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The Spatial and Public Economics of Regions, a Theoretical and Empirical Survey

Fabien Candau

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Abstract

The aim of this paper is to survey what has been done by the New Economic Geography (NEG) on a regional scale in order to answer the three following questions: what are the predictions of the NEG concerning the future of regions in the triad? Are these predictions robust? What can be the optimal public policy on a regional and national scale in a world characterized by agglomeration, trade liberalization and entrepreneurs' mobility?

JEL classification: H00; R58; F12

Keywords: Economic geography; Growth; Region; Public policy.

1 Introduction

« Consider a general equilibrium model in which an arbitrary number of goods is produced either as inputs or for final consumption. The only nonproduced goods are land and labor, each of which is assumed to be homogeneous. Assume that each production function has constant returns to scale and that all input and output markets are competitive [...] Under these circumstances, consumers would spread themselves over the land at a uniform density to avoid bidding up the price of land above that of land available elsewhere. Adjacent to each consumer would be all industries necessary directly or indirectly to satisfy the demands of that customer. Constant returns assures us that production could take place at an arbitrary small scale without loss of efficiency. In this way, all transportation costs could be avoided without any need to agglomerate economic activity » Edwin S. Mills (1967, p198)

In this quote extracted from a section entitled "A World without Cities", Edwin Mills intuitively describes what is going to be called some years later the Spatial Impossibility Theorem. This theorem, that we owe to Starrett (1978), simply says that agglomeration of activities cannot arise in a world of pure and

perfect competition where space is homogeneous. Thus in order to understand why activities are agglomerated in some places authors have focused on¹:

1. Localized externalities (Marshall (1890))
2. Heterogeneity of space (von Thünen (1826)), Ricardo (1917), Heckscher (1918) and Ohlin (1933)
3. Imperfect competition (Hotelling (1929))

More recently, a new approach born with Fujita (1988), Krugman (1991.a) and Venables (1996), has revisited this problematic of "Who does What, Where and Why?". That literature which makes the heterogeneity of space endogenous by integrating pecuniary externalities and imperfect competition starts from the same observation that activities are unevenly spread in space. As a very crude approximation, Figure 1² illustrates how that statement is obvious, a significant part of the world being agglomerated in huge cities and this agglomeration increases from year to year³.

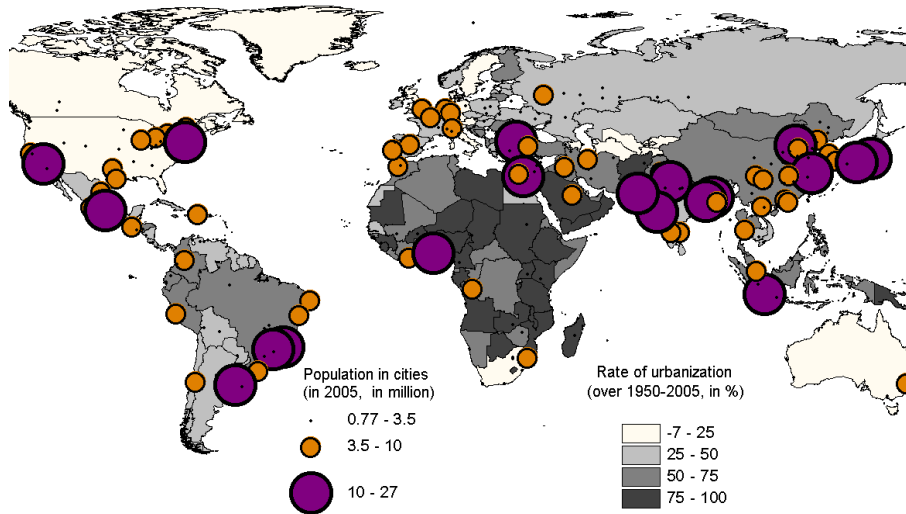


Figure 1 – Urban population and rate of urbanization growth

The questions arise by these observations are relative to the conditions of agglomeration: a) what are they?; b) Can these conditions vanish in the future?; c) What is the place of governments in a world characterized by agglomeration, trade liberalization and mobility of firms? Here we focus on models that deal

¹For a survey of these three determinants see Fujita and Thisse (1996) and Ottaviano and Thisse (2005)

²Source: Author's calculation based on the World Urbanization Prospects (Department of Economic and Social Affairs).

³For instance the rate of urbanization growth in half a century will be around 75% in a majority of African countries

exclusively with entrepreneurs' mobility⁴. In order to emphasize the evolution and progress of the NEG in part due to a recent but intensive dialogue between empirical and theoretical studies we proceed in four steps: the first one examines the main results of the theoretical field, while the second presents articles which question these conclusions empirically. The third step emphasizes the theoretical refinements that have been introduced and lastly the fourth part focuses on public policy and most particularly on welfare, tax competition and investment in R&D.

2 From dispersion to agglomeration, the initial theoretical considerations

« *The more populous region will offer both a greater real wage and a greater variety of goods. In equilibrium all workers will have concentrated in one region or the other. Which region ends up with the population depends on initial condition; in the presence of increasing returns history matters* » Krugman (1979, p.478)

This first part presents models where entrepreneurs are i) immobile between sectors, mobile geographically ii) mobile between sectors but immobile between regions iii) mobile between regions and at the source of endogenous growth.

2.1 Regional factor mobility

2.1.1 Consumers' behavior

All individuals in the Krugman (1991.a) model share the constant-elasticity-of-substitution utility function of Avinash Dixit and Joseph Stiglitz (1977):

$$U = M^\mu A^{1-\mu} \quad \text{with} \quad M = \left[\int_0^N c_i^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

where M is the consumption of the manufactures aggregate, A of the agricultural product, N is the large number of potential varieties and $\sigma > 1$ is the elasticity of substitution among these varieties. A share μ of nominal income (denoted Y) is spent on manufactures. The budget constraint is then given by:

$$PM + p_A A = Y$$

where p_A is the price of the agricultural product and P the price index of industrial varieties:

$$P = \left[\int_0^N p_i^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} \quad (2)$$

⁴Models that deal with capital mobility have been widely surveyed in Baldwin et al. (2003). Since the publication of this monograph no significant improvements have been made except one concerning the heterogeneity of firms which is the subject of a large digression.

which is a decreasing function of the number of varieties N (because $1 - \sigma < 0$). p_i is the price of a typical variety i . The impact of N on the price index depends on the elasticity of substitution. The more differentiated the product varieties, the greater the reduction in the price index. The maximization problem yields the following uncompensated demand for agriculture and manufactures:

$$M = \mu \frac{Y}{P}, \quad A = (1 - \mu) \frac{Y}{p_a} \quad (3)$$

$$c_i = \mu \frac{Y}{P^{1-\sigma}} p_i^{-\sigma} \quad (4)$$

We can now turn to the firms' behavior.

2.1.2 Firms' behavior

Concerning the cost function, many types of modelling have been adopted, firstly Krugman (1991.a) considers in its Core-Periphery model (CP for short) that there are specific factors: entrepreneurs are the only input necessary to the production of a typical variety with a technology that involves a fixed input of α and a marginal requirement of β . The cost function is thus given by $TC_{CP} = \alpha w_h + \beta w_h q$. Secondly in their Footloose Entrepreneurs model (FE for short), Forslid and Ottaviano (2003) consider that the fixed cost and the marginal cost are associated with different factors: the fixed cost involves α units of entrepreneurs while the variable cost requires β units of workers. Thus the total cost of producing q units of a typical manufactured variety is $TC_{FE} = \alpha w_h + \beta w_a q$. To sum up we can write these total costs in a general form such as:

$$TC = \alpha f + \beta m q \quad (5)$$

with $(f, m) = (w_h, w_h)$ in the CP, $(f, m) = (w_h, w_a)$ in the FE.

Because each firm produces a distinct variety, the number of firms is also the number of varieties consumed. Thus each firm is a monopolist on the production of its variety, and faces the demand function (4). But a key feature of the Dixit-Stiglitz monopolistic competition is that firms ignore the effects of their action on income Y , and on the price index P . Hence the demand curve as perceived by a typical firm is not (4), but rather $q = b p^{-\sigma}$ where $b = \mu Y / P^{1-\sigma}$ is considered as a constant by each firm. According to this behavior, when maximizing its profit, a typical firm sets the following price:

$$p = \beta m \sigma / (\sigma - 1) \quad (6)$$

Because there is free entry, profits are always equal to zero, which, using equations (5) and (6), gives the output level:

$$q = \alpha f (\sigma - 1) / \beta m \quad (7)$$

In equilibrium in the CP model a typical firm employs $\alpha f + \beta m q$ entrepreneurs, so that the total demand is $n(\alpha f + \beta m q)$, which according to (7) is equal to

$n\alpha\sigma$. As entrepreneurs' labour supply is given by S , the equalization provides the following number of varieties: $n_{CP} = \frac{S}{\alpha\sigma}$. In the FE a typical firm employs α units of entrepreneurs, so that the total demand is $n\alpha$. As entrepreneurs' labour supply is also S , the equalization gives the following number of varieties: $n_{FE} = \frac{S}{\alpha}$. In summary:

$$n = \frac{S}{\varepsilon} \quad (8)$$

with $\varepsilon = \alpha\sigma$ in the CP, $\varepsilon = \alpha$ in the FE. The number of varieties produced is then proportional to the number of workers.

2.1.3 Transaction costs

So far, the model has almost been described as a closed economy. The next step is to relax this assumption. Industrial varieties are exchanged between regions under transaction costs which take the form of iceberg costs: if an industrial variety produced in the Northern market is sold at price p there, then the delivered price (c.i.f) of that variety in the South is going to be τp . The assumption of iceberg costs implies that firms charge the same producer price in both regions. The first-order conditions for a typical firm's sales on its local market and on its export market are $p = \beta m\sigma/(\sigma - 1)$ and $p^* = \tau\beta m\sigma/(\sigma - 1)$, but in all models authors assumed that $\beta = (\sigma - 1)/\sigma$, which gives

$$p = m, \quad p^* = \tau m$$

This normalization and the fact that wages in the agricultural sector are taken as the numeraire and normalized to one, simplify prices, which only depend on entrepreneurs' wages in the CP and which are equal to one in the FE. Furthermore the entrepreneurs' total number is also normalized to one: $S + S^* = 1$.

Then, iceberg transaction costs imply a modification of the price index. Using the above normalization the authors find:

$$P^{1-\sigma} = \frac{Sm^{1-\sigma} + \phi S^* m^{*1-\sigma}}{\varepsilon}, \quad (P^*)^{1-\sigma} = \frac{Sm^{1-\sigma} + \phi S^* m^{*1-\sigma}}{\varepsilon} \quad (9)$$

where ϕ measures the free-ness of trade : $\phi = (\tau)^{1-\sigma}$. This degree of trade increases from $\phi = 0$ with infinite trade costs, to $\phi = 1$, with zero trade costs. *Ceteris paribus*, at the symmetric equilibrium ($S = 1/2$), an increase in S (and so a decrease in S^*) implies, as long as there are transaction costs ($\phi < 1$), an increase in price index in the South and a decrease in price index in the North.

We now need to integrate transaction costs into the demand function. By inserting the above prices (6) in the demand function (4), and by considering the total demand as the sum of local demand and export demand, we get:

$$q = \mu \left(\frac{Y}{P^{1-\sigma}} p^{-\sigma} + \phi \frac{Y^*}{P^{*1-\sigma}} p^{-\sigma} \right) \quad (10)$$

Considering this expression, we have just seen that an increase in the population in the North, increases $P^{1-\sigma}$ and decreases $P^{*1-\sigma}$, and thus fosters a decrease

in the total demand q in the North (if $\phi < 1$). Turning to the effect of a change of income location requires the following equations:

$$Y = Sw_h + Lw_a \quad (11)$$

$$Y^* = S^*w_h^* + L^*w_a \quad (12)$$

An increase in the entrepreneurial force, S , in the North, and thus a decrease in the South, S^* , increases expenditure in this country and lowers it abroad, which causes, as long as there are impediments to trade ($\phi < 1$), an increase in demand q .

These equations permit us to present the market clearing in a tidy form by equalizing the demand (10) to the supply which is given by equation (7) :

$$fm^{\sigma-1} = b\left(\frac{Y}{P^{1-\sigma}} + \phi\frac{Y^*}{P^{*1-\sigma}}\right) \quad (13)$$

with $b = \frac{\mu}{\alpha\sigma}$. The most significant difference between the FE and CP models is that in the CP model, nominal wages cannot be obtained analytically since m , Y , P , f and m depend on w_h while in the FE only f and Y depend on w_h and thus the analytical expression of nominal wages is rather straightforward. The detailed description of the FE is postponed to the section concerning public policy; indeed the tractability of this model is going to be an advantage in this section. For the moment we focus on the CP model which is one of the main tool of section 4. Indeed in this section we are going to consider models which drop agricultural workers, and in such a context the FE total cost function is no longer useful and the interest of the CP model is restored.

2.1.4 Market clearing condition and the long run in the CP

In the CP model, $f = m = w_h$, which gives the following market clearing thanks to (13):

$$w_h^\sigma = b\left(\frac{Y}{P^{1-\sigma}} + \phi\frac{Y^*}{P^{*1-\sigma}}\right)$$

As we have just noticed, nominal wages cannot be obtained analytically, however it is possible to investigate the relationships between price indices and wages by linearizing the model around the symmetric equilibrium (when $S = S^* = 1/2$). Indeed, at the symmetric equilibrium, a modification of one variable in one region is associated with an equal modification of the corresponding variable in the other region, but with an opposite sign, so by letting $\frac{dw_h}{w_h} = -\frac{dw_h^*}{w_h^*} = \widehat{w}_h$ and so on, we get the following expression by way of a log differentiation of price indices and wages:

$$\widehat{P} = \frac{1}{1-\sigma}Z_\phi[\widehat{S} + (1-\sigma)\widehat{w}_h] \quad (14)$$

$$\sigma\widehat{w}_h = Z_\phi(\widehat{Y} + (\sigma-1)\widehat{P}) \quad (15)$$

$$\text{with } Z_\phi = \frac{1-\phi}{1+\phi}$$

where Z_ϕ can be considered as a reversed measure of trade openness: there is autarky when $Z_\phi = 1$, and free trade for $Z_\phi = 0$.

Concerning the first expression (14), and since entrepreneurs' supply of labor is perfectly elastic, $\widehat{w}_h = 0$, an increase in the number of entrepreneurs in the North, \widehat{S} , implies a decrease in the price index in this country. This effect is known as the **local competition effect** (Fujita et al. (1999)) or as the **market crowding effect** (Baldwin et al. (2003)). Concerning the second expression (15), we can eliminate \widehat{P} by using (14); we then divide the two sides of this equation by \widehat{Y} , which gives:

$$\frac{\widehat{S}}{\widehat{Y}} = \frac{1}{Z_\phi} - \left(\frac{\sigma}{Z_\phi^2} + 1 - \sigma\right) \frac{\widehat{w}_h}{\widehat{Y}} \quad (16)$$

thus by considering once again that entrepreneurs' labour supply is perfectly elastic, $\widehat{w}_h = 0$ we get the famous **home market effect** (Krugman (1980)), also known as the **market access-effect** (Baldwin et al. (2003)):

$$\frac{\widehat{S}}{\widehat{Y}} = \frac{1}{Z_\phi}$$

then one percent change in the northern demand for manufactures, \widehat{Y} , increases entrepreneurs' employment, \widehat{S} , by $\frac{1}{Z_\phi} (> 1)$ percent in the North. This effect captures the idea that increasing returns activities tend to concentrate their production near the largest market and export to the smallest. When trade is liberalized (Z_ϕ tends to zero) this effect increases, this can be understood as the fact that the large market serves as a base for exports, and thus when the cost of exporting decreases, the interest of being agglomerated increases. We are going to discuss the pervasiveness of this HME in the next section. Furthermore we can observe that an increase of S increases Y , (see the equation of income (11)). Then the larger manufacturing sector has a larger home market, and since we have just seen that the larger home market has a more than proportionally larger manufacturing sector, these equations provide what Krugman (1991.a) called the **backward linkage** in honor of Hirschman (1958), which is considered as a 'cryptic moniker' by Baldwin et al. (2003) who qualify this mechanism as the **demand-linked circular causality**.

To sum up, two opposite forces drive these relative nominal wages, on the one hand an increase in the number of entrepreneurs in one region exacerbates local competition among firms, thus new entry triggers a slump in the price index, and thereby in operating profits, too, so that in order to stay in the market firms need to remunerate their workers less (local competition effect). But on the other hand as the income generated by the new entrepreneur is spent locally, sales and operating profits increase and under the 'zero profit condition' this implies a higher nominal wage (market access effect). However entrepreneurs do not consider the relative nominal wage when they decide to migrate but the relative real wage. Hence in the long run migration stops when real wages are equalized in case of symmetry ($S = \frac{1}{2}$), or when agglomeration in

one city generates a higher relative real wage. Thus by denoting Ω this relative real wage, and by defining it by:

$$\Omega = \frac{V}{V^*} = \frac{w_h}{w_h^*} \left(\frac{P^*}{P} \right)^{-\mu} \quad (17)$$

where V is the location's total real income in the North, we will have a stable total agglomeration in the North if $\Omega > 1$, and a stable dispersed equilibrium if $\frac{d\Omega|_{S=1/2}}{dS} < 0$.

Let us notice that in the long run (17) one additional force appears: the term P^*/P which is the **cost of living effect**, is known as an agglomerative force. Indeed, we already know that goods are cheaper in a central place because imports are lower and thus the burden of transaction costs too. Hence, entrepreneurs' purchasing power is higher in this location which attracts other entrepreneurs. This is the **cost-linked circular causality** also called **forward linkage**.

2.1.5 The tomahawk diagram

In order to see how the size of regions globally changes with trade liberalization, the literature uses numerical simulations and obtains the Figure 2, called the 'tomahawk diagram'.

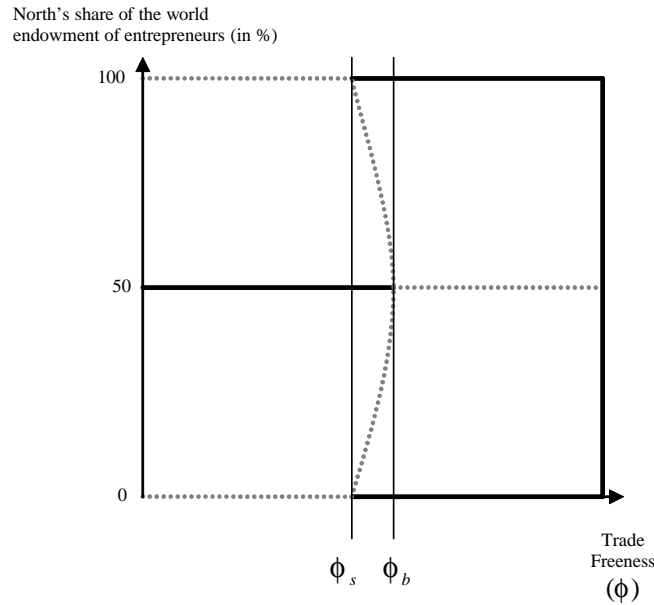


Figure 2 – The tomahawk diagram

In Figure 2, the vertical axis measures the north's share of the world endowment of entrepreneurs, while the horizontal axis plots the trade liberalization level. From Figure 2 two important results can be drawn:

Proposition 1 *Trade liberalization leads to agglomeration*

Indeed before a critical point of trade liberalization⁵ ϕ_s , the negative effects of high transaction costs are too strong to be overtaken by the positive effects of agglomeration, and thus the two regions remain identical. But after this point, agglomeration can occur catastrophically in one of the two regions.

Proposition 2 *Depending on the trade liberalization level, two or three different location configurations are stable equilibria*

Indeed, after a critical point of trade liberalization ϕ_s , and before the critical point⁶ ϕ_b , dispersion of activities in the two regions, or agglomeration in the South, or agglomeration in the North are all stable equilibria⁷. After ϕ_b agglomeration in the North is equivalent to agglomeration in the South.

These two propositions are strong and deserve to be compared to other modelling.

2.2 Sectorial factor mobility

If entrepreneurs' mobility is a central determinant of agglomeration on a regional scale, one can wonder what will happen if this mobility is restricted by immigration law or by cultural divergence. This question has been undertaken by Krugman and Venables (1995) in a model called the Core Periphery Vertical Linkages (CPVL for short). In this model, agglomeration or more exactly specialization is driven by the interest of firms that produce and use intermediate goods. Indeed in a big market these firms find bigger outlets (backward linkage) but also intermediate inputs at a lower price (forward linkage). This model has been simplified by Ottaviano (2002), actually known as the Footloose Entrepreneurs Vertical Linkages (FEVL for short) and a unified version, which we propose to survey here, has been proposed by Ottaviano and Robert-Nicoud (2006). In this last version the authors consider the fixed cost as a Cobb-Douglas function of workers and manufacturing goods which are used respectively in the proportion $1 - \mu$ and μ , while the variable cost is also a Cobb-Douglas function of workers and manufacturing goods but where these two inputs are used in the proportion $1 - \gamma$ and γ ; in such a case the total cost is given by $TC = \alpha w_a^{1-\mu} P^\mu + \beta w_a^{1-\gamma} P^\gamma q$ and as before we can write this total cost in such a general form as:

$$TC = \alpha f + \beta m q \tag{18}$$

with $(f, m) = (w_a^{1-\mu} P^\mu, w_a^{1-\gamma} P^\gamma)$. The CPVL is found by assuming that the share of workers used as a fixed cost and as a variable cost is the same: $\mu = \gamma$, while in the FEVL, the authors assume that firms only use agricultural workers

⁵ ϕ_s is given implicitly by $1 = \phi_s^{\sigma a} (\phi_s \frac{1+\mu}{2} + \frac{1-\mu}{2\phi_s})$ with $a = \mu/(\sigma - 1)$

⁶ This critical point is equal to $\phi_b = \frac{1-\sigma a}{1+\sigma a} \frac{1-\mu}{1+\mu}$

⁷ Stable equilibria are represented by a solid line, as opposed to dashed lines which represent unstable equilibria

as a variable cost: $\mu \neq \gamma = 0$. Agricultural wages are taken as the numéraire and normalized to one. Then in the CPVL we get $(f, m) = (P^\gamma, P^\gamma)$, while in the FEVL we have $(f, m) = (P^\mu, 1)$. The pure profit of the firm, Π , is thus composed of operating profit minus the fixed cost:

$$\Pi = \pi - \alpha f \quad \text{with } \pi = pq - \beta mq \quad (19)$$

By maximizing this pure profit a typical firm sets the following price:

$$p = \beta m \sigma / (\sigma - 1) \quad (20)$$

By assuming that $\beta = \frac{\sigma-1}{\sigma}$ and by inserting this price in operating profit (19) we get:

$$q = \frac{\pi \sigma}{m} \quad (21)$$

By using (20) and iceberg costs into price index yields:

$$P^{1-\sigma} = nm^{1-\sigma} + \phi n^* m^{*1-\sigma}, \quad (P^*)^{1-\sigma} = nm^{1-\sigma} + \phi n^* m^{*1-\sigma}$$

This implies that in the CPVL price indices are defined in a recursive way since $m = P^\gamma$, while in the FEVL this is not the case because $m = 1$.

Turning to sales two kinds of agent need to be considered: on the one hand workers and entrepreneurs consume manufactured goods as final goods, their demand is denoted d_1 and on the other hand firms use these goods as intermediate inputs; their input demand is denoted d_2 . Then the total demand in the North is $c = d_1 + nd_2 + \tau(d_1^* + nd_2^*)$ where d_1 and d_2 are found by applying respectively the Roy identity to the indirect utility, and the Shephard lemma to the total cost function. The market clearing condition is given by equalizing (21) to the total demand c , which gives:

$$\begin{aligned} \pi &= mb \left(\frac{E}{P^{1-\sigma}} + \phi \frac{E^*}{P^{*1-\sigma}} \right) \\ \text{with } b &= \frac{\mu}{\sigma} \end{aligned}$$

with E the total expenditure in the North:

$$E = L + n(1 + (\sigma - 1) \frac{\gamma}{\mu}) \pi$$

The expression of this short run is very close to that displayed by the classic CP model: indeed two opposite forces drive this operating profit, on the one hand an increase in the number of firms in the industrial sector exacerbates local competition between them, thus new entry triggers a slump in the price index, and thereby in operating profits, too. But on the other hand as the revenue generated by the new firm is spent on intermediate inputs, sales and operating profits increase more than proportionally in the presence of iceberg costs (market access effect). However firms do not consider the operating profit when they decide about entry or exit but the pure profit. Hence in the long run,

there is neither entry nor exit when pure profit is equal to zero or by equivalence when $q = \frac{\pi}{\alpha f}$ is equal to the unity. Firms' creation or destruction stop in the North and in the South when respectively $\dot{n} = 0$ and $\dot{n}^* = 0$, where \dot{n} and \dot{n}^* are defined by:

$$\begin{aligned} \dot{n} &= n(q-1), & \dot{n}^* &= n^*(q^*-1) \\ \text{with } q &= \frac{\pi}{\alpha f} \end{aligned}$$

In the two models f is a price index function, then a new agglomeration force occurs in the long run. In the CP/FE model this force was called the cost of living effect, here it is better to call it the production-cost-linked agglomeration (Baldwin et al. (2003)). Indeed we already know that goods are cheaper in a central place because imports are lower and thus the burden of transaction costs, too, hence, the profitability of firms is higher in this location which attracts further entry. As in the CP/FE model, in these two vertical linkage models, the dispersive force, which is strongest when trade is restricted, erodes faster than agglomeration forces with respect to ϕ , then the dispersive equilibrium where the two countries produce manufacturing goods turns into an agglomerative one where only the North or the South produces these items. But the similarity between the two classes of model does not stop here: indeed, the configurations of equilibrium are exactly the same as those described by the Tomahawk diagram (See Figure 2), even the break point and sustain point are identical⁸. Then Proposition 1 and 2 seem to be strong results, and we may wonder if the introduction of forward-looking behavior⁹ and endogenous growth *à la* Grossman-Helpman-Romer could change these results.

2.3 Regional growth

Based on capital mobility, Martin and Ottaviano (1999) and Baldwin et al. (2001) introduce endogenous growth in the NEG framework. This introduction

⁸This result is surprising since these models are quite different, in fact these models are all "isomorphic" as has been demonstrated by Robert-Nicoud (2005): "[these models] can entirely characterized by the same set of equations in the appropriate state-cum-parameter space"

⁹Concerning forward-looking behavior, Krugman (1991b) is the first one to emphasize the importance of expectations versus history, however its model is a pre-economic geographical model. Indeed in the place of pecuniary externalities, technological externalities are used as a central force of agglomeration. Ottaviano (1999) and Ottaviano *et al.* (2002) go one step beyond by linking pecuniary externalities and forward-looking behavior in the linear version of the C-P model while Baldwin (2001) argues that the richness of the C-P model (overlap between break point and sustain point) is a good basis to investigate through numerical simulations the role of expectations in the decision of location. Between these two approaches, Ottaviano (1999) proposed a model which is closed to the FE that we have studied so far, and which mimics C-P's results. From these papers an important conclusion emerges: forward-looking expectations are equivalent to myopic behavior in case of high migration costs, impatience of workers, and weak agglomeration forces; in the opposite case, a specific (agglomerate or dispersive) equilibrium could be locally stable (between ϕ_b and ϕ_s) but globally instable owing to the mere shift in expectation.

has generated a flourishing literature which has been surveyed thoroughly by Baldwin and Martin (2004). But surprisingly models with entrepreneurial mobility take a small place in this literature, only two models, those of Baldwin and Forslid (2000) and Fujita and Thisse (2002), focus on this issue. We propose to survey the latter model, which deals with the FE instead of the CP and thus appears more tractable. Considering this model, the main difference with the FE/CP model comes from the introduction of an R&D sector where entrepreneurs produce a patent which represents industrial firms' fixed costs. The presence of this new sector thus generates spillovers for the industrial sector by increasing its productivity level. In this paper, the authors confirm the conclusion of the Footloose Capital model with endogenous growth: geography and growth are linked, an increase in the growth rate fosters agglomeration and agglomeration improves the growth rate. This R&D sector produces patents under perfect competition and the number of patents produced depends on the capital of past ideas K and on the number of entrepreneurs, S . Thus in the North the number of patents produced is:

$$n = KS \quad (22)$$

where K is determined in an endogenous way by entrepreneurs' spatial distribution, or more precisely by the spatial distribution of personal knowledge $k(j)$ and by the entrepreneurs' interaction intensity. The authors proposed the following form $K = \left[\int_0^{S_r} k(j)^\gamma dj + \eta \int_0^{1-S_r} k(j)^\gamma dj \right]^{1/\gamma}$ where γ expresses entrepreneurs' complementarity in the creation of knowledge and η the nature of spillovers. When $\eta = 1$ spillovers are global, and on the opposite when $\eta = 0$ spillovers are local. Moreover, the personal knowledge of an individual j , $k(j)$, is assumed to be a positive function of the patent stock $n^w (= n + n^*)$ such as $k(j) = \delta n^w$, the authors normalize δ to one and by inserting $k(j)$ into the equation of K they find : $K = N [S + \eta(1 - S)]^{1/\gamma}$. But instead of using $[S + \eta(1 - S)]^{1/\gamma}$ Fujita and Thisse use a more general form denoted $\kappa(S, \eta, \gamma)$ which is assumed to be a convex and increasing function of S with $\kappa(0, \eta, \gamma) = 0$, $\kappa(1, \eta, \gamma) = 1$ and $\kappa(S, 0, \gamma) = 1$. They thus get:

$$K = n^w \kappa(S, \eta, \gamma) \quad (23)$$

The lifetime of patents is supposed to be infinite, the monopoly power of a firm is thus also eternal, so that the variation of the stock of patents in the economy over the time is given by $\dot{n}^w = n + n^*$ and so by using (22) and (23) yields:

$$\dot{n}^w = n^w g(S) \quad (24)$$

where $g(S)$ is the growth rate of variety which depends on entrepreneurs' spatial distribution:

$$g(S) = S\kappa(S, \eta, \gamma) + S^* \kappa^*(S, \eta, \gamma)$$

This expression calls for an important remark : the growth rate follows a U-shape with respect to the number of entrepreneurs. This means that agglom-

eration leads to a higher growth than dispersion¹⁰. Furthermore whatever entrepreneurs' spatial distribution, any policies that make local spillovers global (increase in η) raise the growth rate. These remarks are going to be useful in section 5. Each firm in the R&D sector take as given the capital of past ideas, K , and then considers entrepreneurs' marginal productivity as equal to K . With the equilibrium northern entrepreneurs' wages, given by the average productivity in this region, equation (22) implies that the unit costs of a new patent is equal to $\frac{w_h}{n^w \kappa(S, \eta, \gamma)}$ and since there is free entry, the zero-profit condition implies that this unit cost equalizes wages, which gives:

$$w_h = \Pi n^w \kappa(S, \eta, \gamma) \quad (25)$$

Since there is free entry in the industrial sector, the price of the patent Π equals the asset value of firms that start their production by buying a patent. In order to calculate this asset value, the authors need to specify the nature of spillovers, then they divide their analysis into two steps: firstly, they consider that spillovers are global and then they consider the opposite point of view. In the former analysis, they conclude that the R&D sector is always agglomerated in one country, for instance in the North, while the industrial sector moves from a partial agglomeration in the North to a total agglomeration in this country when trade is liberalized; dispersion is then never sustainable, contrary to the latter case of local spillovers where the process of agglomeration leads the two sectors from dispersion to agglomeration. We consider this last assumption of local spillovers as central and thus we decide to focus on it (we write $\kappa(S)$ instead of $\kappa(S, \eta, \gamma)$). With the help of (22) the number of firms at time t is given by $\dot{n}^w = n_0 S e^{g(S)t}$ where n_0 is the initial number of varieties, by solving the differential and by assuming that the growth rate is constant in time, the authors find that the number of variety in the North is given by:

$$n = \theta n^w \quad (26)$$

where θ represents the share of the North contribution to the growth of the total number of varieties: $\theta = \frac{\kappa(S)S}{g(S)}$. By inserting this number of varieties (26), with $p = 1$ ¹¹ into price index defined by (2) yields:

$$P^{1-\sigma} = (\theta + \phi \theta^*) n^w \quad (27)$$

The equilibrium operating profit in the North is given by $\pi = pq - \beta mq$, and then equal to¹² $\pi = q/\sigma$. All this allows the authors to obtain the asset value of an industrial firm: $\Pi(t) = \int_t^\infty e^{-\gamma(\tau-t)} \pi(\tau) d\tau$, and this asset value gives the

¹⁰Indeed $g(S)$ is symmetric around $1/2$ and when $S = 0$ and $S = 1$ we get $g(0) = g(1) = 1$, and $g' \leq 0$ when $S \leq \frac{1}{2}$. And an increase in η raises the growth rate $g(S)$ which attains its maximal value at $\eta = 1$, in this last case $g(S) = 1$.

¹¹Remember that in the FE we have considered $\beta = (\sigma - 1)/\sigma$, $m = w_a = 1$, then by eq.(6) we obtain $p = 1$.

¹²Where the equilibrium output q is available from the FE model (in (10))

nominal wage since $w_h(t) = \Pi(t)n^w\kappa(S)/\theta$. Thus $w_h(t)$ is given by:

$$w_h(t) = \frac{\mu}{\sigma} \frac{\kappa(S)}{\gamma + g(S)} \left[\frac{E}{\theta + \phi\theta^*} + \frac{E^*}{\phi\theta + \theta^*} \right] \quad (28)$$

where γ is the subjective discount rate of consumers. In this model this subjective discount rate is equal to the equilibrium interest rate¹³. Considering equation (28), expenditure E now is given by:

$$\begin{aligned} E &= L + S\gamma[\chi + W(0)] \\ \text{with } \chi &= \frac{\mu}{\sigma} \frac{E^w}{\gamma + g(S)} \end{aligned} \quad (29)$$

where χ is the entrepreneur initial endowment, and $W(0)$ is the present value of wages given by $W(0) = \int_0^\infty e^{-\bar{r}(t)t} w_h(t) dt$ where $\bar{r}(t)$ is the average interest rate: one unit of income at the time t is converted to $\int_0^\infty e^{-\bar{r}(t)t} w_h(t) dt$ unit at the time 0. With $r(t) = \gamma$ and $w_h(t)$ given by (28) we get $W(0)$. Lastly the ratio of indirect utility is given by:

$$\Omega = \frac{\gamma c + w_h}{\gamma c + w_h^*} \left(\frac{P}{P^*} \right)^{-\mu}$$

The necessary condition in order to prove that agglomeration in the North is a stable steady state growth path (ss-growth path for short) is given by $\Omega > 1$, while $\Omega = 1$ needs to be verified when $S \in (0, 1)$. However this condition is not sufficient here: indeed, the North can have a higher nominal wage while the South can have a lower price index (and *vice versa*) and then entrepreneurs can increase their intertemporal utility by changing their location during their life cycle. As the authors remark, entrepreneurs "convexify their location choices" since their forward looking behavior and their mobility allows them to average their consumption in their lifetime. As a result, the authors show that in the interval $[\phi_s, \phi_b]$ for a given and constant number of entrepreneurs in one region, cross-migration can occur. Concerning the Tomahawk diagram, Figure 3 illustrates what happens when trade is liberalized in unexpectedly¹⁴. For high trade costs, the dispersive ss-growth path is stable but after ϕ_s the symmetric equilibrium becomes a quasi ss-growth path, and lastly after ϕ_b the agglomerative ss-growth path is the only stable one.

¹³Indeed the Euler condition gives $\frac{E^w(t)}{E^w(t)} = r(t) - \gamma$ where $E^w(t)$ represents the worldwide expenditure, and according to the equilibrium output (10) workers' total demand in the industrial sector is equal to μE^w . Moreover in the agricultural sector workers' demand is equal to $(1 - \mu)E^w$, then with L^w the total workers' demand we get $L^w = (1 - \mu)E^w + \mu E^w$, which gives $E^w = L^w$ and since L^w is constant in time, we obtain $\frac{E^w(t)}{E^w(t)} = 0 = r(t) - \gamma$ and thus $r(t) = \gamma$.

¹⁴Since entrepreneurs are forward looking the description of the Tomahawk diagram needs to be made carefully. We can consider that trade policy changes unexpectedly or as the authors argue "another way may be to assume that the transport parameter changes very slowly in comparison with the actual working of market processes, and hence the actual configuration of the economy at each time can be approximated by that of the ss-growth or quasi ss-growth equilibrium under the corresponding value of trade costs".

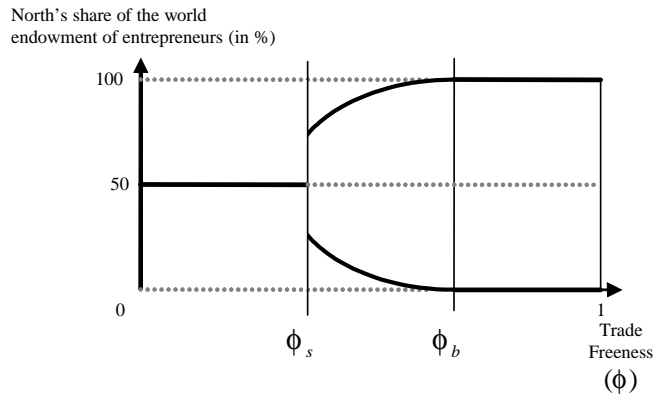


Figure 3 – The tomahawk diagram

Once again we can remark that proposition 1 and 2 still hold: indeed trade liberalization leads to agglomeration (Proposition 1) and even if between the break and sustain point the dispersive equilibrium is not a stable equilibrium as in the FE/CP/VL models, two opposite configurations of location remain stable (Proposition 2). These results are strong and then deserve empirical verifications.

3 The empirical observations

3.1 Questioning Proposition 1

3.1.1 The Japanese case

In order to analyze how the location of the Japanese population has changed over the past 8,000 years, Davis and Weinstein (2002) calculate different measures of the Variation in Regional Density (VRD for short). Regarding this VRD, three central points are remarkable: at first in the early stages of economic development (from -6000 to 300) the VRD is relatively high, in such a case the *first nature* (climate, endowment of resources) explains the agglomeration of the population; secondly from 1721 through 1872, all indicators decrease and this period of dispersion seems to correspond to a period of closure to trade in Japan. Lastly the schift to free trade and the start of the Japan's industrial revolution around the year 1872 is marked by a rise in the VRD which reveals an increase in the concentration of activities. These intuitions are confirmed by Fujita et al. (2004) who point out that from 1920 to 2000, the population's share of the periphery (non-metropolitan areas) decreases from 36.4% to 17.9% while the share of Tokyo increases from 11.8% to 25.1%. However these observations are insufficient, the close study of the net migration of the three largest metropolitan areas (Tokyo, Osaka, Nagoya) and of Theil's measure of the interregional per capita real income differential allow Fujita et al. (2004) to reach interesting conclusions.

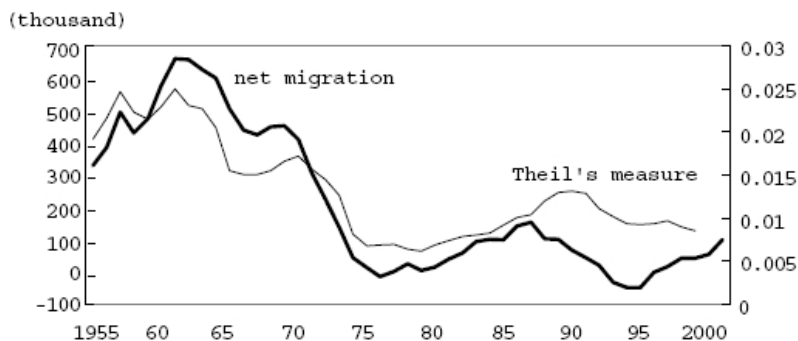


Figure 4 – Net migration and the Theil's measure (Source: Fujita et al. (2004))

From Figure 4 three cycles of urbanization can be defined. In the first one, within the years 1955-1975, the authors consider that the intuitions of the CP model are perfectly verified between 1955 and 1962. Indeed, this period is characterized by an increase in the share of manufacturing industries such as electrical industries or material industries, which have strong increasing returns and technological linkage, but also by a decrease in primary activities and in the internal costs of transportation. However on account of increasing wages and in land prices in these metropolitan areas, the growth rate of net migration clearly decreases around the year 1965. Land rent is thus a central variable that is lacking in the CP model and that we are going to consider in the next section. During the second cycle (1975-1985), the globalization of the world economy and the appreciation of the yen increase competition between Japan, the USA and the newly industrialized countries of East Asia. This exacerbation of competition has led to significant structural change in the Japanese economy. Indeed workers in the periphery, specialized in traditional commodities production, have endured a decrease in their real wages while on the other hand the only one city which enjoyed at the time an international airport and a major concentration of human capital i.e. Tokyo has been able to undertake a specialization in knowledge-intensive activities such as the R&D of high-tech products. Finally the decrease of net migration during the period 1985-95 is in part due to the recession that started in 1990 after the breakdown of the land markets bubbles¹⁵.

3.1.2 The USA case

At global level Kim (1995) is one of the first authors to analyze the distribution of economic activities in the USA on long series, his study over the period 1860-1987 reveals that the regional specialization in manufacturing has first increased until 1947 and next declined by 32.2 %¹⁶. By using the Gini location

¹⁵Concerning the third cycle, Fujita et al. (2004) propose to "interpret it as the 'sinking ship syndrome'; people desperately climb to the top of the ship while it is slowly sinking"

¹⁶This result is obtain at the three-digit level, at the two-digit level the decreasing rate is around 47 % over the period. This indicates a bias in the aggregation.

coefficient, based on the Hoover Location Quotient (LQ for short)¹⁷, this author moreover shows that this specialization and de-specialization seems to be followed by a phenomenon of concentration (between 1860-1927) and dispersion of activities (between 1947-1987). More recently, Holmes and Stevens (2004) confirm this point of view: indeed by calculating the same location quotient for the years 1947 and 1999, they observe that "the term manufacturing belt is no longer appropriate for this area" since the LQ has strongly decreased over the period. On the contrary, the LQ of the residual region has risen from 0.45 to 0.9, which may indicate that a phenomenon of dispersion grows in some places in the US. By analyzing the effects of the NAFTA on American border states, Hanson (2001) found clear evidence of a positive impact on employment in American border states. For him this indicates "that the manufacturing activities that are expanding in U.S. border cities are activities that previously took place in interior U.S. sites, NAFTA is likely to have a larger than anticipated impact on industry location". By focusing on US counties, Hanson (2005) performs a structural test of a competitive model of Krugman's (1991.a), the Helpman (1998) model which displays a dispersion of activities when trade is liberalized (this model is going to be discussed in the next section), and finds that the parameters estimated verify the theoretical hypothesis.

At city level This phenomenon of dispersion is perhaps more evident on an urban scale: Glaeser and Kahn (2004) show that the spreading out of the metropolitan area, commonly known as sprawl¹⁸, is an important feature of the American landscape. For these authors the main explanation of such an evolution is based on the automobile: before this mode of transport big cities

¹⁷Hoover's location quotient is defined by:

$$LQ_{ij} = \frac{E_{ij}}{E_{ius}} / \frac{E_j}{E_{us}}$$

where E_{ij} is employment in the industry i for region j , E_j is total employment in region j , E_{ius} is total employment in industry i , E_{us} is total employment in the USA. Then the Lorenz curve of location disparities is obtained i) by calculating the LQ of one industry i for all regions j ii) by ranking the regions according to their LQs in descending order iii) by calculating the cumulative percentage of employment in industry i over the regions iv) by calculating the cumulative percentage of employment in total manufacturing over the region. If industry i is perfectly dispersed over space, then the location quotient is equal to one, and the location curve follows a 45-degree line, on the contrary if industry i is agglomerated in some regions, then the location curve becomes concave. The Gini coefficient is defined as the area between the 45-degree line and the location curve divided by the triangular area. This Gini coefficient has many drawbacks, and needs to be considered carefully, Ellison and Glaeser (1997) and Maurel and Sédillot (1999) highlighted the problem of such classical indices and proposed a better coefficient based on a "dartboard approach" (see Combes et al. 2006 for a survey of these coefficients).

¹⁸The concept of sprawl can be considered under two distinct forms, the first one links high job decentralization with high population density. A metropolitan area can be composed of several employment subcenters where each subcenter is dense, the second one, the most common, considers that high decentralisation is linked with low density. In other words subcenters have a lower density than the initial center. Glaeser and Kahn (2004) show that this second version of sprawl tends to dominate.

were located around ports and railroad hubs¹⁹, but the introduction of cars has eliminated or decreased the interest of being agglomerated in the core of these urban giants. With Margo (1992), the authors also concede that rising American incomes have generated a higher demand for land, thus the concomitance of a mode of transport that reduces distance and the ability to obtain a larger lot land size tends to foster a decrease in the density of the agglomeration. The main question is to know whether this sprawl is caused by efficient market or by distortions. For instance, the lack of marginal cost pricing in transportation can distort the price of road travel, then the use of the automobile becomes artificially too cheap, which can generate excessive urban sprawl (Walter (1961)). Thus, fighting against urban sprawl can be a good policy in this case. In an important work, Burchfield et al. (2005) also analyze the causes of urban sprawl by using satellite photography data and through this "portrait from space" they observe that urbanized land has increased from 1.30% to 1.92% over the period 1976-1992, which can appear relatively small, however as has been emphasized by Anas and Rhee (2003), the annual growth rate which is equal to 2.48% represents 2.5 times the annualized growth rate of the population. Thus what are the causes of this urban sprawl? Burchfield et al. (2005) identify a large panel of causes which are i) the specialization of cities in sectors where jobs are not located near the city center ii) the provision of infrastructures that are appropriate for cars than for public transports iii) the slow population growth and the uncertainty about the future of this growth iv) geographical elements that are in favour of urban sprawl, such as no mountains or rugged land in the fringe, but also a temperate climate (considering the last factor, and in order to get two indices of extreme climate, the authors use the cooling degree days, which reflect the demand for air conditioning, and the heating degree days, which represent the demand for fuel. They show that their sprawl index can be reduced by respectively 6.512 and 4.986 points by a one standard deviation increase in mean cooling days and heating days) v) the availability of ground water (this factor is important since it reflects the indivisible public facilities that are present in the agglomeration. For instance, the authors report that in San Antonio, the Water System charges developers of the periphery fees that can attain \$24,000. In common language these areas are on a "bad line", which means that they are far from all connection points, then the presence of ground water availability can permit to reduce costs by sinking and thus avoid the connection to the public supply. As a result they find that the sprawl index increases by 1.222 points with water ground availability) vi) the presence of land beyond municipal boundaries favours sprawl since it allows the developer to deviate from the city's regulation²⁰.

¹⁹ A look on the map presented in the introduction can indeed illustrate that a majority of huge cities such as New York, Sao Paulo, or Lagos are ports, while others such as Paris, or Moscow are well-known to be the hubs of all transportation infrastructures.

²⁰ Concerning the causes of agglomeration Kim (1997) pursues his study of concentration and specialisation in cities' data, and demonstrates that a city's manufacturing structure reflects that of the region to which it belongs. For this author this fact indicates that concentration is ruled by regional comparative advantage rather than by increasing returns or scale economies.

3.1.3 The EU case

At global level Forslid et al. (2002) are the first to simulate a NEG model at a very global level. Their model based on Haaland and Norman (1992) considers three kinds of factors: physical capital, human capital (entrepreneurs) and labour, which are mobile between the 14 sectors taken into account but not between the 10 regions chosen. Among the 14 sectors, energy and agriculture are in pure and perfect competition and use sector-specific natural resources which lead to decreasing returns to scale with respect to the three production factors in this sector. The ten other sectors are increasing-returns-to-scale activities which evolve under monopolistic competition. The authors analyze the impact of trade liberalization on four of the ten regions, which are northern Europe (Finland, Iceland, Norway, Sweden), the southern EU (Greece, Italy, Portugal, Spain), the western EU (Benelux, Ireland, France, the UK) and the central EU (Austria, Denmark, Germany, Switzerland). The most significant change in the location of production, concerns textile, leather products, and food stuffs. For those three sectors, comparative advantages seem to be the reason for agglomeration. Indeed, textile and leather industries move toward the South which has a labour comparative advantage, while food industries which have become more and more intensive in capital, have left the southern EU for the North and the West. Concerning the most important increasing-returns-to-scale activities which are metals, chemicals, transport equipments and machinery, they all seem to follow a non-monotonous relationship between trade liberalization and agglomeration. The last result is confirmed by the calculation of a concentration index which is very clearly bell-shaped with respect to trade openness. The main criticism that can be levelled at this model lies in the fact that parameters used in simulations are not estimated but chosen in an ad-hoc way which is why these results should be considered with great care.

At the national level

« Modelling the desirability of variety has been thought to be difficult, and several indirect approaches have been adopted. The Hotelling spatial model, Lancaster's product characteristics approach, and the mean-variance portfolio selection model have all been put to use. These lead to results involving transport costs or correlations among commodities or securities, and are hard to interpret in general terms. We therefore take a direct route » Dixit and Stiglitz (1977, p297)

« A universal adoption of the assumption of monopoly must have very destructive consequences for economic theory » John Hicks (1939, p. 83)²¹

The importance of natural comparative advantage is also emphasized by Ellison and Glaeser (1999), who estimate that this advantage can account for 50% of the geographic concentration of activities

²¹Quoted by Neary (2000, p.3)

Dixit and Stiglitz (1977) emphasize that they will propose a ‘direct route’ to model diversity; now this direct route is the most travelled, but the Dixit-Stiglitz monopolistic competition has some drawbacks: firms have a myopic behaviour when they neglect the impact of their individual decisions on the industry’s price indices. Neither do they take into account the impact of their own pricing behaviour on income (what’s d’Aspremont et al. (1996) called the "Ford effect"). Already pointed out by Bain (1967), and confirmed by Head and Mayer (2004) for who « oligopolistic markets seem empirically more important than those that combine atomism with product differentiation », this lack of interaction among firms does not appear totally satisfying. According to this, Combes’s work (1997) is of interest since it conciliates economic geography with strategic behaviour among firms in an oligopolistic model. Moreover his goal to integrate interaction leads this author far away from the modelling presented before, indeed the preference for diversity is given up and workers are not mobile ; unemployment is assumed and the equilibrium after a shock is restored by an adjustment of the quantity of workers employed in each market (wages are rigid). Then agglomeration implies stronger competition since the goods produced are homogeneous, but also implies an increase in employment and then a higher demand. In such a setting the author shows that in the long run, the conclusion of the CP model holds, agglomeration occurs endogenously when increasing returns are high and when trade is liberalized. Combes and Lafourcade (2001) enrich this model by integrating vertical linkages in firms, accordingly the agglomeration incentive becomes even stronger since the need for intermediate inputs increases demand, and since the Cournot competition lowers the price of these intermediate inputs and thus production costs. By extracting from this theoretical framework a specification that is structurally estimable the authors are able to test their model (which is not rejected) and next to use the results of these estimations in order to make numerical simulations. This model is assessed in 64 French sectors over the period 1978-1993. Their simulations indicate the firms’ mark up is higher in Paris and in other agglomerated location than in the Periphery. Yet, the level of sales is even higher in these central places, indeed simulations show that profits decrease monotonically with distance from the French capital. Lastly the authors simulate the impact of a 30% reduction in transaction costs and show that after such a shock, profits in Paris but also in Lyon reach a peak. This last result and the variation after the 30% shock of a concentration indicator²² (calculated at regional and national level) seem to indicate that the agglomeration process decreases on a national scale but increases on a regional scale. Moreover a similar analysis has been undertaken by Teixeira (2002) on Portuguese data, and the author drew a very similar conclusion. In a complementary way, Crozet (2004) shows that agglomeration forces are limited in space. In the case of Germany and Italy, the activities that the Lombardy and Bavarian regions can attract are located within a radius of approximately 100 to 150 km. Lastly Redding and Sturm (2005) worked on German cities’ data over the period 1919-2002 and find that

²²Glaeser and Ellison (1997) coefficient

during the forty years of German division the cumulative differential of growth between border cities and other West German cities is around 30%. All this may indicate that the Core-Periphery conclusion of agglomeration when trade costs decrease is well adapted to the regional scale but perhaps not to the national scale.

At city level Lastly we can remark that the urban development of some European capitals seems to follow a reversed U-curve. For instance Brakman et al. (2005) show that the population of Madrid and Dublin has increased between respectively 1900-1970, and 1840-1970, but since the seventies these two cities experienced a decrease in their population to the advantage of their Periphery. Moreover Marchand (1993) notes that the first/closer Parisian suburb (called Petite Couronne) and the second suburb (Grande Couronne) increased to the detriment of the center over the period 1920-1990.

3.2 Questioning Proposition 2

The previous studies seem to conclude that the agglomeration of activities has followed a reversed U-curve since the industrial revolution, thus the question remains as to whether multiple equilibria are theoretical curiosities or if a region which hosts the agglomeration of activities can become peripheral after a significant shock. In order to test this, Davis and Weinstein (2002) calculated the Rank Correlation (RC) between the regional density in a given year and the regional density in 1998. If we plot this RC over the period, we can remark that the shape of this curve is impressively flat. Indeed, in the year 725 this RC was around 0.70 and attained monotonically 1 in 1998, which means that after significant structural changes which have brought the Japanese economy from the feudal regime to the modern era, the rank of regions has remained approximately the same. This result suggests that radical change are not so frequent, agglomeration in one location seems to be a stable equilibrium. Moreover, in order to isolate one temporary shock that can lead to a multiplicity of equilibria, Davis and Weinstein (2002) analyzed the effects of the U.S. bombing campaign against Japanese cities. They strictly reject the hypothesis that the growth of cities' size follows a random path, in other words a temporary shock does not have a permanent effect, indeed cities recovered their initial population 15 years after the shock²³. David and Weinstein (2004) go beyond this result by analyzing a more detailed database: they found that cities not only recover their population but also their specialization. Those results need to be taken with great care because Japan is a small country where the mountains and the sea restrict people's location. However, they are an indication that agglomer-

²³This result is confirmed by Dumais et al (2002) on US county data over the period 1972-1992. An interesting observation made by these authors and confirmed by Barrios et al.(2005) on Irish and Portuguese data is that although regional agglomeration is stable, firms' mobility between region is high, a possible explanation is that dead firms are replaced by firms which come from other regions.

ation is a stable equilibrium²⁴. And that is all the more so as Brakman et al. (2004) find a similar conclusion concerning the impact of the shock of the allies' bombing on the growth of Germany cities. However by making a distinction between the West and East Germany they show that the effect of the shock was only temporary in West Germany and had a permanent effect in East Germany. This result suggests that public policies can have a significant impact on the existence of multiple equilibria. Indeed the policies of the two governments were very different, while the Federal Republic of Germany (FRG) wanted to promote a reconstruction of the country, the German Democratic Republic (GDR) focused on the creation of new attractive areas like Eisenhüttenstadt or NeuHoyerswerda. However, the authors do not confirm this suggestion: the introduction of the Federal Republic of Germany aid to reconstruction into the assessment tends to show that the FRG policies have hindered the adjustment process through the return of the pre-war relative city-size. The explanation of such a result is that the most heavily hit cities were not those which benefited from the most significant aids. More investigations seem necessary; the authors do not include the GDR's support in their regression and thus they do not explain why the shock has been permanent in East Germany.

4 From agglomeration to dispersion, theoretical refinements

Empirical investigations seem to relativize some conclusions of the FE model, in particular dispersion seems to occur after agglomeration, then we propose to examine some extensions or criticisms, such as the weakness of the Home Market Effect, the introduction of heterogeneity, and the integration of land rent and commuting costs.

4.1 The weakness of the home market effect

*We have been able to work only with a highly specialized example, it is probable, however that "home market effects" of the kind we have illustrated here are actually quite pervasive. Helpman and Krugman (1985, p. 209)*²⁵

As we have seen, the Home Market Effect (HME) is one of the pillars of the NEG, thus an important issue is to check the robustness of this effect. This test has been initiated by Head et al. (2002) who found that the HME is pervasive

²⁴We can cast doubt about the fact that this study attains its aim to prove that there is no multiple equilibria for two reasons, at first the fact that agglomeration is permanent perhaps only means that the shock was not enough high (in order to verify this, it is perhaps possible to estimate the shock and then to simulate it), secondly Davis and Weinstein want to know if agglomeration and dispersion are multiple equilibria after the second war, but in the theoretical model this happen only for a small range of ϕ ($\phi \in [\phi_s, \phi_b]$) and perhaps the Japanese trade liberalization was not in this interval during the period analysed.

²⁵Quoted by Head, Mayer and Ries (2002)

in the sense that this effect exists in a model without product differentiation but with strategic competition between firms (the Brander (1981) model) and remains verified when iceberg transaction costs and Dixit-Stiglitz preferences are relaxed (Ottaviano et al. (2002)). However, by using the Markusen and Venables (1988) model these authors demonstrate that the introduction of the armington assumption in the increasing returns activities is not innocuous concerning the HME. The reason for such a result is that in a world with no firms mobility, national product differentiation protect one from competition, but entrepreneurial mobility increases local competition. Indeed, when an entrepreneur migrates from the South to the North his status switches from being an imperfect competitor to being a perfect competitor for other entrepreneurs in the North. This tends to decrease wages and thus the incentive of agglomeration.

More recently Head and Mayer (2004) asked several other relevant questions concerning the home market effect such as:

« How do we construct demand measures in the presence of more than two countries? Indeed how does one even formulate the home market effect hypothesis? The ratios and shares of the theoretical formulations neglect third country effects »

These questions have found an answer in the theoretical paper of Behrens et al. (2004). The authors extend the Krugman (1980) model to a multicountry set-up, and demonstrate that the home market effect exists in such a framework only when countries have a symmetrical bilateral protection. This situation, which is highly implausible, raises the question of the real existence of the HME. Until now empirical works, such as those of Davis and Weinstein (1999,2003), have approximated the HME by an index which is far from the theoretical framework which leads Behrens et al. (2004) to write that "this regression coefficient is hard to interpret clearly". In other words, more than 25 years after its theoretical discovery, the HME only starts being tested seriously (see Crozet and Trionfetti (2005)). In the following we will survey how the weakness of the HME in the framework of the NEG changes the conclusions.

4.1.1 Imperfect elasticity of substitution of the labor supply

The HME is easily understandable: because of transport costs it is more profitable to produce in the country offering a larger market, and to export to the other. Which is harder to explain is the fact that this HME increases with respect to trade liberalization. Indeed the equation (16) of the HME, reported below for convenience (30), clearly shows that when the elasticity of the labor supply is equal to zero ($\frac{\hat{w}}{\hat{\varphi}} = 0$) then the HME becomes equal to $\frac{1+\phi}{1-\phi}$ and thus increases in ϕ . This paradoxical result comes from the fact that the dispersive force of the market crowding effect disappears when trade is liberalized, thus the difference in the size of the demand becomes more and more significant in determining the choice of location as trade gets freer. This effect emphasized by Baldwin (2000) is known as the **magnification effect of globalization**.

This author remarks that this "magnification effect emphasizes the tendency for a general lowering of natural and manmade barriers to trade to make the remaining barriers and discrimination more important, not less important".

$$\frac{\widehat{h}}{\widehat{Y}} = \frac{1}{Z_\phi} - \left(\frac{\sigma}{Z_\phi^2} + 1 - \sigma\right) \frac{\widehat{w}}{\widehat{Y}} \quad (30)$$

$$Z_\phi = \frac{1 - \phi}{1 + \phi} \quad (31)$$

However this effect is thwarted by a positive elasticity of the labor supply ($\frac{\widehat{w}}{\widehat{Y}} > 0$), indeed the equation (30) shows that an increase in trade liberalization (decrease in Z_ϕ) makes the impact of the demand (\widehat{Y}) stronger on nominal wage (\widehat{w}) and this tends to reduce the HME. In Figure 5, we follow Head and Mayer (2004) by plotting the numerical simulations of the equation (30), the horizontal axis measures ϕ , while the vertical axis displays $\frac{\widehat{h}}{\widehat{Y}}$ i.e the HME. Then we can verify that the monotonically increasing HME with respect to trade liberalization (the magnification effect) only holds when the elasticity of the labor supply tends to zero. When that elasticity is high (0.04), the HME vanishes.

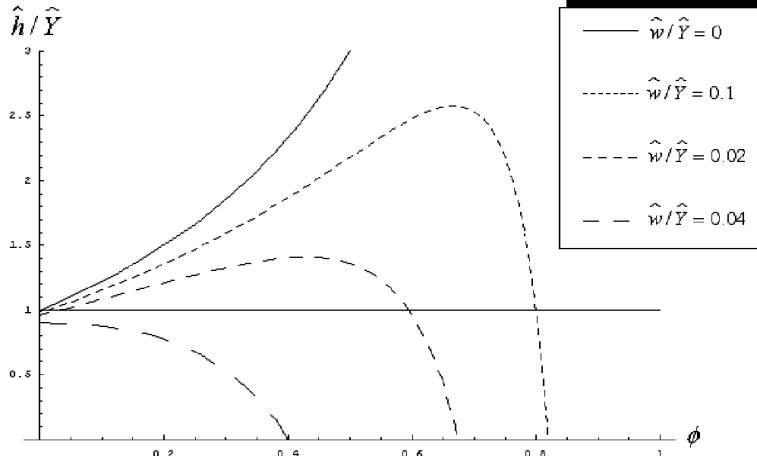


Figure 5 – The Home Market Effect

In the CP model this elasticity is equal to zero since it is assumed that labour is specific to each sector. By introducing arable land into the production of agricultural goods, and by assuming that entrepreneurs are not mobile between regions but between sectors, Puga (1999) introduces such an imperfect elasticity of substitution, which decreases the HME and which exacerbates competition between entrepreneurs since firms can now substitute entrepreneurs' labor with land when wages are relatively too high. With this modelling the author shows that the dispersion-agglomeration configuration of the CP is enriched by a dispersion of activities when trade liberalization is high enough²⁶.

²⁶Moreover, unlike the CP and FE, agglomeration (and de-agglomeration) appears gradually.

4.1.2 Other transaction costs

In the FE model, one basic assumption is to consider that homogeneous agricultural goods is trade costless. It is thus important to know if this simplification is central to the conclusion of the CP. We already know from Davis (1998), which is based on Helpman and Krugman (1985) that if the two sectors bear identical transaction costs then the home market effect disappears. By making the same extension on the CP model, Fujita Krugman and Venables (1999) show that the dispersive equilibrium can be stable for all levels of industrial trade costs. As Figure 6.a illustrates there is in fact an overlap of industrial transaction costs between which agglomeration and dispersion are stable, but unlike the initial model there is no break point.

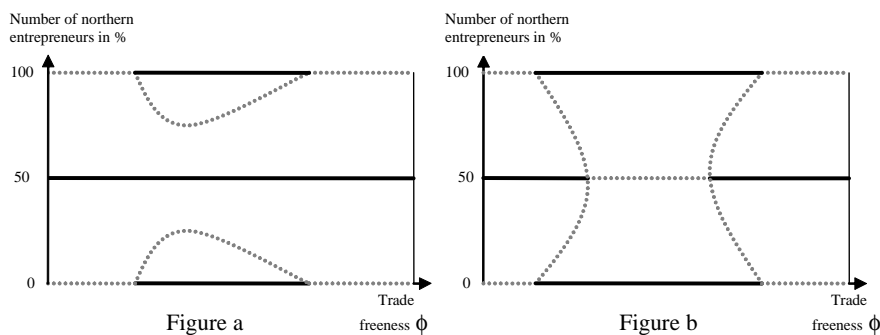


Figure 6 – The tomahawk diagrams

Another interesting extension made by these authors is to integrate a specialization of each country in the production of homogeneous goods, thus they introduce the Armington (1969) assumption into this sector. This introduction gives less categorical results, as Figure 6.b shows the introduction of agricultural transaction costs generates a scenario in three steps, for high industrial trade costs dispersion dominates, for intermediate costs, agglomeration occurs and vanishes for low industrial transaction costs.

4.2 Land rent and commuting costs

« One cannot get rid of land as a factor of production and of rent as a determining element of cost and exchange value » Samuelson ((1957), p2)

The introduction of land rent and commuting costs has been operated mainly by Krugman and Livas (1996), Tabuchi (1998), Helpman (1998), and Murata and Thisse (2005). On the one hand, Tabuchi (1998) added commuting costs and land rent to the seminal model of the NEG and then build a tale between the Core-Periphery of Krugman (1991.a) and the monocentric city of Alonso (1964). On the other hand, Helpman (1998) drops the agricultural sector and

introduces an exogenous housing stock while in Livas and Krugman (1996) the dispersive force of immobile farmers is replaced by entrepreneurs' costly need to commute. In the last model, the authors analyze trade relation between two cities, and between both of them and the rest of the world. Murata and Thisse (2005) simplify this setting by removing the rest of the world. Here, we propose to survey the last analysis. There are two monocentric cities in this model, the North and the South, and only one sector, the Increasing Returns to Scale activity (IRS). Entrepreneurs work in this IRS sector and are mobile between cities, those agents who own one land unit are spread along a line, and because their business is located in the middle of this line (called the Central Business District (CBD)) they need to commute. These commuting costs have a direct impact on their labour force. As each of them owns one labour unit, the total amount supplied by an entrepreneur who lives on the fringe of the CBD (i.e. at location x , the CBD being at location 0 by convention) is:

$$s(x) = 1 - 2\theta |x| \quad (32)$$

where θ (with $\theta < 1$) is the commuting cost level. $|x|$ measures distance from CBD. Furthermore, as the number of entrepreneurs is h , entrepreneurs' maximal distance from the CBD is $\frac{h}{2}$, thus the total labour supply net commuting costs in one city is equal to:

$$S = \int_{-h/2}^{h/2} s(x)dx = h(1 - \theta h/2) \quad (33)$$

In comparison with the CP, replacing S by $h(1 - \theta h/2)$ has modified the force at work, the home market effect given by (16) is now equal to:

$$\frac{\hat{h}}{\hat{Y}} = \frac{1}{Z_\phi Z_\theta} - \left(\frac{\sigma}{Z_\phi^2 Z_\theta} + \frac{1 - \sigma}{Z_\theta} \right) \frac{\hat{w}}{\hat{Y}} \quad (34)$$

where $Z_\theta = \frac{1 - \theta/2}{1 - \theta/4}$ is an inverse measure of commuting costs; there is no commuting cost when $Z_\theta = 1$ and very high commuting costs when $Z_\theta = \frac{2}{3}$ ($Z_\theta \in [\frac{2}{3}, 1]$). Thus by considering once again that entrepreneurs' labour supply is perfectly elastic, $\hat{w} = 0$, we get:

$$\frac{\hat{h}}{\hat{Y}} = \frac{1}{Z_\phi Z_\theta} \quad (35)$$

Hence one percent change in the northern demand for manufactures, \hat{Y} , increases entrepreneurs' employment, \hat{h} , by $\frac{1}{Z_\phi Z_\theta} (> 1)$ percent in the North. The novelty is that here, this home market effect is reduced by commuting costs. Moreover the income earned by entrepreneurs is different to the CP since entrepreneurs earn a land rent and pay commuting costs. As the land rent on both edges of the segment is normalized to zero, with w_h the entrepreneurs' wage near the CBD, then their wage net of commuting costs earned at both edges is:

$$s(h/2)w_h = s(-h/2)w_h = (1 - \theta h)w_h \quad (36)$$

Because consumers are identical in terms of preferences and income, at equilibrium they must reach the same utility level. Thus entrepreneurs who live in the fringe of the segment only receive a net wage of $(1 - \theta h)w_h$, but pay no land rent. On the contrary, workers who live near the CBD do not pay high commuting costs, but the price of the services yielded by land is higher in this location. Thus, the increase in real wage near central places offsets the land rent. A move from the suburb to the CBD implies a decrease in commuting and therefore an increase in the net wage, but also an equivalent increase in the land rent which equalizes utility among individuals. In other words, the following condition must be verified:

$$s(x)w_h - R(x) = (1 - \theta h)w_h$$

where $s(x)$ is the total amount supplied by a worker who lives on the fringe of the CBD, $R(x)$ is the land rent prevailing at x , while the RHS (right-hand side) represents the wage net of commuting costs earned on both edges given by (36). By inserting expression (32) in this system we find the following land rent:

$$R(x) = \theta(h - 2|x|)w_h \quad \text{with } x \in (-h/2, h/2)$$

Thanks to that, we can find the Aggregate Land Rent (ALR):

$$ARL = \int_{-h/2}^{h/2} R(x)dx = \theta h^2 w_h$$

While on the one hand, Tabuchi (1998) assumes that there are absentee landlords, and on the other, Helpman (1998) assumes that the aggregate land rent is owned at global level, here Murata and Thisse (2005) (but also Livas and Krugman (1996)) assume that each entrepreneur owns an equal share of the ALR where they reside. Thus their non salaried income is:

$$ALR/h = \theta h w_h / 2 \tag{37}$$

In comparison with the CP the income of each individual now incorporates the land rent and commuting costs:

$$Y = h(1 - \frac{\theta}{2}h)w_h$$

where $1 - \frac{\theta}{2}h$ comes from the income of land ownership (37) and from the wage net of commuting costs $((1 - \theta h)w_h)$.

From this we can verify that a positive variation of h increases Y , indeed we know by log differentiating this equation of income that:

$$\widehat{Y} = Z_\theta \widehat{h} + \widehat{w}$$

then one percent change in entrepreneurs' employment in the North, \widehat{Y} , increases the northern demand by $\frac{1}{Z_\theta}$ percent (with $\widehat{w} = 0$). Thus the larger manufacturing sector has a more than proportionally larger home market, moreover from

the HME equation (35) we know that the larger home market has a more than proportionally larger manufacturing sector, this is the demand-linked circular causality already emphasized previously. However here this backward linkage decreases with commuting costs.

The last difference with the CP model concerns the migration equation which becomes equal to:

$$\Omega = \frac{w_h}{w_h^*} \frac{1 - \theta h/2}{1 - \theta h^*/2} \left(\frac{P^*}{P} \right)$$

hence the novelty comes from the term $(1 - \theta h/2)$ which enters multiplicatively in the indirect utility, and creates a dispersive force independently of transaction costs which is the **land market crowding effect**.

In comparison with the CP, the conclusion of the model is reversed, agglomeration appears when trade costs are high, but when trade is liberalized, entrepreneurs prefer to be dispersed since this spatial configuration allows them to alleviate the burden of commuting costs. Considering this model, Candau (2006) shows that whatever the value of trade costs the dispersive equilibrium Pareto dominates the agglomerative one.

4.3 Tastes heterogeneity

Murata (2003) and Tabuchi and Thisse (2002), enrich the conclusion of the NEG by introducing taste heterogeneity in the choice of location. This taste heterogeneity is central since the common assumption that all individuals share the same preferences is highly implausible, as the authors point out that some mobile people have a strong attachment to their regions, not only for monetary reasons but also for non market attributes (local or social amenities: the climate, the culture, the family etc...), thus such heterogeneity can weaken agglomeration forces. More precisely, by using a probabilistic migration dynamics borrowed from the discrete choice theory, the authors show that from the dispersion of activities a gradual and partial agglomeration appears before a gradual re-dispersion. Another interesting result suggested by this model is that non-market interests can be higher when individuals reach a certain level of real income, which indicates that people's mobility may decrease with the development level.

4.4 Firms heterogeneity

Until now we have only analyzed entrepreneurs' mobility, however, in many cases entrepreneurs are not mobile, they simply invest in another country and the reward of their capital is repatriated. Martin and Rogers (1995) are the first to analyze such a situation. Their model, where entrepreneurs' mobility is replaced by capital mobility is called the Footloose Capital (FC for short). The FC is very close to the FE, only two differences emerge: entrepreneurs do not own labour but capital thus in all the equations presented for the FE model in the first section the label w_h needs to be replaced by π which is the reward to

capital, and capital mobility is ruled by the following equation:

$$\Omega = \frac{\pi}{\pi^*}$$

where price indices have disappeared since entrepreneurs consume where they reside and not where they invest. Unlike the FE, the fact that the capital is repatriated cuts out demand-linked circularity since the shift in production cannot lead to a shift in expenditure, and also rules out cost-linked circularity since the cost of living effect does not impact on the equation of capital mobility. In terms of conclusion, the FC model does not verify either Proposition 1 (departing from dispersion trade liberalization never generates any agglomeration of the population) or Proposition 2 (there are no multiple locally stable equilibria except for free trade where each location defined by $S \in [0, 1]$ is a stable equilibrium). However, by assuming that countries are asymmetric in size, Baldwin (1999) shows that agglomeration appears gradually with respect to ϕ . This is illustrated by Figure 7 where the dashed line represents the result of this asymmetric FC model. In such a case, the agglomeration rent ($\Omega > 1$) also exists after ϕ^P .

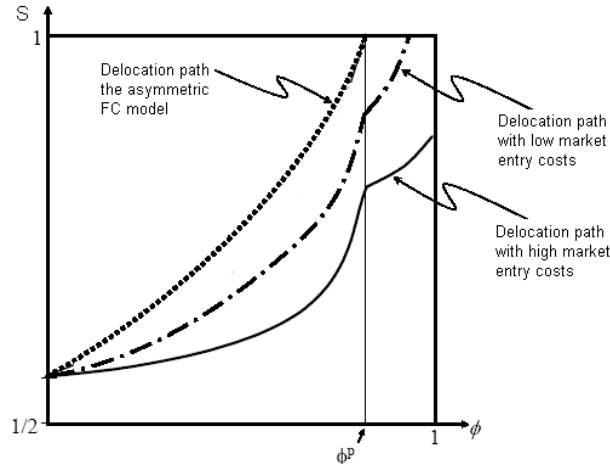


Figure 7 – The tomahawk diagram

However things are different if we integrate the heterogeneity of firms. Such a work initiated by Melitz (2003)²⁷ has been used in the FC model by Baldwin and Okubo (2005). Heterogeneity is introduced via the marginal production costs, now each firm produces a variety with a specific labour input coefficient, denoted β_i for a typical firm i . The innovation technology that permits to obtain a particular β_i is stochastic in the sense that this marginal cost is distributed to a firm randomly. More precisely the distribution of β_i is assumed to be a Pareto probability distribution. Unlike the classical Dixit-Stiglitz model, selling

²⁷see also Bernard et al. (2003), Helpman et al. (2004), Melitz and Ottaviano (2003), Yeaple (2005)

a new variety requires firms to pay fixed costs to enter local and export markets. These ‘beachhead’ costs can be advertising costs, rules of origins (see Demidova et al. (2005)), etc. As a result of such a modelling, three kinds of firms are distinguished: the X-type which profits low marginal costs ranked between 0 and β_X and which pays a beachhead cost F ; this type of firm sells on both the local and foreigner markets. The D-type which produces under intermediate marginal costs ranked between β_X and β_D , and also pays a beachhead cost F , this type of firms is not competitive enough to sell abroad and then they restrict their objective to the domestic market. Lastly the N-type has to produce a variety with high marginal costs ranked between β_D and β_0 ; these marginal costs are even too high to sell varieties on the local market. These beachhead costs which are sunk require firms to take into account their future operating profits, the authors assume that the discount rate is equal to zero and that the firm’ death process follows a Poisson law. With this setting, Baldwin and Okubo consider two polar cases, the case where delocation is very slow and free/entry is fast, which is a simplified version of the Melitz model, and the case where delocation is high and free/entry slow, which is a modified version of the FC model with heterogeneity and beachhead costs. Here we are going to focus on the last case. Authors assume that the North is initially bigger than the South and show that when trade gets freer, the most southern efficient firms first move gradually toward the North, then after a certain level of trade liberalization, denoted ϕ^P , all the X-type firms have moved, and the move of D-type firms begins, if the market entry cost is low enough then a total agglomeration in the North can happen, conversely with a high entry cost only a partial agglomeration occurs. The diagram 7 illustrates these findings.

5 Public Policy

5.1 Individual welfare

Up to now we have only analyzed entrepreneurs’ relative welfare in order to know where they want to reside. Charlot et al. (2006) proposed a deeper analysis by studying the individual welfare of the four interest groups (S entrepreneurs in the North, S^* in the South, L workers in the North and L^* in the South) which are given by:

$$\begin{aligned} V_S(h, \phi) &= w_h P^{-\mu}, & V_S^*(h, \phi) &= w_h^* P^{*-\mu} \\ V_L(h, \phi) &= P^{-\mu}, & V_L^*(h, \phi) &= P^{*-\mu} \end{aligned}$$

since these authors work with the FE model, P and P^* are given by (9) with $m = 1$, $\varepsilon = \alpha = 1$ and thus equal to:

$$P = (S + \phi S^*)^{1/(1-\sigma)}, \quad P^* = (S + \phi S^*)^{1/(1-\sigma)}$$

and w, w^* are found by resolving the market clearing condition (13) with $m = 1$, $\varepsilon = \alpha = 1$, $f = 1$ which yields:

$$\begin{aligned}
w_h &= \frac{bL((\phi S + S^*) + (S + \phi S^*)\phi + bS^*(\phi^2 - 1))}{-(\phi S + S^*)(S + \phi S^*) + b(S^*(S + \phi S^*) + S(\phi S + S^*)) + b^2SS^*(\phi^2 - 1)} \\
w_h^* &= \frac{bL((S + \phi S^*) + (\phi S + S^*)\phi + bS(\phi^2 - 1))}{-(\phi S + S^*)(S + \phi S^*) + b(S^*(S + \phi S^*) + S(\phi S + S^*)) + b^2SS^*(\phi^2 - 1)} \\
\text{with } b &= \frac{\mu}{\sigma}
\end{aligned}$$

The objective is to analyze these expressions under the opposite equilibria of agglomeration and dispersion, and then to compare these equilibria in order to determine which one is the better social outcome.

When all entrepreneurs are located in the North $S = 1 - S^* = 1$, the welfare of this group is given by²⁸:

$$V_S(1, \phi) = \frac{2bL}{1-b} \quad (38)$$

According to this expression entrepreneurs do not care about transaction costs and this is easily understood as they have nothing to import. Immobile workers in the North share the same indifference concerning transaction costs, while in the South these costs have a real importance, their decrease, is welfare-enhancing:

$$V_L(1, \phi) = 1, \quad V_L^*(1, \phi) = \phi^a \quad (39)$$

$$\text{with } a = \mu/(\sigma - 1) \quad (40)$$

Under dispersion entrepreneurs' and workers' welfare is given by:

$$V_S\left(\frac{1}{2}, \phi\right) = V_S^*\left(\frac{1}{2}, \phi\right) = \frac{2bL((1 + \phi)/2)^a}{1-b} \quad (41)$$

$$V_L\left(\frac{1}{2}, \phi\right) = V_L^*\left(\frac{1}{2}, \phi\right) = \left(\frac{1 + \phi}{2}\right)^a \quad (42)$$

An entrepreneur prefers agglomeration to dispersion when $V_S(1, \phi) > V_S(\frac{1}{2}, \phi)$, then by using (38) and (41) we can verify that happens if $\phi < 1$, which means that:

Proposition 3 *Whatever the level of transport costs, entrepreneurs prefer agglomeration to dispersion.*

However this proposition appears specific to the FE or CP models. Indeed on the one hand Ottaviano and Robert-Nicoud (2006) show that entrepreneurs' mobility between regions is essential to that conclusion: actually by using their FEVL where entrepreneurs are intersectorially mobile but cannot move between

²⁸This expression (and some others) differs from Charlot et al. (2005) since authors make different normalizations: $\alpha = 1/\sigma$, $S = \mu$ under agglomeration, $S = \mu/2$ under dispersion and $L = L^* = 1 - \mu$ (see their lemma 2).

nations, they show that this proposition is found in the Core, but not in the Periphery where trade costs need to be sufficiently low in order to verify this result. On the other hand Candau (2006) demonstrates that this proposition depends largely on the dispersive force used, indeed by using the Murata and Thisse (2005) model where the dispersive force of immobile workers is replaced by commuting costs, this author shows that whatever the level of transport costs, entrepreneurs prefer dispersion to agglomeration.

Concerning workers, those in the North prefer agglomeration to dispersion on condition that $V_L(1, \phi) > V_L(\frac{1}{2}, \phi)$. By using equation (39) and equation (42) such a result is obtained when $\phi < 1$. Southern workers prefer agglomeration to dispersion on condition that $V_L^*(1, \phi) > V_L^*(\frac{1}{2}, \phi)$. By using equation (39) and equation (42) such a result is obtained when $\phi > 1$, which is impossible. This implies that whatever the value of trade costs, peripheral workers always prefer dispersion.

This provides the following proposition in the FE:

Proposition 4 *Regional conflict of interests: whatever the value of trade costs, inhabitants of the agglomeration (entrepreneurs and workers) prefer agglomeration while peripheral workers prefer the dispersive equilibrium. Then no agreement is possible for trade liberalization which is a non Pareto improving policy.*

Since the unanimous preference either for agglomeration or for dispersion is impossible, the authors propose to follow Kaldor (1939), Hicks (1940) and Scitovsky (1941) in their costs-benefit analysis. For Kaldor a situation A (Agglomeration) is preferred to a situation D (Dispersion), if the gainers (entrepreneurs) of the reform that lead from D to A (trade liberalization) can compensate for the losers of this reform (workers). Ex-ante the Hicks criterion considers that a situation A (Agglomeration) is better than a situation D (Dispersion), if the losers of the change (D \rightarrow A) cannot bring the gainers to give up this reform. As a result, the Kaldor criterion concludes that the agglomerative equilibrium is socially desirable only when trade costs are sufficiently low, while according to the Hicks criterion agglomeration is always desirable. This means that the former criterion considers dispersion as the best outcome when trade costs are high while the latter argues the reverse. According to the Scitovsky criterion a situation A is better than a situation D only if the two previous criteria agree with that proposition, then here we are typically in a situation of indetermination. Concerning the FEVL, Ottaviano and Robert-Nicoud are confronted with the same indetermination problem. Then the cost benefit analysis does not shed much light on the new economic geography model. In order to remedy to the problem, Charlot et al. turns to Rawls and Bentham. In particular they use the Social Welfare Function proposed by Atkinson (1970), which allows one to distinguish between the Utilitarian and the Rawlsian point of view:

$$W = \frac{1}{1-\eta} [L(V_L)^{1-\eta} + L^*(V_L^*)^{1-\eta} + S(V_S)^{1-\eta} + S^*(V_S^*)^{1-\eta}]$$

where η is the aversion toward inequality: with $\eta = 0$ the government is utilitarian and maximizes the sum of individual indirect utilities while with $\eta = +\infty$

it is Rawlsian, and then maximizes the utility of the worst off. Authors find that the utilitarian government always prefers agglomeration when varieties are sufficiently differentiated, however when these varieties are good substitute dispersion becomes the better equilibrium under a critical value of trade liberalization. Since this critical value is lower than the critical value obtained by Kaldor, a utilitarian government is going to sustain the agglomeration well-founded for a wider range of ϕ than the government advised by Kaldor. Accordingly the authors consider that the utilitarian behavior is biased regarding agglomeration. Ottaviano and Robert-Nicoud find the same result when vertical linkage and trade costs are low in the FEVL. Furthermore in the two models the Rawlsian government is always in favour of dispersion. In other words, the evaluation of the market outcome depends hugely on societal value. Lastly Fujita and Thisse (2002) show that this proposition of regional conflict interests can disappear if the growth gained from agglomeration is significant enough, however if the boost given by agglomeration is too weak then the same remark concerning societal value holds.

5.2 Tax competition

5.2.1 Theoretical consideration

The Basic Tax Competition model (BTCM) emphasizes that a race to the bottom in tax rates can occur when capital mobility increases. However, the New Economic Geography literature has put this result into perspective: beside the mobility of factors, the mobility of goods also matters. In a world of increasing returns, and in order to be close to demand and to minimize transaction costs, firms have strong incentives to be agglomerated in central places. Such agglomeration generates a rent for the mobile factors which allows the government that hosts this agglomeration to increase its taxes without capital flight. By using the FE model when $h = 1$ this rent is given by the following expression:

$$\Omega(1, \phi) = \frac{2\phi^{1-a}}{1 + \phi^2 - b(1 - \phi^2)}$$

To see how this expression varies with transactions, a log differentiation of it gives:

$$\frac{d\Omega/\Omega}{d\phi/\phi} = (1 - a) - \frac{\phi^2(1 + b)}{1 - (1 - \phi^2)(1 + b)/2}$$

this expression is increasing until $\phi^{\max} = \sqrt{\phi_b}$ and decreasing later. This is summarized by the following result:

Proposition 5 *The agglomeration rent is bell-shaped with respect to trade liberalization.*

This agglomeration rent, which is linked to trade liberalization in a non monotonic way, has generated a flourishing literature concerning the tryptic

trade integration / imperfect competition / agglomeration (Andersson and Forslid (2003), Baldwin and Krugman (2004), Kind et al. (2000), Ludema and Wooton (2000), Ottaviano and Van Ypersele (2002)). Indeed because this rent successively increases and decreases with the freeness of trade, a race to the top can be followed by a race to the bottom. These conclusions seem to be verified by stylized facts. In order to have a global view of the evolution of this tax competition on a European scale, we follow Baldwin and Krugman by dividing the EU into two parts: the core that hosts a major part of agglomeration and the periphery. But unlike the authors we do not consider only a geographical definition of the core, but rather an economic definition: a country is defined as a part of the core when at least one of its regions (level NUTS2) has a market potential per capita higher than 8000 euros per inhabitant per km. Thanks to this definition based on Combes and Overman (2004)'s map 3, the Core is defined by: Benelux, France, Germany, Great Britain, the Netherlands, Switzerland, and the Periphery by: Austria, Finland, Italy, Ireland, Greece, Norway, Portugal, Spain, Sweden. According to this clustering, Figure 8 displays how the tax gap between the Core and the Periphery measured by the Statutory Tax Rate (STR), the Effective Average Tax Rate (EATR) and the Effective Marginal Tax Rate (EMTR) follows a bell-shape over the period 1986-2003²⁹.

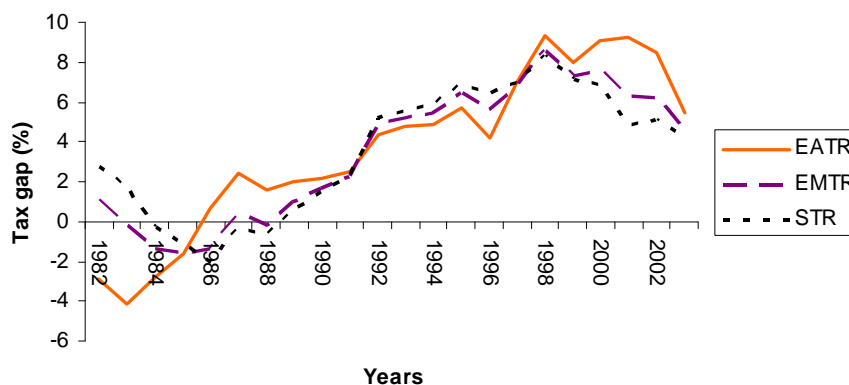


Figure 2.8 – Tax Gap (based on Devereux et al. (2002))

In order to take into account the difference of size between the Core and the Periphery, Baldwin and Krugman (2004) analyze the tax policies between governments in case of total agglomeration of activities in the North, so they hence-

²⁹The STR is the most basic measure of corporate income taxes, here local taxes are integrated to the calculation. The EMTR measures the effect of taxation on the incentive of a firm to make an marginal investment, while the EATR measures the effect of taxation on the installation of a new firm (see Devereux et al. (2002), Box 1 p 461 for the detail of calculations)

forth limit themselves to $\phi > \phi_b$. Preferences are given by:

$$U = M^\mu A^{1-\mu} G$$

where G is the supply of local public goods. With Andersson and Forslid (2003) it is assumed that public goods are produced via the private goods. Thus the composition of demand and all the variables that we have analyzed so far (wages and prices) are not affected by tax. We assume that each jurisdiction supplies the same amount of public goods but the financing of these goods f and f^* can differ from one jurisdiction to the next (implicitly each government's efficiency can vary³⁰):

$$f = tY, \quad f^* = t^*Y^*$$

Because the supply of public goods is the same everywhere, migration stops when post-tax reward is higher in the Core. The location equilibrium condition is thus given by:

$$\frac{V}{V^*} = \frac{1-t}{1-t^*} \geq 1$$

We furthermore assume that governments maximize the following objective function:

$$W = W(f, t), \quad W_f > 0$$

As has been pointed out by Baldwin and Krugman (2004), denoted BK for short, the common point between the Leviathan and a benevolent government is that their objective functions rise with the collected revenue and decline with the tax rate, however because the tax rate also has an impact on the revenue, a shift in it first has a positive effect on the objective and then a negative one. Thus, the objective function needs to be a bell-shaped curve when the tax rate increases.

The local governments play a Stackelberg game, the sequence of this game is the following: i) The North sets a tax rate t ii) The South reacts through a tax rate t^* iii) Migration occurs.

This game is resolved by backward induction. The third stage is already known by the previous analysis of the model. The second stage is summarized by Figure 9. The vertical axis represents the objective function of the South, while the horizontal axis plots the level of taxation in this country.

There are two possible situations: if the South does not succeed in stealing the Core, then its revenue is small because it can tax only immobile workers (thus equal to $t^*L^*w_a$), on the contrary, if this country succeeds in attracting all the activities, then its revenue is going to be much higher ($t^*(w_h^* + L^*w_a)$). Total agglomeration in the North depends therefore on the potential taxation levied by the South. The Northern government can indeed be upset by a tax t_b^* , which enables the South to break the Core equilibrium:

$$t_b^* = 1 - \Omega(1, \phi)(1-t) \tag{43}$$

³⁰ Another explanation of these equations and of the 'no delocation condition' has been proposed by Baldwin and Krugman (2004) who assume that supply of public goods can differ from one jurisdiction to the next but that entrepreneurs do not take this difference into account when they decide to move.

This break-point tax rate rises with t and falls with $\Omega(1, \phi)$.

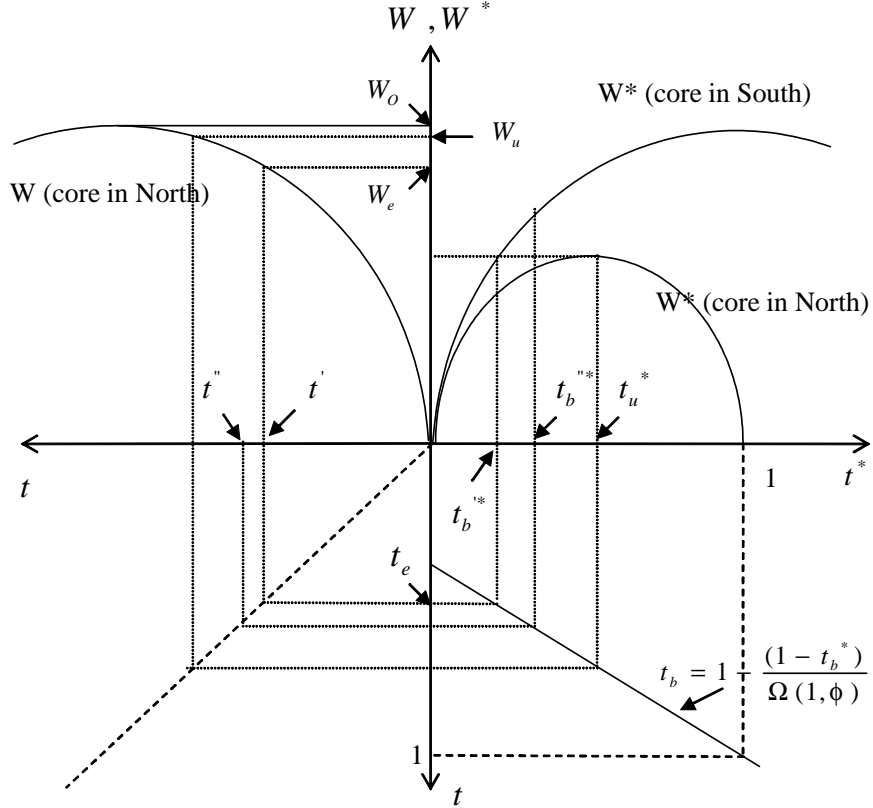


Figure 9 – The tax game

Thus, if we start from a situation where the Core/North sets a high tax rate, say t'' , then the break-point tax rate, denoted t_b'' on the diagram is also high, and thus the South can steal the Core by setting t^* equal to t_b'' . If the North decides to choose a lower tax level, say t' , then in such a case the South can steal the Core by lowering t^* to t_b' . However in such a case t_b' is equivalent to the tax rate that maximizes the objective function of the South without the Core, namely t_u^* , thus the South is indifferent between the Core or the Periphery. Therefore, in the first stage, if the North wants to keep the Core, it needs to set a tax below or equal to t' , such that the South does not want to deviate from t_u^* . This limit tax rate, denoted t_e , is thus equal to t' on the diagram and analytically found by:

$$t_e = 1 - \frac{1 - t_b^*}{\Omega(1, \phi)} \quad (44)$$

$$\text{where } t_b^* \text{ s.t. } W^*[t_u^* Y^*(0, \phi), t_b^*] = W^*[t_u^* Y^*(1, \phi), t_b^*] \equiv W_e^*$$

We now need to verify that the North always prefers to have the Core. This is ensured by the fact that the North wins W_e with the Core and nothing without, accordingly the North will always "limit tax" the South. By using a specific objective function, $W(f, t) = G - t^2/2$, and by applying the above described game, the authors determine the differential $t_e - t_u^*$ which represents the level of tax competition:

$$t_e - t_u^* = 1 - L - \frac{(1 + \sqrt{b}) - (1 - \sqrt{b})L}{(1 + \sqrt{b})\Omega(1, \phi)} \quad (45)$$

This gives the following proposition:

Proposition 6 *Trade liberalization leads to an increase in the tax gap between the Core and the Peripheral regions at first and next to a race to the bottom in terms of taxation.*

Proof. Indeed we get:

$$\begin{aligned} \frac{\partial(t_e - t_u^*)}{\partial\phi} &= C \frac{\partial\Omega(1, \phi)}{\partial\phi} \\ \text{with } C &= \frac{(1 + \sqrt{b}) - (1 - \sqrt{b})L}{(1 + \sqrt{b})\Omega(1, \phi)^2} > 0 \end{aligned}$$

and we know from proposition 5 that $\frac{\partial\Omega(1, \phi)}{\partial\phi}$ is at first positive and next negative when ϕ increases. ■

5.2.2 Empirical verification

The previous proposition is a strong result which goes against the conclusion of the basic tax competition model, and which can disappear in a model à la Krugman and Livas (1996) since in this model the agglomeration rent is strictly decreasing in ϕ . A formal proof of this can be found in Candau (2006). Then the need to test this proposition empirically is necessary. Such a work has been undertaken by Gilbert et al. (2005), who propose to test the following equations:

$$t_t - t_t^* = \alpha_1\phi_t + \alpha_2\phi_t^2 + F + \epsilon_t \quad (46)$$

$$t_t - t_t^* = \alpha_1\phi_t + \alpha_2\phi_t^2 + \alpha_3(Y_t - Y_t^*) + F + \epsilon_{ijt} \quad (47)$$

$$t_t - t_t^* = \alpha_1\phi_t(Y_t - Y_t^*) + \alpha_2\phi_t^2(Y_t - Y_t^*) + F + \epsilon_{ijt} \quad (48)$$

$$t_t - t_t^* = \alpha_1\phi_t + \alpha_2\phi_t^2 + \alpha_3(Y_t - Y_t^*) + \alpha_4\phi_t(Y_t - Y_t^*) + \alpha_5\phi_t^2(Y_t - Y_t^*) + F + \epsilon_{ijt}$$

where $t_t - t_t^*$ and $Y_t - Y_t^*$ represent respectively the tax gap and the Gross Domestic Product (GDP) gap between two countries at the period t . This estimation is based over the period 1982-2001 and tested on the EU15 and EU25. For the EU15 the authors use successively the statutory tax rate, the ex-post tax rate, the effective average tax rate and the effective marginal tax rate, while only the former two are available for the EU25. F combines fixed

effects associated with countries and time : $F = \nu + \nu^* + \nu_t$. For all these estimations, the following constraint is set:

$$Y_t > Y_t^*$$

This constraint allows one to distinguish between the Core and the Periphery. Then in the first equation the authors simply test if the tax gap is bell-shaped with respect to ϕ . In the second one they include the GDP gap in order to understand if this gap plays an independent role on ϕ in the shape of the tax gap. In the third equation, the authors want to test if the GDP gap and ϕ interact on the evolution of the tax gap. Lastly the fourth equation tests simultaneously all the assumptions presented above. Concerning the measure of ϕ , the authors adopt the method developed by Head and Mayer (2004), which is the following: from the demand equation they find that the total value of import from i to j , and from i to i , is respectively given by:

$$c_{ij} = \mu\phi n^* \frac{Y}{P^{1-\sigma}} p^{*1-\sigma}, \quad c_{ii} = \mu n \frac{Y}{P^{1-\sigma}} p^{1-\sigma} \quad (49)$$

then by dividing c_{ij} by c_{ii} they get:

$$\frac{c_{ij}}{c_{ii}} = \frac{\phi n^* p^{*1-\sigma}}{n p^{1-\sigma}} \quad (50)$$

idem for $c_{ji} = \mu\phi^* n \frac{Y^*}{P^{*1-\sigma}} p^{1-\sigma}$ and for $c_{jj} = \mu n^* \frac{Y^*}{P^{*1-\sigma}} p^{*1-\sigma}$, then by multiplying the previous equation (50) by c_{ji}/c_{jj} one finds:

$$\sqrt{\frac{c_{ji}}{c_{jj}} \frac{c_{ij}}{c_{ii}}} = \phi \quad (51)$$

The interest of this method is that c_{ji} , c_{ji} are bilateral trade data which are easily available, and c_{ii} and c_{jj} are approximated by the national production minus the total exportation of the country. The results of equation (46) and (47) reveal that the tax gap measured by the effective average tax rate and the effective marginal tax rate follows a bellshape with respect to ϕ for the EU15. Concerning statutory tax rate and ex-post rate, the relationship is less robust for the EU15 and EU25. However equation (48), which takes into account interaction between the tax gap and the GDP gap is significant for the two samples. This means that the bell-shaped tax gap tends to be flatter when the difference between countries is small, or in other words, the more countries' sizes differs, the higher the bell-shaped tax gap with respect to ϕ . This result is interesting and deserves perhaps to be studied on a theoretical angle. Indeed Baldwin and Krugman (2004) only consider the case of total agglomeration in one country and thus implicitly they study the evolution of the tax gap between countries that are diametrically different, then we can imagine that if these countries were less different then the bellshape would be less pronounced. But actually this is not the case: indeed the sole model that analyzes tax competition under partial agglomeration, i.e. the Borck and Pflüger (2006) model, finds that

the tax gap strictly increases when trade is liberalized. Moreover, we wished that the empirical study of Gilbert et al. were based on aggregate data, indeed the choice of taxes by governments is certainly made by considering the most mobile firms, and then a definition of ϕ at industry level (as in Head and Ries (2001), Head and Mayer (2004) etc) would improve the analysis. Besides, Gilbert et al. use their estimation results in order to calculate the level of integration that allows one to obtain the maximal tax gap between two countries. They find that in 2000 the new members of the EU25 were far from this maximum level of ϕ beyond which a race to the bottom is predicted.

5.3 Some extensions and propositions

5.3.1 Tax competition

In this section, we propose two extensions of the literature on tax competition. The Baldwin and Krugman (2004) model analyze the effect of identical and reciprocal trade liberalization on tax competition, however in Europe, the enlargement starts with preferential and non reciprocal trade liberalization. For instance, after the collapse of communism, the CEECs were integrated into the General System of Preference, and soon afterwards they signed the European Association Agreements and more recently the Free Trade Agreements. Then we are going to show that such liberalization changes the issue, only a race to the bottom appears. Secondly, the EU fosters economic integration by liberalizing trade between countries, but also by investing in internal infrastructure inside of peripheral regions, what can be the effect of such a policy on tax competition?

Unilateral trade policy Instead of analyzing reciprocal trade, we consider what happens when market access to the Core is given by ϕ , while market access to the South is given by ϕ^* , with such trade costs, price indices are now given by:

$$P^{1-\sigma} = h + \phi^* h^*, \quad (P^*)^{1-\sigma} = \phi h + h^* \quad (52)$$

and nominal wages by:

$$w_h = b\left(\frac{Y}{h + \phi^* h^*} + \phi^* \frac{Y^*}{\phi h + h^*}\right), \quad w_h^* = b\left(\phi \frac{Y}{h + \phi^* h^*} + \frac{Y^*}{\phi h + h^*}\right) \quad (53)$$

with $b = \frac{\mu}{\sigma}$ (54)

In such a case the agglomeration rent is given by:

$$\Omega = \frac{2\phi^{*1-a}}{1 + \phi\phi^* + b(\phi\phi^* - 1)} \quad (55)$$

This expression permits to affirm that when the Core liberalizes its market to the Periphery then the agglomeration rent decreases. Indeed by differentiating Ω with respect to ϕ we obtain:

$$\frac{\partial \Omega}{\partial \phi} = -\frac{2(1+b)\phi^{*2-a}}{(1 + \phi\phi^* + b(\phi\phi^* - 1))^2} < 0 \quad (56)$$

Concerning tax competition, the tax gap is still given by equation (45) (but with Ω given by (55)). For convenience we report this expression below:

$$t_e - t_u^* = 1 - L - \frac{(1 + \sqrt{b}) - (1 - \sqrt{b})L}{(1 + \sqrt{b})\Omega}$$

This gives the following result:

Proposition 7 *Non reciprocal trade liberalization of the Core leads countries to launch a race to the bottom.*

Proof. Indeed we get:

$$\begin{aligned} \frac{\partial(t_e - t_u^*)}{\partial\phi} &= C \frac{\partial\Omega}{\partial\phi} \\ \text{with } C &= \frac{(1 + \sqrt{b}) - (1 - \sqrt{b})L}{(1 + \sqrt{b})\Omega^2} > 0 \end{aligned}$$

and we know from (56) that $\frac{\partial\Omega(1, \phi, \phi^*)}{\partial\phi} < 0$ thus $\frac{\partial(t_e - t_u^*)}{\partial\phi} < 0$ ■

Improvement of internal infrastructure in the Periphery We are going to consider that trade between regions is reciprocal and given by ϕ as in Baldwin and Krugman, but that trade inside nations implies internal costs ϕ_I in the North and ϕ_I^* in the South. Thanks to this, price indices are given by:

$$P^{1-\sigma} = \phi_I h + \phi h^*, \quad (P^*)^{1-\sigma} = \phi h + \phi_I^* h^*$$

and nominal wages by:

$$w_h = b\left(\phi_I \frac{Y}{\phi_I h + \phi h^*} + \phi \frac{Y^*}{\phi h + \phi_I^* h^*}\right), \quad w_h^* = b\left(\phi \frac{Y}{\phi_I h + \phi h^*} + \phi_I^* \frac{Y^*}{\phi h + \phi_I^* h^*}\right)$$

In such a case, the agglomeration rent is the following:

$$\Omega = \frac{2\phi_I^{1+a}\phi^{1-a}}{(1+b)\phi^2 - (b-1)\phi_I\phi_I^*} \quad (57)$$

From this expression we are able to show that when a supranational policy improves the internal infrastructure of the Periphery, then the agglomeration rent decreases. Indeed by differentiating Ω with respect to ϕ_I^* we obtain:

$$\frac{\partial\Omega}{\partial\phi_I^*} = \frac{2(b-1)\phi_I^{2+a}\phi^{1-a}}{((1+b)\phi^2 - (b-1)\phi_I\phi_I^*)^2} < 0 \quad (58)$$

which is negative since $b = \frac{\mu}{\sigma} < 1$.

Concerning tax competition, the tax gap is still given by equation (45) but with Ω given by (57), and this yields the following result.

Proposition 8 *A supra national policy that improves the internal infrastructure of the Periphery leads countries to launch a race to the bottom.*

Proof. We have:

$$\frac{\partial(t_e - t_u^*)}{\partial\phi_I^*} = C \frac{\partial\Omega}{\partial\phi_I^*}$$

$$\text{with } C = \frac{(1 + \sqrt{b}) - (1 - \sqrt{b})L}{(1 + \sqrt{b})\Omega^2} > 0$$

and we know from the (58) that $\frac{\partial\Omega(1, \phi, \phi^*)}{\partial\phi_I^*} < 0$ thus $\frac{\partial(t_e - t_u^*)}{\partial\phi_I^*} < 0$ ■

Ireland's past policy in terms of taxation, can perhaps be understood in this way.

5.3.2 Regional infrastructure and Growth

Until now we have spoken about governments' aim to attract as many activities as possible. The reason for such a policy is often based on the goal of promoting national growth. Surprisingly, the FE model with endogenous growth built by Fujita and Thisse (2002) has never been used in order to illustrate how policies can affect the growth rate. Here we want to focus on two policies: internal trade cost improvement in the Periphery and improvement of knowledge spillovers. In the previous analysis we have presented the static FE model with internal trade costs in the case of agglomeration in the North. However we have not considered what happens when trade costs are relatively high. The top of Figure 10.a, where the horizontal axis plots the number of entrepreneurs in the North while the horizontal axis displays their relative welfare illustrates this. We can see that when trade between nations are relatively high ($\phi = 0.6$) and internal trade in the South is utterly integrated ($\phi_I^* = 1$) any deviations from the dispersive equilibrium generate a decrease in welfare and thus render the situation in which entrepreneurs are equally spread between nations stable. However internal trade costs are often non null, as the simulations illustrate, the higher entrepreneurs are in the South, the more they tend to be agglomerated in the North. For instance at $\phi_I^* = 0.97$, 80% of the entrepreneurs' population are located in the North. Furthermore when we described the Fujita and Thisse model, we remarked that the growth rate follows a U-shape with respect to the number of entrepreneurs with a minimum at $S = 1/2$ (see the bottom of Figure 10). This implies that a decrease in southern internal costs leads to a decrease in rate growth³¹.

³¹ Parameters: $\sigma = 5, \mu = 0.4, L = L^* = 1/2, \alpha = 1, \phi_I^* = 1$

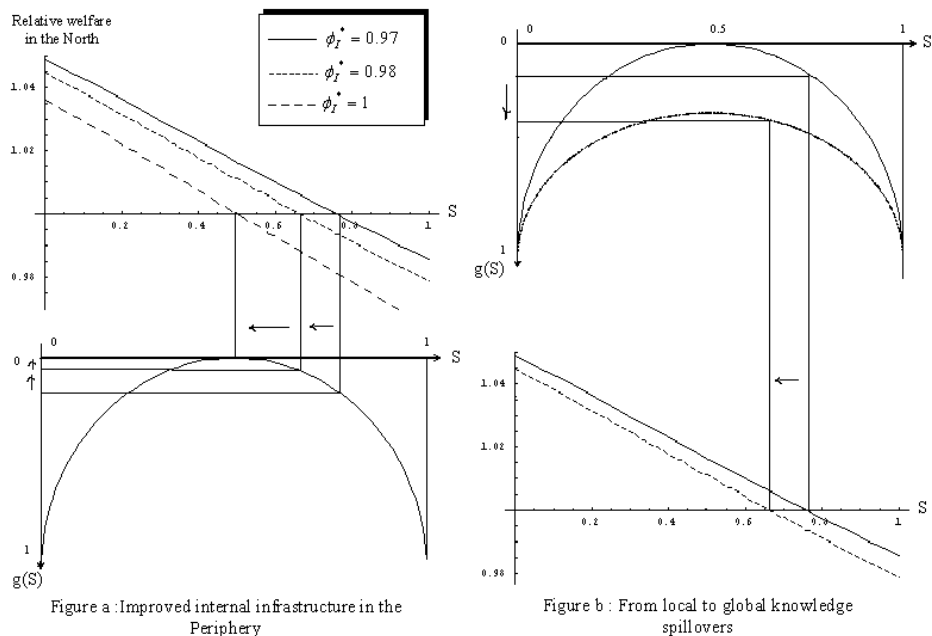


Figure 2.10 – Public policies

Moreover we have noticed that an increase in η which represents the nature of spillovers (local spillovers when $\eta = 0$, global spillovers when $\eta = 1$) raises the growth rate $g(S)$ in a way described by the top of Figure 10.b. Since now spillovers are not only localized in the North but common to both nations, some relocations occur, then such a policy as fosters the diffusion speed of human capital is beneficial to territorial equity and growth. In brief we can write the following result: *Public policies that aim to improve internal infrastructure in the Periphery are detrimental to growth while policies that succeed in diffusing the technological knowledge of the North to the Periphery foster global growth.*

Of course, these results can to be verified in formally by using the Fujita and Thisse model in more detail, but Martin (1998, 1999) has already proved such a proposition by using the Footloose Capital model.

6 Concluding remarks

The two propositions that were initially put forward by the theoretical aspect of the NEG have been questioned by empirical works which seem to correct the idea that agglomeration occurs when trade liberalization tends to free trade and are also sceptical as to the hypothesis of multiple equilibria. These investigations and criticisms have marked a new starting point for theoretical works which now integrate land rent, commuting costs, endogenous growth and have investigated the public policies that the NEG may recommend. We have thus reached a point where empirical works need to test these recommendations.

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