = l^\alpha$: production requires labor,
- w: wage, is the same in all regions because labour is homogeneous and perfectly mobile,
- $f(z_m, z) = \beta(z - z_m)^2$: fixed investment cost that depends on the gap between the ideal infrastructure z and the one available in region m, z_m,
- $t_m(z, z_m)$: fee (if positive) or subsidy (if negative).

The firm indifferent between locating in region A and region B, $\hat{z}(t_A, t_B)$, is the one for which $\Pi_A(\hat{z}) = \Pi_B(\hat{z})$. Since the profit function is a decreasing function of the distance between z and z_i, all firms with a type satisfying $z < \hat{z}(t_A, t_B)$ locate in region A while those with type $z > \hat{z}(t_A, t_B)$ locate in region B.

Regional governments choose noncooperatively their infrastructure and their fiscal policy as to maximize the wage bill minus the sunk cost of the infrastructure plus fees collected or minus subsidies paid.
The fiscal game has a unique interior Nash equilibrium given by:
$t_A^* = -\alpha(\frac{\alpha}{w}^{\frac{\alpha}{1-\alpha}} + \frac{2}{3}\beta(z_B - z_A) + \frac{1}{3}\beta(z_B^2 - z_A^2)$,
$t_B^* = -\alpha(\frac{\alpha}{w}^{\frac{\alpha}{1-\alpha}} + \frac{4}{3}\beta(z_B - z_A) - \frac{1}{3}\beta(z_B^2 - z_A^2)$.

The equilibrium fee or subsidy varies with the degree of differentiation of the infrastructure between the two regions and with the coefficient β.
A region will be able to tax firms heavily when the degree of adequacy between the firm's type and the one of the region's infrastructure is important (high β).
Similarly, the less the regional infrastructure are differentiated, the more the regions will suffer from fiscal competition and the tax will thus be lower.

In the first stage of the game, regions strategically choose the infrastructure they provide, anticipating the outcome of fiscal competition. In order to maximize their

objective function, the regions will choose maximum differentiation. That is, $z_A^* = 0$ and $z_B^* = 1$.

Hence, regions can gain by specializing in a unique infrastructure niche and thus by differentiating the infrastructure services they offer from those of other regions. This dampens the head-to-head competition that results when regions offer identical infrastructures and are forced to compete on subsidies.

Justman, Thisse and Van Ypersele (2002) investigate how regions can attract firms by proposing infrastructure services that are differentiated by quality. Contrary to their previous model, they propose thus here a vertical differentiation setting.

There is a continuum of firms of measure N competitively selling a numeraire output x, and requiring infrastructure service as well as labour (l) for production. Labour is homogeneous and perfectly mobile. Firms are technologically differentiated, and each is characterized by a type $\theta \in [\underline{\theta}, \bar{\theta}]$, which describes the ability of a firm to exploit the quality of infrastructure. Each region ($m \geq 2$) chooses an infrastructure quality q_m between $\underline{q}$ and $\bar{q}$ at a fixed cost $c(q_m)$. In addition, they charge a fee t_m to the firms locating on their territory.
The firms' profits take thus the following shape:
$\Pi_m(l, \theta) = \theta q_m l^\alpha - wl - t_m$

After maximizing firms' profits, Justman et al. (2002) determine the type of the firm indifferent between locating in m and $m + 1$. This shows, as expected, that a region supplying a better infrastructure is able to claim a higher fee or offer a lower subsidy.

In a second stage, regions decide on their level of fees, after quality has been set. Region m's choice of fee maximizes an objective function comprising three parts: (1) gains from local employment; (2) fee income per firm; (3) the cost of the infrastructure supplied by the region. This leads to the "fiscal agglomeration property": the number of active regions only depends on the distribution of the firms' type. That is, the number of regions which can generate a positive surplus is limited by the dispersion of the abilities of the firms to use the infrastructure. As a consequence, the agglomeration of the firms in a limited number of regions can be the result of the fiscal competition for developing an infrastructure of better quality.

In the first stage, the regions will choose to differentiate at the maximum their infrastructure's quality. Their objective is to avoid a too fierce fiscal competition that would reduce their surplus.

In summary, when regions compete on infrastructure quality they have an incentive to increase the degree of differentiation between them, which reduces the dissipation of regional surplus through Tiebout competition.

Richter and Wellisch (1996) built a model of decentralized government activities

in a federation consisting of many jurisdictions which behave in a perfectly competitive manner. In each jurisdiction, immobile as well as mobile households reside. Mobile firms locate as to maximize their profits. Jurisdictions provide local public goods and local public factors as to maximize the utility of their immobile residents.

Two sources of inefficiencies in the local behaviour are detected.
First, as local governments are interested in the welfare of inside residents, they will provide local public factors at an inefficiently low level and tax mobile households and firms inefficiently high in order to restrict rent outflow.
The second source arises when local authorities have no tax on mobile households at their disposal. Hence, they cannot internalize the congestion costs created by mobile households through direct taxation. The only tool to restrict immigration or to favour emigration is to underprovide local public goods. In addition, local governments provide inefficiently low levels of public factors and tax mobile firms inefficiently high in order to reduce the marginal product of labour which keeps mobile households out of the jurisdiction.

Dohse (1998) studied, using a numerical approach, how different strategies of infrastructure provision (federal, regional or not public) affect the spatial distribution of firms and households in a federation. He illustrates the mechanisms at work in different configurations when the number of firms (seven) and regions (three) expand. This shows however the limits of a numerical example as these numbers remains even so relatively far from reality.
We will only consider the decentralized provision of public goods.

The production function of the seven firms depends on their location:
$x_m^i = AE_m.RP_m.L_m^\alpha.\sigma.G_m^\beta$, i=1,...7 , m=1,...3, where

- AE_m: concave agglomeration function which depends on the number of firms (agglomeration economies if larger than 1, diseconomies otherwise),
- RP_m: local productivity shift term ($RP_A > RP_B > RP_C$),
- L_m: perfectly mobile labour,
- σ: negative impact of taxation,
- G_m: local public infrastructure.

The firms move costlessly and choose their location as to maximize profits:
$\Pi_m = x_m - w_m L_m$. Note that the profits of firms located in the same region are identical.

Each household supplies one unit of labour. Labour is perfectly mobile between regions such that, at equilibrium, regional wages equates.

The regional governments provide infrastructure according to their regional tax revenues: $G_m = t\Pi_m n_m$. A region's level of infrastructure depends thus on the number of firms located in the region, n_m, and on their profits.

Dohse (1998) imposes that the tax rates (t) have to be the same as with centralized provision: $t^* = \frac{\beta}{1+\beta}$. Note that this corresponds to a regional government maximizing regional output.

Computed numerically, three equilibria emerge: (4,3,0); (4,0,3) and (0,4,3). If the initial firm concentration in region A is low, it will be difficult for this region to attract other firms despite its advantage in terms of productivity. This results from the fact that the two other regions can raise more tax revenues and thus provide a higher level of infrastructure. In addition, firms realize higher agglomeration economies. However, if the initial allocation of firms is nearly uniform across regions, then the highest level of infrastructure is provided to those regions where the marginal product of infrastructure is highest.

Part IV
Education and Training

As an investment in human skills, education can help to foster economic growth and enhance productivity, contribute to personal and social development, and reduce social inequality. As individuals and nations increasingly recognize that high levels of knowledge and skills are essential to their success, spending on education is increasingly considered as an investment in the collective as well as individual future.
Differences in growth between countries can be explained by persistent differences in the accumulation of physical and human capital as well as by the market situations and technological progress. All these elements can be influenced by economic policies and the institutional context of the countries. To give a rough idea[10], in Belgium for instance, the increase of human capital accounts for 0,45 points of percentage of the evolution of the growth rate of the GDP per capita. In terms of expenditures, in 1999, education mobilized around 0,05% of GDP.

In the context of competition between firms, investment in human capital raises a specific question with respect to investment in physical capital. Indeed, investment in education is mobile by itself, i.e. workers, once trained, can move to and work in another region. That is, while infrastructure is considered as a *local* public good, education in one region constitutes a public good for the other regions as well. The fact that one region can thus "free-ride" on the education system of another region, creates a new type of externality.

The first section of this fourth part is concerned with the impact of educational

[10]OECD (2002).

policies on the regional economic geography and productivity. Section 2 deals with the well-known ”brain-drain” phenomena. In section 3, we briefly look at how regional governments select the quality of their education programs. The last section considers more specifically the effect of education policies on the location choices of firms and workers.

1 Regional economic geography and productivity

Karlsson and Zhang (2001) analyze how changes in education policy and in regional amenities affect the economic geography. They do so in the context of a dynamic two-region model with human capital accumulation.

The economic system produces two commodities, one in each region. The only university in the economy which carries out higher education is located in region *1*. There are three types of individuals: perfectly mobile workers, students and teachers. The two last cited live only in region *1*. The utility level a person obtains in a given region is dependent on the region's amenity level and on the consumption levels of services and commodities produced by the manufacturing industry.
The production function for the two regions' production sectors depends on the average level of human capital and on the labour force present in its region.
There are two ways for improving the human capital in a region, namely through education (teaching time on average devoted to each student) and through ”learning by producing”.

The impact of the educational policy is measured through an increase in the ratio between the number of students and the total number of workers in the economy. Some labour force will thus move from the regional production sectors to the university. Hence, the regions' labour force is reduced as the government promotes education. In addition, region *1*'s (region *2*'s) residential population is increased (decreased). The number of teachers, measured as a fraction of the total number of students, increases but by a lesser extent than the latter. Thus, the teaching time devoted to each student decreases. If the two regions' human capital accumulation exhibits decreasing returns to scale, that is, if as human capital is increased it is more difficult to further improve the level of human capital, then the average level of human capital in both regions increases. This induces a reduction in the two regional wages. If region *2*'s human capital is indeed reduced, then the region's output is definitely reduced.

As region *2*'s amenity is improved, some workers of region *1* migrate to region *2*. As each region's number of students is assumed to be positively and proportionally related to each region's workers, region *1*'s number of students is reduced while region *2*'s number of student is increased. Since environment affects the regional distribution of labour force and students, it will also affects the level of human capital (increases if increasing returns to scale).

It is thus difficult to evaluate the impact of a change in the education policy on the equilibrium structure of the economic geography. Depending on whether human capital accumulation exhibits increasing or decreasing returns to scale, promoting education will deteriorate or enhance the regional level of human capital as well as regional production.

Leach (1996) built up a model in which individuals make occupational as well as locational choices. They decide whether to acquire the training that will turn them from unskilled into skilled workers incurring training costs θ and whether to migrate to the other region incurring migration costs γ.
The firms in the regions use both skilled and unskilled workers in the production of a single good. These firms are competitive, paying each type of labour a wage equal to its marginal product.

We only consider the case in which the training costs are the same for all agents, and there is an exogenous distribution of migration costs. If the two regions are identical in terms of productivity, then no migration occurs. But, as the productivity of region *1* raises (by a scale factor), the wage of the skilled workers in region *1* (w_{1s}) increases as does, in a lesser extent, the wage of the unskilled (w_{1u}). The difference between those two (y_1) now exceeds the training cost and more workers choose to become skilled. The ratio of unskilled workers to skilled workers in region *1* (r_1) falls and y_1 is driven back to its equilibrium value. The higher wages in region *1* also lead to greater migration from region *2* to region *1*.

Suppose now that a "federal" government subsidize the cost of worker training, lowering θ. Since an agent in region i chooses to become skilled if his training cost is smaller than the skill premium (y_i), the fraction of agents in region i who choose to become skilled is now larger. Hence, a training subsidy reduces the ratio of unskilled workers to skilled workers in both regions (r_i) and this reduction is less important in region *1* because of its higher productivity (lower $r_2 - r_1$). As a consequence, the location premium decreases and the extent of migration is reduced. Note also that the reduction in the skill and location premia lowers the gap between average wage incomes.

Hence, this education policy makes the regions more alike in their employment structures. Indeed, a training subsidy will lead more unskilled workers to become skilled in the "depressed" region than in the other one, tending to erase the differences in the r ratios between the regions. This education policy also reduces regional income disparities even though it does not target one particular region.

2 Brain-drain

Labour mobility, with its well-known "brain-drain" phenomena, reduces the incentive for public funding of education. For instance, a regional government can find it optimal not to finance education in its region while benefitting from the other region's education system through the migration of skilled workers. Hence, the fact that one region can "free-ride" on the education system of the other region, paves the way for asymmetric equilibria.

Justman and Thisse (1997a) studied the implications of the mobility of skilled labour for local public funding of higher education.
The economy consists of two separate locales, $i = 1, 2$. Production is local, and uses two factors: land (m_i) and skilled labor, h_i denoting its local supply.
Net profits of local landowners are written:
$\Pi_i = F(m_i, h_i) - F_2(m_i, h_i)h_i - cs_i$, where

- $F(m_i, h_i)$: constant-returns-to-scale production function,
- F_2: partial derivative of *F* with respect to *h*, equals the wage of skilled labor,
- *c*: constant cost of a school place,
- s_i: number of school places in locale *i*.

Skilled labor remains to work where it was trained with exogenous probability q ($0 < q < 1$), immigrating to work in the alternative locale with probability $1 - q$. Hence, $h_1 = qs_1 + (1 - q)s_2$ and $h_2 = (1 - q)s_1 + qs_2$.
As the quantity of land in each locale is fixed, net profits can be rewritten: $\Pi_i = g(h_i) - cs_i$ or $\Pi_i = g(qs_i + (1 - q)s_j) - cs_i$.

Landowners choose the number of school places available in their locale in order to maximize their net profits.
Two possible types of equilibria emerge. In a symmetric equilibrium, we have $s_1 = s_2 = s$ where *s* is determined by $g'(s) = \frac{c}{q}$.
In an asymmetric equilibrium in which one locale finds its optimal to "free-ride" on the education system of the other, we have, say, $s_1 = 0$, and s_2 satisfies $g'((1 - q)s_2) = \frac{c}{(1-q)}$. Due to the concavity of g, this can hold only if $q < \frac{1}{2}$.
If the education is provided federally, that is, the joint profits of the landowners in both locales are maximized, then a quantity s such that $g'(s) = c$ would be provided. Hence, the uncoordinated Nash equilibrium leads to under-investment in higher education by local jurisdictions. The only way to implement a first-best symmetric equilibrium would be to subsidize the fraction $1 - q$ that migrates to the other region.

In this paper, Justman and Thisse (1997a) treat migration as an exogenous variable. Hereafter, they let migration flows react to wage differentials, which seems to better fit reality.

In a model of fiscal competition, Justman and Thisse (1997b) try to answer the question of whether funding of higher education should be decentralized among local governments.
Two types of workers are present in each of the n regions: unskilled workers which are immobile, and skilled workers. The latter are perfectly mobile, ensuring the same wage in all regions at equilibrium, and provide a higher quantity of labour than the unskilled workers. As the quantity of land in each region is fixed and identical, the quantity of labour available on the local markets is the same everywhere. The cost of education of a skilled worker is constant and identical in each region.
When the number of students in one region increases, the number of skilled workers in that region increases as well as the number of skilled workers in the other regions. In other words, there are spillover effects in the provision of education. The direct effect remains however the strongest.

Considering first the centralized solution, the social optimum requires that the wage of a skilled worker equals its opportunity cost, that is, its cost of education plus the wage of an unskilled worker. The equilibrium "skilled" wage leads to the following relationships: an increase in the productivity of the skilled workers induces a lower wage for both types of workers since it increases the optimal quantity of labour available. In addition, a higher cost of education decreases the optimal quantity of skilled labour, thereby increasing both wages.
When funding of higher education is decentralized, the following two-stage game is played. First, the regions choose the number of students native of their region which will be educated. In a second stage, the skilled workers chooses where to reside and work.
Depending on the nature of the objective function of the regions, the uncoordinated Nash equilibrium will lead either to under-investment or over-investment of education with respect to the social optimum. If regions maximize the regional net output, there will be under-investment. This tendency is exacerbated when the number of regions increases. The reason of this under-provision of education is that the regions do not internalize all the benefits of education and this leads to some regions free-riding on the others.
If the regions maximize the revenues of the landowners and of the workers native of their region (including emigrants), there will be over-investment. This results from the fact that the regions do not take into account the positive (and negative) impact of their educational choices on the land rents and the wage of the unskilled (and skilled) workers.
If the regions maximize net land rent or the net regional wage bill, there will be under-provision.

In general, the decentralization of funding of higher education leads thus to under-investment in education. The cause resides in the perfect mobility of skilled workers.

In terms of the way migration is modeled, we have thus, on one side, Justman and Thisse (1997a) in which the probability of migration is completely exogenous. On the other side, the probability of migration of the skilled workers in Justman and

Thisse (1997b) is determined endogenously (perfect mobility). And in between, Justman and Thisse (2000) look at the effect of imperfect mobility of skilled workers. That is, the probability of migration depends on the wage and amenity differentials and takes explicitly account for the fact that some skilled workers have a higher mobility than others.

At the centralized solution, total ("federal") output net of education costs is maximized. The necessary first-order conditions set the marginal product of human capital equal to the cost of training in each region. As the wages are the same in both regions, the probability of migration is also the same and therefore there is no net migration. Referring to Justman and Thisse (1997a), in a symmetric centralized solution s is determined by $g'(s) = c$.

The sequence of interaction between local governments and factor markets in a decentralized situation is as follows: first, each local government chooses its education policy $\{s_1, s_2\}$; then, skilled workers choose where to live and to work; finally, production takes place and the factors of production are paid at their marginal product.
Two regional objective functions are considered.
First, local governments maximize local output net of education costs. This leads to less local expenditure on education than global output maximization, and the shortfall is greater the more strongly migration responds to pecuniary incentives.
Secondly, if regions maximize native product, then they will over-invest in education. Indeed, they ignore, on the one hand, the negative impact on the earnings of non-native skilled workers and, on the other hand, the positive impact on the returns of the immobile asset in the other region. Note that this over-provision is larger the less migration is responsive to wage differences.

Corroborating the conclusions of Justman and Thisse (1997b), local public funding of education departs thus from a federal provision in either direction depending on the balance of political forces at the local level. When geographical interests are predominant, the local government under-invests in education. However, when they take into account the welfare of native-born highly educated emigrants, they will tend to over-provide education.

Webb (1985) looks at the effect of a brain drain on the burden to governments of achieving their education objectives.
The model consists of two regions where labour is composed by skilled and unskilled workers. The former have the possibility to migrate from region *1* to region *2*. The supply of educated labour is an increasing, concave function of the education subsidy: $S_i(E_i)$. The stock of migrants, *M*, is assumed to be a function of the wage differential for skilled workers: $M(\alpha, w_2 - w_1) = \alpha m(w_2 - w_1)$. When country *1* (*2*) increases its education subsidy, the flow of migration increases (decreases). Indeed, a higher education subsidy in country *1* increases its regional supply of labour. This leads to a reduction of the wage in region *1*, giving an incentive to skilled workers to migrate to the other region. Hence, an increase in one country's education subsidy

reduces wages and increases the local supply of educated labour in both countries as well as reducing the effectiveness of education subsidies in achieving their objective in the other country.

The two governments possess an objective function which is decreasing in the education subsidy and increasing with respect to the local labour supply of skilled workers.
The effect of a change in the education subsidy on the welfare function has an ambiguous sign. It is equal to the marginal opportunity cost to the government of funds spent on education, plus the change in welfare due to the change in net local supply of educated labour which follows from a change in its subsidy.

International mobility of labour affects the education policies of local governments. Thus, in this last model, brain drain leads to under-investment in education by both governments.

As seen in the previous models, this is not necessarily the case. Depending on the nature of the regional welfare functions, education will be either over- or under-provided by the regions with respect to the social optimum. When native workers (including emigrants) have a large weight in the objective function of the regions, then the regions will over-invest in education. Contrariwise, when regions care most about local factors, there will be under-investment as the regions tend to free-ride on the other region's education policy.

3 Quality of education

Hoyt and Jensen (2001) examine the issue of quality differentiation of public services. They model the provision of education as a two-stage game. In stage one, local governments choose the quality of their education (high or low). In stage two, they simultaneously choose their taxes. Finally, residents choose where to locate considering the tax/public service mix and the housing prices. All individuals prefer, ceteris paribus, high to low quality of education but some have a stronger taste for quality than others (vertical differentiation).
The objective of the local governments is to maximize the value of property (land[11]), that is, to maximize the price of housing. They use either property taxes or head taxes to finance education.

Beginning with head taxes, product differentiation in educational quality necessarily results in a higher price of housing in one city, but a lower price of housing in the other depending on the cost of quality. To see this, let us start from a situation

[11]The presence of land rents is typical to models of Urban Economics (see Fujita (1986) and Huriot and Thisse (2000)). Note that the model of Hoyt and Jensen (2001) is the only one surveyed here where land plays a crucial role through the housing market.

where the prices of housing, as well as quality of education (low), are the same in both cities ($p^1 = p^2 = p^U$ and $q^1 = q^2 = q^L$ resp.). Population is thus evenly distributed among them: $N^1 = N^2 = \frac{1}{2}$. Further suppose that city *1* adopts high quality and city *2* does not. If the price of quality is low, that is, if the price of quality does not exceed its value for the median agent, then utility for the marginal individual is higher in city *1* given $p^1 = p^U$ and $N^1 = \frac{1}{2}$. As a result, some individuals will migrate from city *2* to city *1*, thereby increasing the demand for housing in the latter. As a consequence, the price of housing in city *1* increases: $p^1 = p^H > p^U$. For what concerns city *2*, the decrease in its population means that housing prices must fall in order to maintain equilibrium in the housing market: $p^2 = p^L < p^U$.
This leads to a "prisoner's dilemma" in the first stage of the game with the following pay-off matrix:

		City 2	
		High	Low
City 1	High	p^U, p^U	p^H, p^L
	Low	p^L, p^H	p^U, p^U

where $p^H < p^U < p^L$ when quality is costly and
$p^H > p^U > p^L$ when quality is cheap.

Thus, when education is financed by a head tax, both cities adopt the same quality of education (there is no product differentiation in educational quality). In particular, when quality is costly (cheap), both cities choose low (high) quality.

Let us now turn to the case where cities use property taxes to finance education. Unlike head taxation, the use of property taxes induces fiscal externalities between the cities, generating "tax competition". That is, the tax rate a city can charge will be lower in both cities when they have different qualities of educational services.
As shown in the table below, if the marginal cost of quality is either high enough or low enough, product differentiation in educational quality necessarily results in a higher price of housing in one city, but a lower price in the other. Both cities will then adopt the same quality in the second stage. However, for intermediate values of the marginal cost of quality, product differentiation can result in a higher price of housing in both cities. In the Nash "quality" equilibrium, cities will choose to differentiate the quality of their education.

		City 2	
		High	Low
City 1	High	p^{U_H}, p^{U_H}	p^H, p^L
	Low	p^L, p^H	p^{U_L}, p^{U_L}

where $p^{U_L} > p^H$: high cost,
$p^H > p^{U_L}$ and $p^L > p^{U_H}$: intermediate cost,
$p^H > p^{U_L} > p^{U_H} > p^L$: low cost.

Hoyt and Jensen (2001) consider thus quality differentiation in education among localities as a way to reduce tax competition among them. When local governments

maximize property value using a property tax, the results show that the level of education provided both for cities that choose high quality as for cities that choose low quality is reduced. The decrease in educational spending (and taxes) in both cities means that under certain circumstances property values in both cities can increase. Hence, the two-stage game can result in quality differentiation in education when a property tax is used.

The results heavily depends on the type of tax used by the local governments. The key difference between head taxes and property taxes resides in the mobility of the residents it induces. When property taxes are used, any increase in public services in a city will lead fewer residents of the other city to migrate there. This means that increases in taxes that increase property values in a city (by increasing its population and therefore the demand for housing) are less effective. The reason for that lies in the fact that quality differentiation leads to a stronger attachment to one of the two cities for each resident depending on his taste for educational quality.
Note that quality differentiation does not occur in some cases in which it would be socially beneficial to have a high and a low quality provider of education. In addition, this socially beneficial differentiation is less likely to occur when education is financed through a head tax.

4 Firms' location and workers' training

Giffard (2000) asks the question of whether public adult continuing education (*formation professionnelle continue*, or *FPC*) constitutes a tool for the regional development. *FPC* permits the accumulation of "spatial" human capital which gives rise to the traditional scale economies and agglomeration effects. It constitutes also a tool for the regional authorities to intervene on the working of the labour market. Indeed, it provides a better level of qualification as well as a more diversified labour force. As a consequence, the matching probability between the firms and the workers increases. Note that the training programs proposed by the regional authorities are strongly related to the needs, the preferences expressed by the firms.
However, a decentralized provision of *FPC* presents also some limits. First, it can lead to under- or over-investment since the decision of training is taken according to its repercussions on the voter. Second, there exists spillover effects (individuals trained in one region can move and work in another one) that are not necessarily taken into account by the regional authorities.

In Gradstein and Justman (1995), education allows a country to attract and absorb foreign capital into the home economy. Individual skills act as a public good and generate externalities. On the one hand, individual skills, reflecting the capacity of an economy to absorb new capital successfully, induces more capital in the home economy. This gives scope for public intervention, e.g. by subsidizing higher education. On the other hand, when countries compete for a limited pool of investment

funds which are not perfectly elastically supplied, then the pool of skills represents a negative externality with respect to the other country's growth (competition effect).

Gradstein and Justman (1995) examine a two-country model in which national output is a function of labour, domestic skills, and foreign capital (which is complementary to domestic skills). Access to foreign capital depends on the extent of formal advanced skills in the domestic economy compared with that in the other country.
There are two time periods: in the first one, individuals choose how much time they spent to learn and to work; in the second one, foreign capital is allocated and production occurs.

First, the authors derive the decentralized equilibrium at which individuals maximize their utility with respect to the fraction of time they spent to learn (x_i^N) and compare it to the single-nation optimum where the country's utility is maximized (x_i^P). If the supply of foreign capital is not perfectly elastic, then the noncooperative equilibrium skill level in each country is lower than the national optimum ($x_A^N(x_B) < x_A^P(x_B)$). The reason is that individuals do not take into account the positive external effect (positive free-rider effect) of their allocation of time to learn and this leads to under-provision. The only way to correct for this is to subsidize education such that the two coincide.
The global individual equilibrium (x^N) is defined as the global symmetric Nash equilibrium among the residents of both countries without any government involvement. When compared to the global social optimum (x^P), they find that $x^N > x^P$ iff the positive externality of the free-rider effect is dominated by the negative externality of the competition effect. This will lead to over-provision of skills when foreign capital is perfectly elastic. However, when the supply of capital is not perfectly elastic (and the number of inhabitants is large), there will be under-provision without government intervention. Indeed, the free-rider effect takes more importance as the amount of investment in one country becomes more responsive to the level of skills developed in that country than to the one in the other country.
At the multi-national equilibrium, governments choose, in a first stage, subsidies. In a second stage, individuals choose training. It appears that the skill level in this case will be higher than at the global optimum. The provision of subsidies eliminates the free-rider effect such that only the negative competition effect remains. The result is an over-subsidization which shows the need for policy coordination.

Hence, the positive externality generated within a country by the acquisition of skills leads to subsidiation of education by the national governments. However, competition for a limited amount of capital represents a negative externality. As a consequence, the subsidies which are optimal from a national perspective, generate overinvestment in skills when englobed in a larger view. The solution would be to reduce education subsidies in a coordinated manner.

Tharakan and Tropeano (2002) propose a model where imperfect matching between firms and workers on local labour markets leads to spatial agglomeration.
There are two regions (*i*=*A*, *B*) with a share of population α_A and $\alpha_B = 1 - \alpha_A$ respec-

tively. The population of each region consists of mobile workers which are endowed with the same level of general human capital (*h*). All workers incur urban costs equal to $\alpha_i t$ where *t* is the unit commuting cost. There are *N* firms, with β_A representing the share of firms located in region A. They produce a homogeneous good according to a technology which exhibits decreasing returns to scale with respect to labour: $Y = F(hl)$.

The framework used to describe the labour market is the one of Hamilton *et al.* (2000). It is described by a circle of circumference one, which stands for the skill space. Each firm and worker has a specific position on the circle. For the firm, it represents the technology it uses and for the worker it represents the technology which perfectly matches his skills. If his skills do not match perfectly any existing technology, then the worker has to undergo a specific training before it can produce output[12]. The training cost depends on the distance between the firm's technology (x) and the worker's skill (x_j). That is, the training cost function is given by $s(h)|x - x_j|$, where $s(h)$ represents the unit cost of training. If the latter relationship is positive, then an increase in general human capital means an increase in the specialization of the worker. However, if $s(h)$ is negatively related to *h*, then human capital improves the ability of workers to match a given technology. Note that there is asymmetric information between workers and firms.

Firms choose location as to maximize their profits: $\Pi_j = F(hl_j) - w_j l_j$. The local wage equals, at equilibrium, the marginal productivity of labour minus the impact of imperfect competition on the labour market. The latter arises from imperfect matching between workers and firms. Imperfect competition confers monopsony power to firms and allows them to set wages lower than the marginal productivity because workers cannot move to another firm at zero cost. The higher the training cost, the greater this monopsony power and the lower the local wage. The regional wage is also positively related to the number of firms since more firms induce a fiercer competition on the labour market. The density of workers present in one region lowers its local wage through a reduction in the marginal productivity.
Firms will decide to migrate to region A if the difference of profits, $\Delta\Pi = \Pi_A - \Pi_B$, is positive. Agglomeration in region A is more likely to occur the larger the size of the regional labour force (centripetal force) and the lower the number of firms in A (centrifugal force).
The reverse holds for the agglomeration of workers, which choose location on the basis of their expected net wage. An increase in number of workers in A lowers the wage through the decreasing returns to scale in the production function and the congestion effect while a strong competition between firms has the opposite effect.

The spatial equilibrium which prevails (symmetric, asymmetric or full agglomeration) depends on the difference of the speed of adjustment of both types agents as

[12]Example given by Kim (1989 p. 695): "A computer programmer is born with the potential ability to be a computer programmer. Thus he will be a computer programmer. The only decisions he makes are (1) how much he will invest in computer programming (say, get a master's degree or go to a technical school) and (2) how widely he will train himself (e.g., learn only one programming language in one machine or learn a variety of different languages and machines)."

well as on the initial conditions, in terms of population and number of firms.

Tharakan and Tropeano (2002) analyze the effects of different public policies: policies which affect workers' mobility, education and competition. We focus here on the second one when the speed of adjustment of firms is infinite, i.e. firms react instantaneously to regional profits' differentials.
Suppose that a higher level of human capital makes workers more mobile on the labour market (and not more specialized). For what concerns workers, the "competition effect" acts as a centripetal force. A higher level of general human capital improves the matching between firms and workers thereby reducing the monopsonic power of the firms. The latter face thus a tougher competition which leads workers to relocate in the neighbourhood of the firms.
From the viewpoint of the firms, there is no effect of h on their profits and hence, on their location. However, an increase in the level of general human capital rises the critical threshold in terms of workers' size above which the economy converges towards complete agglomeration and experiences higher spatial disparity.

In summary, if an improvement in the level of human capital leads to greater mobility of workers between tasks, then an increase in human capital can increase or decrease regional disparities depending on the workers' density.

Rioux and Verdier (2002) investigate the impact of regional integration on the incentives for local governments to finance general human capital. They try to answer the question of whether regional integration leads to a "race to the bottom" or a "race to the top" for local educational policies. What will be the effects on regional productivity and wages?

The model displays strategic interactions between two regions where only firms are mobile. As in Tharakan and Tropeano (2002), human capital has two dimensions: a vertical dimension determined by the the level of general human capital and a horizontal dimension, which refers to the specific skills a worker obtains through specific training. One of the differences between the two models resides in the fact that the general human capital is provided by the *regional* governments. Hence, all workers, after school in region *i*, are endowed with the same level h_i. In each region however, individuals differ in their specific skills. These specific skills are uniformly distributed with density Δ_i on a circle C_i of length L_i where C_i represents the skill space and L_i reflects the degree of diversity in workers' specific skills. The training cost function is given by $s(h_i)|x^i - x^i_j|$. Another difference with Tharakan and Tropeano (2002) lies in the fact that this cost is shared between a worker, paying a share α_i, and the firm hiring him, $1 - \alpha_i$.

The functioning of the labor market replicates the analysis made by Tharakan and Tropeano (2002). Note that a higher level of general human capital in region i has two effects on the firms' profits. First, there is a positive productivity effect as it increases workers' marginal productivity, once they are matched to the firm's technology. Second, there is a negative flexibility effect associated to the fact that workers

better endowed with general human capital can learn new specific skills at a lesser cost and are thus easier employable. This increases competition between firms, pushing wages upwards.
Note that the equilibrium wage is negatively related to the share of training costs paid by the worker through its impact on the monopsonic power of the firms.

First, Rioux and Verdier (2002) consider how the educational policy of two *identical* regions is affected when firms are allowed to move between regions. The timing of the game is as follows: first, regional governments choose their level of general human capital; second, firms choose their location as to maximize their profits; then firms set wages in a Nash fashion and finally, workers train and production occurs.
In the first period local governments maximize welfare defined as the net expected wage of their citizens minus the cost of the general human capital. This gives a symmetric Nash equilibrium in which $h_i = h_j = h$. Note that when the share of training costs paid by the workers (α) increases in one region, then the monopsonic power of the firms in that region increases, thereby giving firms an incentive to locate there. The regional government can thus increase h_i to mitigate the negative impact of a higher α on wages, even though this reduces firms' profits via the flexibility effect.
If the productivity effect outweighs the flexibility effect, then the expected profits of the firms are positively related to the level of general human capital. This gives a regional government an incentive to increase the latter strategically in order to attract firms locally. Compared to a situation without regional integration, h will thus be higher as well as local wages. This situation is more likely to happen the higher the population density, the size of labour pool of firms and the share of training costs paid by the firms.
The results are reversed when the flexibility effect dominates the productivity effect.

What happens when two regions of different sizes are integrated?
If the flexibility effect dominates, the level of general human capital in the larger region (A) will be higher than in the smaller region. Intuitively, the size of the employment pool of a firm in the larger region is bigger than in the small one. Thereby, competition is less fierce in region A and provides an incentives for firms to locate there. When the flexibility effect outweighs the productivity effect, local governments are willing to reduce their provision of h_i in order to attract firms. However, because of its size advantage on the labour market, the larger region can afford to invest more in general education without loosing too many firms.

When the regions differ only by their production technology, the region with the highest productivity will provide more general education than in the symmetric integration case. The reason is that the marginal return to general human capital is higher in that region, since the local wage is higher. Thus, if the productivity (resp. flexibility) effect dominates, firms will choose to locate in the region endowed with the highest (resp. lowest) productivity.

Hence, the impact of regional integration on local governments' educational policies depends crucially on the relative importance of the productivity effect and the

flexibility effect.

Conclusion

Empirical studies have shown that the location decisions of firms can be influenced by regional policies. When considering in which region to settle, firms compare the profits they would obtain in each region. These profits are determined among others by three elements: (1) the local taxation; (2) the set-up costs and (3) the wages. Hence, local governments have a decisive influence on the choice of location of firms through their fiscal, infrastructure and education policies.

Recent theories of location, and the "New Economic Geography" in particular, help explaining the choices made by the firms. Firms producing in locations with relatively many firms face fiercer competition in the local product and factor markets. This tends to make activities dispersed in space. However, the combination of increasing returns to scale and trade costs, as well as industry linkages, encourages firms to locate close to large markets, which in turn are those with relatively many firms. This creates pecuniary externalities which favour the agglomeration of economic activities. The balance of these centrifugal and centripetal forces will, first of all, encourage firms to agglomerate (or disperse) and, second, provide regional authorities with more or less incentives to "sponsor" firms in terms of taxes, infrastructures or skilled workers.

Choosing which regional policy to activate is critical. Indeed, deciding to subsidize a multinational for instance, can force regions to enter in a costly "subsidy tournament". More generally, the danger when regions compete in taxes (or subsidies), is to exhaust the financial resources of the regions without any significative impact on the regional welfares. This nightmare can be however somewhat weakened by the presence of spatial externalities which give a region some locational advantage.
Competition in infrastructure does not present the same problem of boundaries. All the equilibria reached by the models surveyed are well defined and limited in space. In addition, when the firms are heterogeneous, providing differentiated infrastructures will dampen the negative effects of fiscal competition. This result shows that combining different fields of regional policies can be beneficial.
Turning to educational policies introduces a new kind of problem. That is, the fact that training is not attached to a region's physical territory is an open invitation to free-riding. Part of the benefits of a region's education policy is likely to spill-over to the other region as the educated workers migrate. The latter region will thus decide to under-invest in education compared to the social optimum.

Let us conclude this survey with three general remarks which suggest some av-

enues for future research.

First, there is room for regional coordination. One explicit argument in favour of the coordination of regional policies is to avoid a waste of resources. A simple example is the subsidy war to which fiscal competition can lead. A second argument resides in the fact that coordination can eliminate some negative externalities. Indeed, cooperation in the field of education policy can eradicate the problem of free-riding and the under-investment which results from it. Finally, regions who coordinate their policies oppose a stronger resistance in front of an external regional competitor.

Second, the results of the models presented in this survey heavily depends on the nature of the objective function of the regional governments. In particular the scope of the regional authority is critical. This was particularily clear in education models: depending on whether the regional authorities take into account geographical or "nationality" interests, they will decide to under- or over-provide education respectively.

Third, in the literature surveyd here, institutional constraints are most often ignored. However, they are clearly apt to alter the nature of regional competition. First, some demarcation disputes may arise between the different levels of authorities (national versus regional governments). For instance, regional policies might be tied to laws fixed at a federal level. Second, the regions' decisions are subject to some budgetary constraints. They have finite resources and they cannot let their budget deficit go too far. The scope for regional deficit is often a matter of federal regulation. Therefore, further research on the impact of regional policies could try to better incorporate this vertical dimension.

References

BARROS, P. and CABRAL, L., 2000, "Competing for foreign direct investment", *Review of International Economics*, 8 (2), pp. 360-371.

BERNHEIM, D. and WHINSTON, M., 1986, "Menu auctions, resource allocation and economic influence", *Quarterly Journal of Economics*, 101 (1), pp. 1-31.

BESLEY, T. and SEABRIGHT, P., 1999, "The effects and policy implications of state aids to industry : an economic analysis", *Economic Policy*, 28, pp. 13-53.

BRANDENBURGER, A. and NALEBUFF, B., 1996, *Co-opetition*, Doubleday, Bantam Doubleday Dell Publishing Group.

CHARLOT, S., 2000, "Economie géographique et secteur public: des infrastructures de transport à la concurrence fiscale", *Revue d'Economie Régionale et Urbaine*, 1, pp. 5-16.

COMBES, P.-P. and LAFOURCADE, M., 2001, "Transportation costs decline and regional inequalities: Evidence from France, 1978-1993", *CEPR Discussion Paper*, 2894.

COMMISSION OF THE EUROPEAN COMMUNITIES, 1999, *Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on cohesion and transport*, COM (1998) 806, Brussels.

COUGHLIN, C., TERZA, J. and ARROMDEE, V., 1991, "State characteristics and the location of foreign direct investment within the United States", *Review of Economics and Statistics*, 73 (4), pp. 675-683.

CUSHMAN & WAKEFIELD HEALEY & BAKER, 2002, *European Cities Monitor 2002*.

DEVEREUX, M and GRIFFITH, R., 1998, "Taxes and the location of production: evidence from a panel of US multinationals", *Journal of Public Economics*, 68 (3), pp. 335-367.

DEWHURST, J., 2000, "Foreign direct investment and development-agency intervention: a theoretical model", *Urban Studies*, 37 (3), pp. 497-511.

DOHSE, D., 1998, "Infrastructure provision and locational efficiency in a federation: a numerical approach", *Papers in Regional Science*, 77 (3), pp. 241-263.

DURANTON, G. and PUGA, D., 2001, "From sectoral to functional urban specialization", *CEPR Discussion Paper*, 2971.

FUJITA, M., 1986, "Urban land use theory", in LESOURNE, J. and SONNEN-

SCHEIN, H. (eds.), *Location theory*, Fundamentals of Pure and Applied Economics n°5, Harwood Academic Publishers, pp. 73-149.

FUJITA, M., KRUGMAN, P. and VENABLES, A., 2001, *The spatial economy: Cities, regions, and international trade*, MIT Press, Cambridge, Massachusetts.

FUJITA, M. and THISSE, J.-F., 2002, *Economics of agglomeration*, Cambridge University Press.

FUMAGALLI, C., 2002, "On the welfare effects of competition for foreign direct investments", *European Economic Review*, forthcoming.

FUDENBERG, D. and TIROLE, J., 1991, *Game theory*, MIT Press, Cambridge, Massachusetts.

GIFFARD,A., 2000, "L'analyse du rôle de la formation professionnelle continue comme outil de politique économique dans les régions. Regards sur la période 1986-1992", *Revue d'Economie Régionale et Urbaine*, 5, pp. 915-938.

GRADSTEIN, M. and JUSTMAN, M., 1995, "Competitive investment in higher education: The need for policy coordination", *Economics Letters*, 47, pp. 393-400.

HAALAND, J. and WOOTON, I, 1999, "International competition for multinational investment", *Scandinavian Journal of Economics*, 101 (4), pp. 631-649.

HAAPARANTA, P., 1996, "Competition for foreign direct investments", *Journal of Public Economics*, 63, pp. 141-153.

HAMILTON, J., THISSE, J.-F. and ZENOU, Y., 2000, "Wage competition with heterogeneous workers and firms", *Journal of Labor Economics*, 18 (3), pp. 453-472.

HAUFLER, A. and WOOTON, I., 1999, "Country size and tax competition for foreign direct investment", *Journal of Public Economics*, 71 (1), pp. 121-139.

HAUFLER, A. and WOOTON, I., 2001, "Regional tax coordination and foreign direct investment", *CEPR Discussion Paper*, 3063.

HEAD, K., RIES, J. and SWENSON, D., 1999, "Attracting foreign manufacturing: investment promotion and agglomeration", *Regional Science and Urban Economics*, 29 (2), pp. 197-218.

HELPMAN, E. and KRUGMAN, P., 1989, *Trade policy and market structure* , MIT Press, Cambridge, Massachusetts.

HOYT, W. and JENSEN, R., 2001, "Product differentiation and public education", *Journal of Public Economic Theory*, 3 (1), pp. 69-93.

HURIOT, J.-M. and THISSE, J.-F., 2000, *Economics of cities: theoretical perspectives*, Cambridge University Press.

JANEBA, E., 1998, "Tax competition in imperfectly competitive markets", *Journal of International Economics*, Vol. 44 (1), pp. 135-153.

JUSTMAN, M. and THISSE, J.-F., 1997a, "Implications of the mobility of skilled labor for local public funding of higher education", *Economics Letters*, 55, 409-412.

JUSTMAN, M. and THISSE, J.-F., 1997b, "Faut-il régionaliser l'enseignement supérieur", *Revue Economique*, 48 (3), pp. 569-577.

JUSTMAN, M. and THISSE, J.-F., 2000, "Local public funding of higher education when skilled labor is imperfectly mobile", *International Tax and Public Finance*, 7, pp. 247-258.

JUSTMAN, M., THISSE, J.-F. and VAN YPERSELE, T., 2001, "Fiscal competition and regional differentiation", *CORE Discussion Paper*, 2001/24.

JUSTMAN, M., THISSE, J.-F. and VAN YPERSELE, T., 2002, "Taking the bite out of fiscal competition", *Journal of Urban Economics*, 52 (2), pp. 294-315.

KARLSSON, C. and ZHANG, W.-B., 2001, "The role of universities in regional development; Endogenous human capital and growth in a two-region model", *The Annals of Regional Science*, 35, pp. 179-197.

KIM, S., 1989, "Labor specialization and the extent of the market", *Journal of Political Economy*, 97 (3), pp.692-705.

KIND, H., MIDELFART-KNARVIK, K. and SCHJELDERUP, G., 2000, "Competing for capital in a 'lumpy' world", *Journal of Public Economics*, 78 (3), pp. 253-274.

KING, I., McAFEE, P. and WELLING, L., 1993, "Industrial blackmail: dynamic tax competition and public investment", *Canadian Journal of Economics*, 26 (3), pp. 590-608.

KRUGMAN, P., 1991, "Increasing returns and economic geography", *Journal of Political Economy*, 99 (3), pp. 483-499.

LEACH, J., 1996, "Training, migration, and regional income disparities", *Journal of Public Economics*, 61, pp. 429-443.

MARTIN, P., 1998, "Can regional policies affect growth and geography in Europe?", *World Economy*, 21 (6), pp. 757-774.

MARTIN, P., 1999, "Are European regional policies delivering?", *European Investment Bank Papers*, 4 (2), pp. 10-23.

MARTIN, P. and ROGERS, C., 1995, "Industrial location and public infrastructure", *Journal of International Economics*, 39 (3-4), pp. 335-351.

MAURER, B. and WALZ, U., 2000, "Regional competition for mobile oligopolistic firms: does public provision of local inputs lead to agglomeration?", *Journal of Regional Science*, 40 (2), pp. 353-375.

OECD, 2002, *Education at a Glance 2002*.

OTTAVIANO, G. and PUGA, D., 1998, "Agglomeration in the global economy: A survey of the 'new economic geography'", *World Economy*, 21 (6), pp. 707-731.

PUGA, D., 2002, "European regional policies in light of recent location theories", *Journal of Economic Geography*, 2 (4), pp. 372-406.

RICHTER, W. and WELLISCH, D., 1996, "The provision of local public goods and factors in the presence of firm and household mobility", *Journal of Public Economics*, 60, pp. 73-93.

RIOUX, L. and VERDIER, T., 2002, "Human capital, local labor markets and regional integration", in HAIRAULT, J.-O. and KEMPF, H., *Market imperfections and macroeconomic dynamics*, Kluwer Academic Publishers, pp. 23-49.

SAMUELSON, P., 1954, "The transfer problem and transport costs, II: Analysis of effects of trade impediments", *Economic Journal*, 64, pp. 264-289.

SAXENIAN, A., 1994, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press.

SIMONIS, D., 2002, "The New Economic Geography: a survey of the literature", *Bureau Fédéral du Plan (Brussels)*, Working Paper 16-02.

TAYLOR, L., 1992, "Infrastructure competition among jurisdictions", *Journal of Public Economics*, 49, pp. 241-259.

THARAKAN, J. and TROPEANO, J.-P., 2002, "On the impact of labour market matching on regional disparities", *Cahiers MSE*, 2002-83.

TIEBOUT, C., 1956, "A pure theory of local expenditures", *Journal of Political Economics*, 64, pp. 416-424.

WALZ, U. and WELLISCH, D., 1997, "Strategic provision of local public inputs for oligopolistic firms in the presence of endogenous location choice", in WILDASIN,

D. (ed.), *Fiscal aspects of evolving federations*, Cambridge University Press, pp. 120-138.

WEBB, M., 1985, "Migration and education subsidies by governments. A game-theoretic analysis", *Journal of Public Economics*, 26, pp. 245-262.

WHEELER, D. and MODY, A., 1992, "International investment location decisions. The case of U.S. firms", *Journal of International Economics*, 33 (1-2), pp. 57-76.