Good Governance, Trade and Agglomeration

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Abstract

The contribution of this paper is twofold. Firstly, we explore the effects of trade liberalization and commuting costs on the location of entrepreneurs. The model reveals a dispersion-agglomeration-dispersion configuration when trade gets freer. Furthermore we prove that when both commuting costs and trade integration are high, then dispersion Pareto dominates agglomeration. Secondly, we use this framework to investigate the effect of trade on corruption at different levels of democracy and instability. We show that corruption is bell-shaped with respect to trade liberalization in stable and democratic regimes but also in unstable dictatorships.

JEL classification: D73; H25; R12; F12

Keywords: Economic geography; Cities; Trade; Corruption.

1 Introduction

Good governance can be defined as a process free of abuse, of corruption and that avoids waste with due regard for the rule of law by which a government makes decisions and implements them. This topic is currently one of the priorities of international organisations to ensure sustainable human development and economic growth. For instance, the World Bank wants to promote a « systematic framework for addressing corruption as a development issue in the assistance it provides to countries and in its operation work more generally »[1]. Moreover, multilateral measures such as the Convention on Combating Bribery of Foreign Public Officials in International Business Transactions, signed in November 1997 by the OECD or more recently the United Nations Convention against Corruption adopted in December 2003[2], indicate the increasing importance of this issue. Beginning with Leff (1964) and Huntington (1968), the debate relative to the effects of bad governance was quite optimistic. For them corruption has a positive impact on growth, because on the one hand it allows

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[1] Marquette (2003)

[2] The Heads of State and Government of the African Union have also signed on july 2003 the African Union Convention on Preventing and Combating Corruption.

one to "speed money" by avoiding bureaucracy delay, and on the other hand it favors the increase in employees' efficiency when bribes act as a piece rate. These conclusions however are not shared by North (1990) or Shleifer and Vishny (1993) who consider that good governance is essential as regards economic performance. These analyses were verified for the first time by Mauro (1995), who shows that corruption lowers private investment, by Tanzi and Davoodi (1997), who demonstrate that this variable impacts negatively on the quality of public investment, by Mauro (1998), who reveals that bad governance creates a bias against public spending on education and, lastly, by Gupta et al..(2000), who finds a similar result concerning health care.

Bad governance and corruption thus appear to be harmful and deserve attention, all the more as they are widespread and significant phenomena. For instance, a recent study of the U.S. General Accounting Office (2004) reports that in Nigeria corruption is known as the "10 percent syndrome" since a 10 percent unofficial "tax" is paid to the institution in order to ensure that it performs its official functions. But bad governance is not only found in developing countries[3], rich and newly industrialized countries are also affected by such a phenomenon. Thus, because good governance is a master challenge for many countries, we want to understand how anti-corruption efforts can operate through trade liberalization. Empirical works have already tackled this question. Azfar and Lee (2002) by analysing a large cross section study of countries, have found a negative link between corruption and tariff rates, and likewise, Rodriguez and Rodrik (2001) show that the level of opening is correlated to institutions that monopolize local markets. Rodrik (2002) also sees trade liberalization as a way to improve institutions. However, by considering case studies and stylised facts these conclusions are perhaps not so robust. In Figure 1 we plot the reverse of the Corruption Perception Index[4] for developing countries i.e for China, Cameroon and Russia and in Figure 2 for developed countries i.e for the EU's Core (average of Belgium, France, Germany and Italy), for USA and for Japan over the period 1980-2004.

[3] Sachs et al. (2004) for instance by controlling for the per capita income, find that Sub-Saharan Africa countries have a relatively good indicator of governance. See however Kauffmann et al. (2005) for a critic of this argument

[4] The Corruption Perceptions Index (CPI) is based on corruption-related data in expert surveys. It reflects the point of view (perception) of business people and experts concerning corruption. An increase in this index reflects a decrease in the perception of corruption, that's why we take the reverse i.e. 1/CPI, thus an increase in this inversed CPI represents an increase in the perception of corruption.

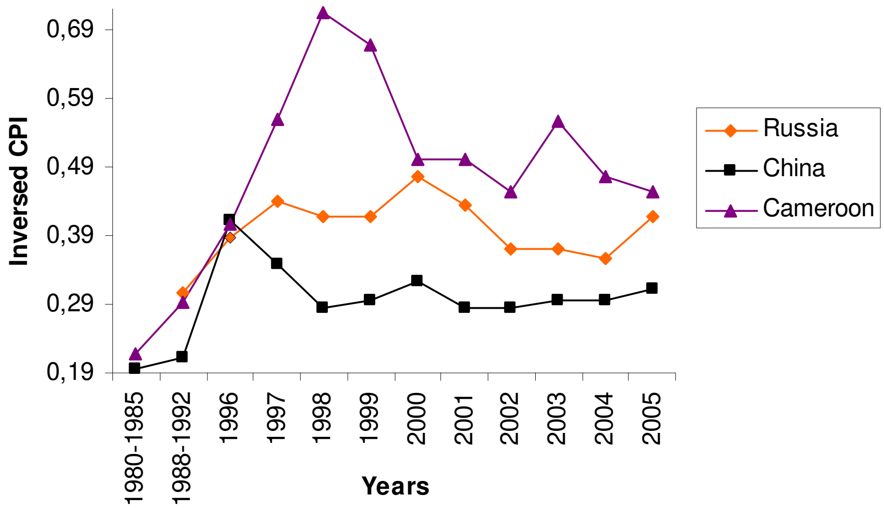

Figure 1 – Corruption perception Index for developing countries (1980-2004)

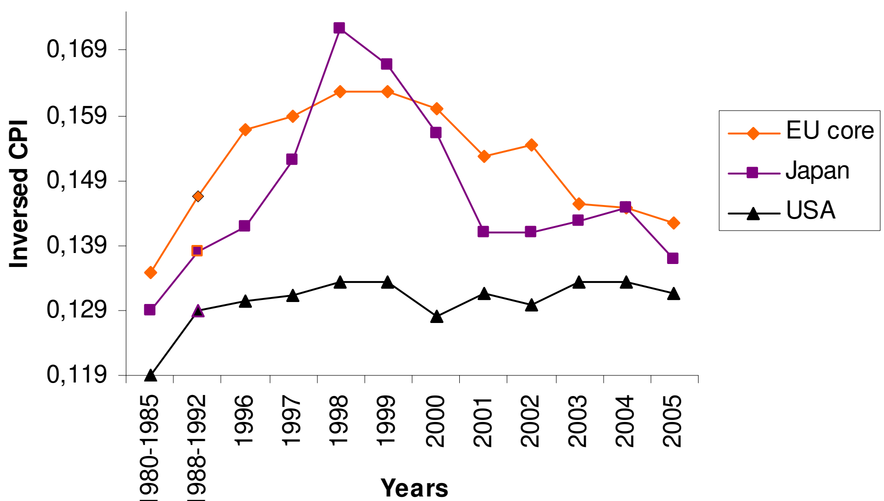

Figure 2 – Corruption perception Index for developed countries (1980-2004)

All these countries have known significant trade and financial liberalizations over this period, and for all of them bad governance trend seems to follow a bellshape. This observation leads us to wonder what the effect of trade is on government behavior at different levels of democracy and instability. The answer is going to be found on the theoretical ground of the New Economic Geography by integrating bad governance, instability and democracy in a model of location. The analysis is divided into three parts: in the first one we develop a new version of the Krugman and Livas (1996) model by integrating an immobile factor in it[5], and by using a specific cost function which makes this model analytically more solvable than the original. The second step displays the location results of this model, at first a gradual agglomeration and then a total one can appear when trade gets freer, but next only dispersion is sustainable. Furthermore, when commuting costs are high, this dispersion Pareto dominates agglomeration because everyone is better off. Lastly, the third part shows under which condition the corruption is bell-shaped with respect to trade liberalization.

2 The model

2.1 Pattern of space

There are three regions in this model, two monocentric cities and the rest of the world. While in the cities a Constant Returns to Scale activity (CRS) can cohabit with an Increasing Returns to Scale activity (IRS), only the former exists in the rest of the world[6]. In this economy, there are two kinds of workers, entrepreneurs who work in the IRS sector and who commute from one city to the next and unskilled workers who are immobile and work in CRS activities. Unlike unskilled workers who do not need to commute and who are located in city suburbs, where land rent is null, entrepreneurs who own one unit of land 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:

$$s(x) = (1 - 2\theta \mid x \mid \tag{1}$$

where θ (with $\theta < 1$) is entrepreneurs' commuting cost level, $\mid x \mid$ measures distance to 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 of entrepreneurs' commuting cost in one city is equal to:

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

[5] Crozet and Koening-Soubeyran (2003), or Brulhart et al. (2003) also integrate an immobile factor, but they drop the explicit treatment of the land rent which is the very new feature of the seminal model.

[6] Contrary to Crozet and Koenig-Soubeyran (2004), Brulhart et al. (2004) or Paluzie(1998), we do not integrate the IRS in the rest of the world because we want to focus on the effect of the external demand, and thus to cut external competition. This is in line with Krugman and Livas (1996) who consider that IRS exist in the rest of the world but make this sector not influencial for cities by taking the wage in this external market as the numéraire and by equalizing it to price.

As land rent at both edges of the segment is normalized to zero, if w_h is entrepreneurs' wage near the CBD, then their wage net of commuting costs earned at both edges is:

$$s(h/2)w_h = s(-h/2)w_h = (1-\theta h)w_h \tag{3}$$

Because consumers are identical in terms of preferences and income, at equilibrium they must reach the same utility level. Thus entrepreneurs who live on 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 significant 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 land rent. A move from the suburb to the CBD implies a decrease in commuting and therefore an increase in net wage, but also an equivalent increase in land rent which equalizes utility among individuals. In other terms, 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 at both edges given by (3). By inserting expression (1) into this system we find the following land rent:

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

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

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

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 it is assumed with Krugman and Livas (1996) that each entrepreneur owns an equal share of the ALR where they reside. Thus their non salaried income is:

$$\frac{ALR}{h} = \frac{\theta h w_h}{2} \tag{4}$$

We can now turn to consumers' behavior.

2.1.1 Consumers' behavior

All consumers share the same Cobb-Douglas utility function and consume one industrial good, which is a composite of different varieties, and one agricultural good:

$$U = M^{\mu} A^{1-\mu} \quad \text{with} \quad M = \left[\int_0^N m_i^{\frac{\sigma-1}{\sigma}} di\right]^{\frac{\sigma}{\sigma-1}} \tag{5}$$

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

$$PM + p_A A = Y$$

where p_A is the price of the agricultural good and P the price index of those varieties:

$$P = \left[\int_0^N p_i^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} \tag{6}$$

which is a decreasing function of the number of varieties produced N (because $1-\sigma < 0$). p_i is the price of a typical variety i. The impact of N on the price index is influenced by 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:

$$M = \mu \frac{Y}{P}, \quad A = (1-\mu)\frac{Y}{p_a} \tag{7}$$

$$m_i = \mu \frac{Y}{P^{1-\sigma}} p_i^{-\sigma} \tag{8}$$

$$\text{with} \quad Y = h(1 - \frac{\theta}{2}h)w_h \tag{9}$$

where $(1-\frac{\theta}{2}h)w_h$ comes from the income of land ownership $(\theta h w_h/2)$ and from the wage net of commuting costs $((1-\theta h)w_h/2)$. From this and the price index expression we can see that an increase in the number of industrial products depresses demand for each variety.

We can now turn to firms' behavior.

2.2 Firms' behavior

Concerning the cost function, we assume that the production of a typical variety of manufactured goods involves entrepreneurs' services as a fixed cost, and the use of β units of unskilled workers for each unit of output produced[7]. Thus the total cost of producing q units of a typical manufactured variety is:

$$TC = w_h + \beta w_u q \tag{10}$$

where w_u is unskilled workers' wages.

[7] This cost function has been used for the first time by Forslid and Ottaviano (2002) in Krugman's Core-Periphery model and has never been applied to the urban economic theory because the immobile factor was absent (see Krugman and Livas (1996), Candau (2005), Murata and Thisse (2005)).

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 (8). 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 (8), but rather:

$$q = bp^{-\sigma}$$

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:

$$p = \beta w_u \sigma/(\sigma - 1) \tag{11}$$

An important and new feature is that prices are now constant and independent of entrepreneurs wages. Because there is free entry, profits are always equal to zero, which, using (10) and (11), gives the level of output:

$$q = (\sigma - 1)w_h/\beta w_u \tag{12}$$

In equilibrium, a typical firm employs one units of capital, so that the total demand is n. As entrepreneurs' labour supply is exactly S, the equalization gives the number of varieties produced:

$$n = S \tag{13}$$

The number of varieties produced is then proportional to the number of workers.

2.3 Trade and commuting effects

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 and in the rest of the world[8] 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 to its local market and to its export markets are:

$$\begin{aligned} p &= \beta w_u \sigma/(\sigma - 1) && (14) \\ p^* &= p^\circ = \tau \beta w_u \sigma/(\sigma - 1) && (15) \end{aligned}$$

[8] Unlike the literature we do not distinguish between regional and international trade. This distinction is indeed interesting as long as there is no preferential aggreement between one of the city and the rest of the world (see Brülhart et al. (2004) and Crozet and Koenig-Soubeyran (2004) for such an analysis) because the effect of regional and international liberalization has the same effect on entrepreneurs' location.

With Krugman and Livas Elizondo we assume that the input-output coefficient is equal to the reverse of the mark-up. This normalization and the fact that wages in the agricultural sector are taken as the numeraire and normalized to one, simplify prices which are equal to one (in (11)). Furthermore the total number of entrepreneurs is also normalized to one: $h + h^* = 1$.

Iceberg transaction costs also imply a modification of the price index. Using the above normalization we find:

$$\Delta \equiv P^{1-\sigma} = S + \phi S^* \tag{16}$$

$$\Delta^* \equiv (P^*)^{1-\sigma} = S + \phi S^* \tag{17}$$

$$\Delta^\circ \equiv (P^\circ)^{1-\sigma} = \phi S + \phi S^* \tag{18}$$

where ϕ measures the freeness 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. At the symmetric equilibrium ($h = 1/2$), an increase in S (and so a decrease in S^*) implies, as long as transaction costs exist ($\phi < 1$), an increase in the price index in the South and a decrease in the price index in the North. Here however, this effect does not depend only on transaction costs but also on urban costs, thus through (2) we find:

$$\frac{\Delta}{\Delta^*} = \frac{h(1-\theta h/2) + \phi(1-h)(1-\theta(1-h)/2)}{\phi h(1-\theta h/2) + (1-h)(1-\theta(1-h)/2)}$$

This expression will allow us to prove the following lemma:

Lemma 1 *Starting from the symmetric equilibrium ($h = 1/2$) a small movement of entrepreneurs from the South to the North, always decreases the relative price index in northern cities as long as trade is not utterly free ($\phi < 1$). Furthermore, this effect is decreasing when it comes to trade freeness as well as commuting costs.*

Proof. At $h = 1/2$, a higher h raises Δ and depresses Δ^* through:

$$\frac{\partial(\Delta/\Delta^*)}{\partial h}\Big|_{h=1/2} = \frac{-8(\theta-2)(\phi-1)}{(\theta-4)(\phi+1)} > 0 \quad if \quad \phi < 1$$

Moreover, as the price index is a decreasing function of Δ ($\equiv P^{1-\sigma}$ with $\sigma > 1$) we have $\frac{d(P/P^*)}{dh} < 0$.

This effect is however limited by a decrease in commuting costs and trade liberalization:

$$\frac{\partial(\Delta/\Delta^*)/\partial h}{\partial\theta} \quad \Big|_{h=1/2} = \frac{16\,(\phi-1)}{(\phi+1)\,(\theta-4)^2} < 0 \quad if \quad \phi < 1$$

$$\frac{\partial(\Delta/\Delta^*)/\partial h}{\partial\phi} \quad \Big|_{h=1/2} = \frac{-16\,(\theta-2)}{(\theta-4)\,(\phi+1)^2} < 0$$

■

We now need to integrate transaction costs into the demand function.

By inserting the above prices (11) into the demand function (8), and by considering the total demand as the sum of local demand and export demand we find:

$$q = \mu(\phi \frac{Y^{\circ}}{\Delta^{\circ}} + \frac{Y}{\Delta} + \phi \frac{Y^*}{\Delta^*}) \tag{19}$$

Ceteris paribus, the demand in the North is an increasing function of the income Y°, and a decreasing function of the price index P°. Obviously the higher international trade liberalization, ϕ, the higher the impact of the rest of the world on the northern demand. Considering the second and third term, we have just seen (Lemma 1) that an increase in the population in the North, increases Δ and decreases Δ^*, and thus fosters a decrease in the total demand q in the North (if $\phi < 1$). But how does a change of location impact on income? A glance at the following equations will provide an answer:

$$\begin{aligned} Y^{\circ} &= L^{\circ} w_u & (20) \\ Y &= h(1 - \theta h/2)w + L w_u & (21) \\ Y^* &= h^*(1 - \theta h^*/2)w^* + L^* w_u & (22) \end{aligned}$$

An increase in the entrepreneurial force, S, in the North, and thus a decrease in the South, S^*, increases home expenditure and lowers it abroad which implies, as long as impediment to trade exists ($\phi < 1$), an increase of the demand q.

2.4 Market clearing condition and long-run equilibrium

These equations now permit us to present the market clearing in a tidy form by equalizing of the demand (19) to the supply (12), which gives:

$$\begin{aligned} \sigma w &= \mu(\frac{Y}{P^{1-\sigma}} + \phi \frac{Y^*}{(P^*)^{1-\sigma}}) & (23) \\ \sigma w^* &= \mu(\phi \frac{Y}{P^{1-\sigma}} + \frac{Y^*}{(P^*)^{1-\sigma}}) & (24) \end{aligned}$$

By inserting income equations into this system, we obtain nominal wages[9], which allow us to express the relative wage in the North through:

$$\begin{aligned} \frac{w}{w^*} &= \frac{L\Delta^{\circ}(\Delta^* + \Delta\phi) + L^{\circ}\Delta\Delta^*\phi + bS^*(\phi - 1)(L\Delta^{\circ}(1+\phi) + L^{\circ}\Delta\phi)}{L\Delta^{\circ}(\Delta + \Delta^*\phi) + L^{\circ}\Delta\Delta^*\phi + bS(\phi - 1)(L\Delta^{\circ}(1+\phi) + L^{\circ}\Delta^*\phi)} \\ with\ \ b &= \frac{\mu}{\sigma} \end{aligned}$$

[9] Wages are given in the North and South respectively by:

$$\begin{aligned} w &= -\frac{b(L\Delta^{\circ}(\Delta^* + \Delta\phi) + L^{\circ}\Delta\Delta^*\phi + bS^*(\phi - 1)(L\Delta^{\circ}(1+\phi) + L^{\circ}\Delta\phi))}{\Delta^{\circ}(-\Delta\Delta^* + b(S^*\Delta + S\Delta^*) + b^2 SS^*(\phi^2 - 1)} \\ w^* &= -\frac{b(L\Delta^{\circ}(\Delta + \Delta^*\phi) + L^{\circ}\Delta\Delta^*\phi + bS(\phi - 1)(L\Delta^{\circ}(1+\phi) + L^{\circ}\Delta^*\phi))}{\Delta^{\circ}(-\Delta\Delta^* + b(S^*\Delta + S\Delta^*) + b^2 SS^*(\phi^2 - 1)} \end{aligned}$$

From the previous subsection we know that two opposite forces drive these relative nominal wages, indeed on the one hand an increase in the number of entrepreneurs in one city 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 ($h = \frac{1}{2}$), or when agglomeration in one city generates a higher relative real wage. Thus by denoting $\Omega(h, \phi, \theta, L^{\circ})$ this relative real wage, and by defining it by:

$$\begin{aligned} \Omega(h, \phi, \theta, L^{\circ}) &= \frac{V(h, \phi, \theta, L^{\circ})}{V^{*}(h^{*}, \phi, \theta, L^{\circ})} && (25) \\ &= \frac{w}{w^{*}} \frac{1 - \theta h/2}{1 - \theta h^{*}/2} (\frac{\Delta^{*}}{\Delta})^{-a} && (26) \\ with\ a &= \frac{\mu}{\sigma - 1} && (27) \end{aligned}$$

where V is total real income of location in the North, including landowner' income. We will have a stable total agglomeration in the North if $\Omega(1, \phi, \theta, L^{\circ}) > 1$, and a stable dispersed equilibrium if $d\Omega(1/2, \phi)/dh < 0$.

Let us notice that in the long run (26) two additional forces appear : on the one hand the term $(1 - \theta h/2)$ which enters multiplicatively in the indirect utility, creates a dispersive force independently of transaction costs, which is the land market-crowding effect and on the other hand the third term Δ^{*}/Δ which is the cost of living effect, is known to be an agglomerative force. Indeed, from Lemma 1 we 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.

3 Locations, critical points and welfare

As the model is symmetric, a dispersion of activities is always an equilibrium. However, the stability of this equilibrium is not always satisfied, a stable agglomerative equilibrium can appear, thus in this section we are going to ask two questions: How sustainable is the agglomeration? When is the symmetric equilibrium broken?

3.0.1 The Sustain point(s)

The sustain point is the critical point of trade liberalization at which the Core-Periphery pattern is sustainable. To determine whether agglomeration in the

North is an equilibrium we need to know whether a small deviation of entrepreneurs increases their welfare or not. If it does, the Core-Periphery pattern is not an equilibrium. In other words total agglomeration, $h = 1$ is an equilibrium if $\Omega(1, \phi, \theta, L^{\circ}) > 1$. Hence, the sustain point is defined implicitly when $\Omega(1, \phi, \theta, L^{\circ}) = 1$, which gives

$$\phi_s : \frac{(2L + L^{\circ})(1 - \theta)\phi^{1-a}}{L(1 + \phi^2 - b(1 - \phi^2)) + L^{\circ}\phi(1 - b(1 - \phi))} = 1 \tag{28}$$

Unlike a part of the literature where the implicit sustain point is unique in the interval $[0, 1]$, here there can be two solutions. Thus by denoting $\underline{\phi_s}$ the lower roots and $\overline{\phi_s}$ the higher ones, the agglomerative equilibrium is sustainable only if $\phi \in [\underline{\phi_s}, \overline{\phi_s}]$. We make some simulations in order to see how much this interval varies with commuting costs and the size of the external market.

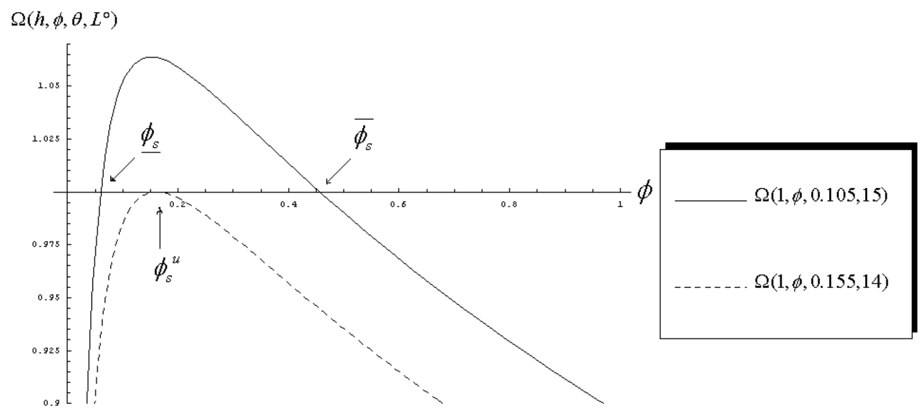

Figure 3 – The Sustain Points

In Figure 3, the horizontal axis measures the level of trade liberalization while the vertical axis displays the relative indirect utility in the case of agglomeration i.e. the right term of equation (28). Sustain points are at the intersection of curves and the unity. The regular line (curve $\Omega(1, \phi, 0.105, 15)$) represents our benchmark and shows that agglomeration is sustainable when ϕ belongs approximately to the interval $[0.07, 0.45]$, indeed in such a case welfare in the North is the highest ($\Omega(1, \phi, \theta, L^{\circ}) > 1$). Starting from this, an increase in congestion costs and a decrease in the size of the external market generates a downward translation of the curve and thus reduces the interval of sustainability (dashed line $\Omega(1, \phi, 0.16, 5)$):

Proposition 2 *The relative welfare under agglomeration in the North is bell-shaped with respect to the free-ness of trade. Thus two sustain points exists until trade points reach a critical value, which forbids any agglomeration sustainability;*

$$\phi_s^u = \frac{aL^{\circ}(-1 + b) + \sqrt{4(-1 + a)(1 + a)L(-1 + b)(L + bL + bL^{\circ}) + (aL^{\circ}(1 - b))^2}}{2(1 + a)(L + bL + bL^{\circ})}$$

Furthermore, an increase in congestion costs (θ) decreases the interval of trade freeness (ϕ) for which the agglomeration is a stable equilibrium.

Proof. We write (28) as:

$$\begin{aligned}\Omega(1,\phi,\theta,L^{\circ}) &\equiv (2L+L^{\circ})(1-\theta)\phi^{1-a} \\ &\quad -L(1+\phi^2-b(1-\phi^2))-L^{\circ}\phi(1-b(1-\phi)) \\ &= 0\end{aligned} \tag{29}$$

Around the extreme value of ϕ we know that $\Omega(1,\phi,\theta,L^{\circ})$ is negative:

$$\begin{aligned}\Omega(1,0,\theta,L^{\circ}) &= -L(1-b)<0 \\ \Omega(1,1,\theta,L^{\circ}) &= -(2L+L^{\circ})\theta<0\end{aligned}$$

Furthermore this expression is respectively increasing and decreasing in ϕ around autarky ($\phi=0$) and around free trade ($\phi=1$):

$$\frac{\partial\Omega(1,\phi,\theta,L^{\circ})}{\partial\phi}=(1-\theta)(1-a)\phi^{-a}(2L+L^{\circ})-2L\phi(1+b)-L^{\circ}(1+b(\phi-1)) \tag{30}$$

thus:

$$\begin{aligned}\frac{\partial\Omega(1,0,\theta,L^{\circ})}{\partial\phi} &> 0 \\ \text{because}\quad \lim_{\phi\to 0}\phi^{-a} &= +\infty\end{aligned}$$

and

$$\frac{\partial\Omega(1,1,\theta,L^{\circ})}{\partial\phi}=-(2L+L^{\circ})(a(1-\theta)+\theta+b)<0$$

In order to show that $\Omega(1,\phi,\theta,L^{\circ})$ is a bell shape we now need to demonstrate that this expression admits only one maximum. This is found if $\frac{\partial^2\Omega(1,\phi,\theta,L^{\circ})}{\partial\phi^2}<0$, which is verified[10]: $\frac{\partial^2\Omega(1,\phi,\theta,L^{\circ})}{\partial\phi^2}=-a(1-a)(1-\theta)(2L+L^{\circ})\phi^{-a-1}-2L(1+b)-2L^{\circ}b<0$. We can find this maximum when the top of the bell shape is equal to zero. Indeed in such a case we know that $\frac{\partial\Omega(1,\phi,\theta,L^{\circ})}{\partial\phi}=0$ or $\Omega(1,\phi,\theta,L^{\circ})=0$, the first expression (given by (30) permits to obtain $\phi^{-a}=\frac{2L(1+b)\phi+L^{\circ}(1+b(-1+2\phi))}{(1-\theta)(1-a)(2L+L^{\circ})}$ and by inserting this into the second expression (29) we get the critical value of trade costs:

$$\phi_s^u=\frac{aL^{\circ}(-1+b)+\sqrt{4(-1+a)(1+a)L(-1+b)(L+bL+bL^{\circ})+(aL^{\circ}-abL^{\circ})^2}}{2(1+a)(L+bL+bL^{\circ})}$$

Lastly, we must demonstrate how the relative welfare under agglomeration ($\Omega(1,\phi,\theta,L^{\circ})$) varies with θ : $\frac{\partial\Omega(1,\phi,\theta,L^{\circ})}{\partial\theta}=-(2L+L^{\circ})\phi^{1-a}<0$. An increase in congestion costs generates a downward translation of ($\Omega(1,\phi,\theta,L^{\circ})$). ■

After the sustain point, we can now turn to the break point.

[10] Indeed according to the "no black hole condition" $1-a>0$

3.0.2 The break point(s)

The break point is the critical point of transaction costs at which a dispersive equilibrium is broken. Suppose that workers are equally dispersed, then in order to determine if this situation is an equilibrium we need to know whether or not a small deviation increases welfare. If it does, dispersion is not an equilibrium. Thus we want to know the sign of $\partial\Omega(h,\phi)/\partial h$ when $h=\frac{1}{2}$. We find that the dispersive equilibrium is broken when $\phi \in [\underline{\phi_b}, \overline{\phi_b}]$, where $\underline{\phi_b}$ and $\overline{\phi_b}$ are given by:

$$\underline{\phi_b} = \frac{\begin{array}{c}2(1+a)bL^\circ(a_1/a)+2L^\circ a_2+4La_4- \\ \sqrt{\begin{array}{c}(4(L^\circ((1+a)b(a_1/a)+a_2)+2La_4)^2- \\ 4(b-1)(L^\circ(a_1+a_2)+2L(-8+a_1-a_2))a_5\end{array}}\end{array}}{2a_5}$$

$$\overline{\phi_b} = \frac{\begin{array}{c}2(1+a)bL^\circ(a_1/a)+2L^\circ a_2+4La_4+ \\ \sqrt{\begin{array}{c}(4(L^\circ((1+a)b(a_1/a)+a_2)+2La_4)^2- \\ 4(b-1)(L^\circ(a_1+a_2)+2L(-8+a_1-a_2))a_5\end{array}}\end{array}}{2a_5}$$

with

$$\begin{aligned} a_1 &= 2a(\theta-2)^2, \quad a_2=(\theta-4)\theta, \quad a_3=1+b \\ a_4 &= 8+ba_1+3a_2 \\ a_5 &= 2La_3(8+a_1+a_2)+L^\circ(a_3a_1-a_2+b(16+3a_2)) \end{aligned}$$

Figure 4 depicts how much these break points depend on parameters[11]. The horizontal axis measures the level of commuting costs, while the vertical axis plots the level of ϕ_b. Normal lines indicate the lower roots of $\underline{\phi_b}$ for three different values of the relative size of the external market, while the dashed lines show how the upper bound $\overline{\phi_b}$ varies with these parameters.

[11] In all the simulations we take the same values for σ,μ,α and L°: $\sigma=5, \mu=0.4, \alpha=1, L=L^*=0.3$ and $L^\circ=15$, when there is no opposite precision.

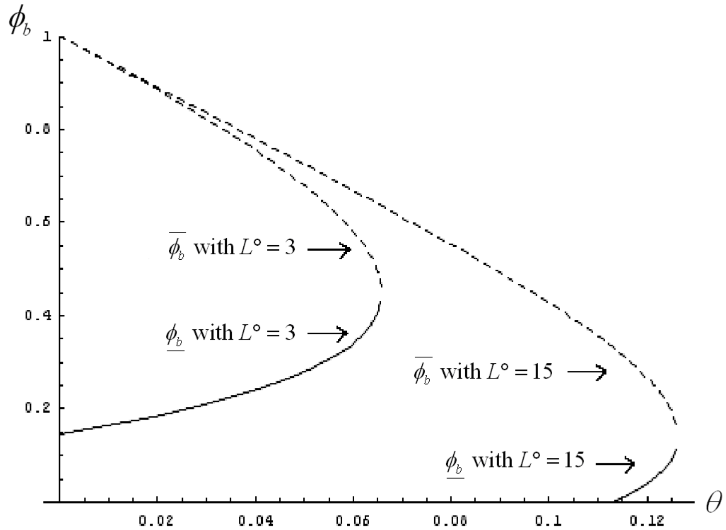

Figure 4 – The Break Points

Clearly the Figure 4 gives the following proposition:

Proposition 3 *An increase in the size of the external market and/or a decrease in commuting costs increase the interval between the upper and lower break point. Furthermore in the case of low commuting costs ($\theta < 0.1$) and a big external market ($L^\circ = 15$) there is only one break point.*

3.1 Gradual agglomeration and catastrophic dispersion

Because there are two sustain points and two break points, the location configuration is going to follow a unversed U-curve trade liberalization where such as dispersion first appears, where agglomeration occurs later followed by dispersion. However, as we have just seen in the previous section, for some value of parameters there is one break point.

Wiggle diagrams In order to get a full understanding of how the size of regions globally changes, we make numerical simulations and obtain the so-called 'wiggle and tomahawk diagram'. That gives:

Proposition 4 *In simulations, trade liberalization fosters a gradual agglomeration at first, then a total agglomeration, and next a catastrophic dispersion.*

From gradual to total agglomeration The wiggle diagram plots the relative real wages in the North as a function of the number of entrepreneurs located in this country. In Figure 5 we consider the case of four different high transaction costs.

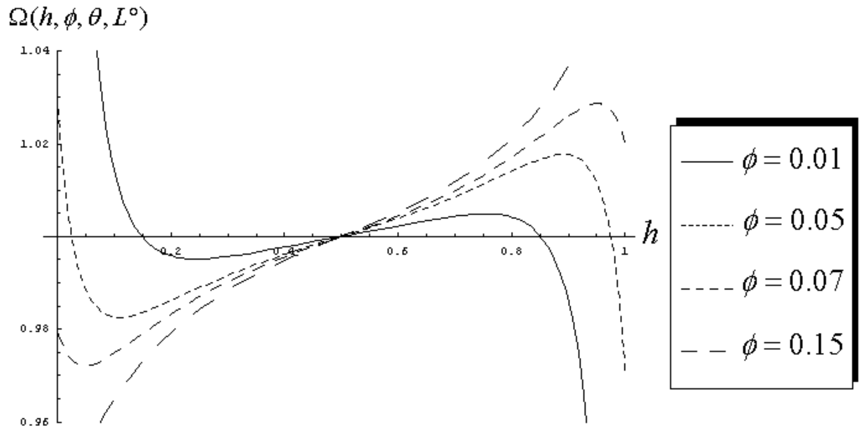

Figure 5 – Gradual agglomeration

In the case of high transaction costs, the model develops an interesting and new feature because there is neither a total dispersion of activities, as in the Krugman (1991.a) model, nor a total agglomeration as in the Krugman and Livas (1996) model, but an intermediate case of partial agglomeration. As we can see in Figure 5 for the regular line ($\phi = 0.01$) and dashed line ($\phi = 0.05$), the relative real wage crosses the horizontal line three times, indicating that there are three interior equilibria, whose sole extremes are stable. Indeed at $h = 1/2$, the relative real wage has a positive slope, which means that a south-to-north migration (or the reverse) is interesting for entrepreneurs, but this interest stops before agglomeration becomes total, indeed the normal line (dashed line) shows that after $h = 0.85$ ($h = 0.97$), the welfare in the South is higher than that in the North, which then makes the partial agglomeration stable.

Furthermore, trade liberalization leads to a total agglomeration, for instance the two small dashed lines ($\phi = 0.07$ and $\phi = 0.15$) show that only a total agglomeration in the South or in the North is stable (the relative real wage has a positive slope).

From agglomeration to dispersion On the Figure 6 we again plot the relative real wages in the North as a function of the number of entrepreneurs for three different values of trade costs. When trade is restricted ($\phi = 0.38$) the location equilibrium reaches a total agglomeration, but if this agglomeration is stable for such a high degree of transaction costs, at intermediate level however, this stability is not unique, both dispersion and agglomeration are possible ($\phi = 0.42$). Indeed in such a case, the location solution depends on the number of workers who can benefit from being agglomerated. If only a small group of southern workers tries to move to the North ($h < 0.8$), then the relative real wage in this region decreases below unity so that workers would regret their move and the world economy comes back to the dispersive equilibrium. Conversely, if the migration shock is higher, then it generates a higher real wage in the North than in the South, and a total agglomeration appears.

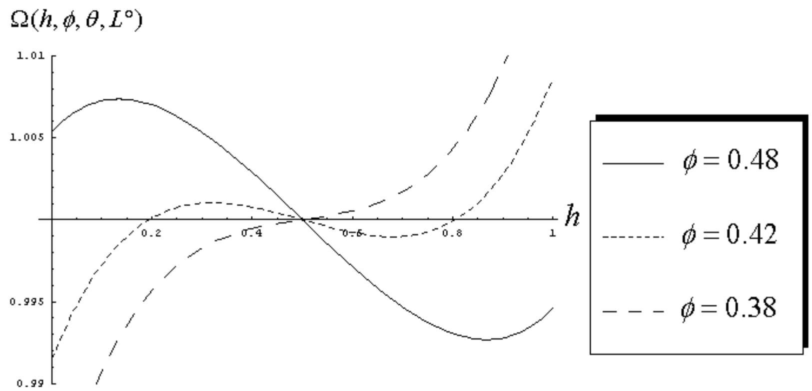

Figure 6 – Catastrophic dispersion

Lastly at a lower level of trade costs ($\phi = 0.48$), the only stable equilibrium is dispersion, indeed from the dispersed equilibrium ($h = 1/2$), any South-North migration implies a decrease in the relative real wage in the North, thus migrants would prefer to return home and dispersion is a stable equilibrium.

The Tomahawk diagram The Tomahawk diagram summarizes this and shows how much the size of regions globally changes with trade liberalization. In Figure 7, the vertical axis measures the number of workers in the North, while the horizontal axis shows the level of trade liberalization.

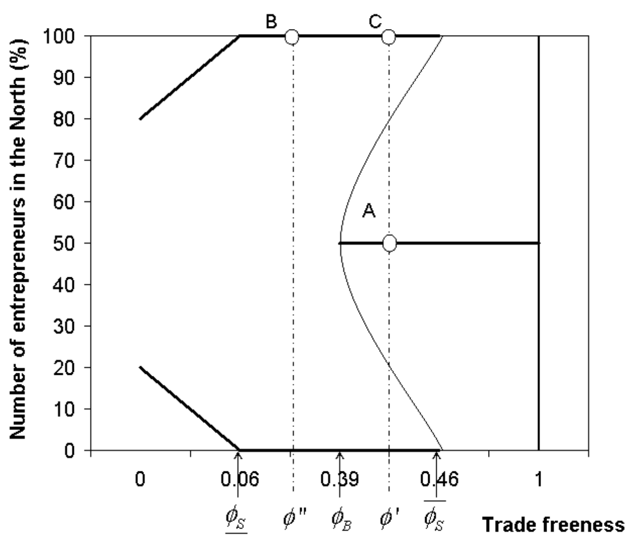

Figure 7: The tomahawk diagram

In this model, four effects determine mobile workers' choice of location (i.e. firms) : the 'market-access effect', the 'cost-of-living effect', the 'local competition effect', and the 'land market-crowding effect'. While the market access effect entails a growth in nominal wages, the cost-of-living effect results in a price reduction. Limiting the effects of these agglomeration forces, the competition effect and the land market crowding effect, play an opposite role and represent the two forces of dispersion of the model. One very important characteristic of the former three forces, is that they all drop toward zero with trade freeness[12], while the latter is constant which means that for high trade liberalization, after $\overline{\phi_s}$, this last force can dominate, and the dispersion of activities becomes the only stable equilibrium. However between $\overline{\phi_s}$ and ϕ_b the difference between opposite forces is small and agglomeration as well as dispersion become sustainable, contrariwise before ϕ_b the land market crowding effect and competition effect are overtaken, then a stable agglomeration appears until ϕ_s. Before ϕ_s firms flee the competition through a partial de-agglomeration.

One of the most interesting facts of the tomahawk diagram, is that trade policy may have no effect for a while, activities remaining dispersed when countries increase their degree of protection (for instance from free trade to ϕ' at A) but a sudden catastrophic effect appears for a higher trade cost (for instance ϕ''). Thus in B, if the whole society takes care of inequality among individuals, or if a global government exists and has a Rawlsian social welfare function, then agglomeration is detrimental (see Charlot et al. (2006)), but coming back to the previous trade policy, ϕ', does not guarantee that one comes back to the dispersed equilibrium, indeed the economy could move from B to C, and not back to A. Thus, location suffers from hysteresis.

3.2 Individual welfare

Until now we have only analyzed entrepreneurs' relative welfare. Here we propose a finer analysis by studying the individual welfare of the four interest groups (h entrepreneurs in the North, h^* in the South, L workers in the North and L^* in the South) which are given by:

$$\begin{aligned} V_h(h,\phi,\theta,L^\circ) &= \frac{(1-\theta h/2)w}{\Delta^{-a}} \\ V_h^*(h,\phi,\theta,L^\circ) &= \frac{(1-\theta h^*/2)w^*}{(\Delta^*)^{-a}} \\ V_L(h,\phi,\theta,L^\circ) &= \frac{1}{\Delta^{-a}} \\ V_L^*(h,\phi,\theta,L^\circ) &= \frac{1}{(\Delta^*)^{-a}} \end{aligned}$$

[12] For instance, in the extreme case of free trade, a delocalisation of firms has no impact on local competition and on the cost of living because the notion of distance has disappeared. The market access also becomes easier, so the advantage to be located on the central place to supply the largest demand vanishes.

The objective is to analyze these expression under the two opposite equilibria, agglomeration and dispersion, and then we want to compare them in order to determine which one is the better social outcome.

Welfare under agglomeration When all entrepreneurs are located in the North, the welfare of this population is given by:

$$V_h(1,\phi,\theta,L^\circ) = \frac{2b(2L+L^\circ)(1-\frac{\theta}{2})^a(\theta-1)}{(1-b)(\theta-2)} \tag{31}$$

According to this expression entrepreneurs do not care about transaction costs and this is easily understood by the fact that 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:

$$V_L(1,\phi,\theta,L^\circ) = (1-\frac{\theta}{2})^a \tag{32}$$

$$V_L^*(1,\phi,\theta,L^\circ) = ((1-\frac{\theta}{2})\phi)^a \tag{33}$$

Furthermore, even if they do not commute, commuting costs affect their welfare in both locations because these costs decrease the number of variety available, and then raise the cost of living (price index) everywhere.

Welfare under dispersion Under dispersion entrepreneurs' and workers' welfare are given by:

$$V_h(\frac{1}{2},\phi,\theta,L^\circ) = V_h^*(\frac{1}{2},\phi,\theta,L^\circ) = \frac{2^{1-3a}b(2L+L^\circ)(\theta-2)(4-\theta)^{a-1}(1+\phi)^a}{b-1} \tag{34}$$

$$V_L(\frac{1}{2},\phi,\theta,L^\circ) = V_L^*(\frac{1}{2},\phi,\theta,L^\circ) = (\frac{1}{2}(1-\frac{\theta}{4})+\frac{1}{2}(1-\frac{\theta}{4})\phi)^a \tag{35}$$

Agglomeration versus dispersion An entrepreneur prefers agglomeration to dispersion when $V_h(1,\phi,\theta,L^\circ) > V_h(\frac{1}{2},\phi,\theta,L^\circ)$, which is satisfied (by using (31) and (33)) when:

$$\phi < \phi_h = \frac{(4^a(2-\theta)^{a-2}(4-5\theta+\theta^2))^{1/a}}{4-\theta} - 1 \tag{36}$$

This result generalizes the findings of Charlot et al. (2006) who analyze welfare in a model without commuting costs (Forslid and Ottaviano model), and find in their proposition 3 that "Whatever the level of transport costs, all skilled workers prefer agglomeration to dispersion", indeed here with $\theta = 0$, entrepreneurs prefer agglomeration from autarky to free trade, because in a such case $\phi_h = 1$.

Concerning workers, those in the North prefer agglomeration to dispersion under the condition that $V_L(1,\phi,\theta,L^\circ) > V_L(\frac{1}{2},\phi,\theta,L^\circ)$. By using equation

(32) and equation (35) such a result is obtained when:

$$\phi < \phi_L = \frac{3\theta - 4}{\theta - 4} \tag{37}$$

In the particular case where there are no commuting costs, northern workers always prefer the agglomerative equilibrium. In the next figure we plot these two critical points (ϕ_h is the black curve which separates the white and gray area, and ϕ_L the limit of the gray and black area), the vertical axis measures the level of trade liberalization while the horizontal axis measures the level of commuting costs. This figure shows that:

Proposition 5 *Conflict of group interest in the North: whatever the value of commuting costs, θ, we have $\phi_L > \phi_h$, which means that if the degree of trade liberalization is between $[\phi_h, \phi_L]$, then entrepreneurs prefer dispersion while workers prefer the agglomerative equilibrium.*

Proof. we want to prove that $\phi_L > \phi_h$, which is equivalent to $\frac{\phi_h}{\phi_L} < 1$ which gives after rearrangement from (36) and (37):

$$\begin{aligned} 4 - 5\theta + \theta^2 \quad &< \quad (2-\theta)^2 \\ &\iff \quad 5 > 4 \end{aligned}$$

Thus whatever the value of θ, we have $\phi_L > \phi_h$. ■

In the South, a worker always prefers dispersion to agglomeration, indeed by using equation (33) and equation (35) we get:

$$V_L^*(1, \phi, \theta, L^\circ) - V_L^*(\frac{1}{2}, \phi, \theta, L^\circ) = -(\frac{(4-\theta)(1+\phi)}{8})^a + \phi(1 - \frac{\theta}{2})^a < 0$$

Thus we have:

Proposition 6 *Pareto improvement: whereas southern workers are always against agglomeration, northern workers are in favor of such an equilibrium when the degree of trade liberalization is lower than $\phi_L = \frac{3\theta-4}{\theta-4}$, but beyond this level, dispersion becomes Pareto improving.*

Figure 8 summarizes these findings, the white area shows that for high commuting costs and low trade costs, dispersion Pareto dominates agglomeration because all individuals are better off in such a situation. In the orange/gray area, where the level of trade costs and commuting costs are intermediate, workers in the North are worse off when dispersion appears, whereas workers in the South and entrepreneurs are better when agglomeration switches to dispersion. Finally, the black area shows that when commuting costs are low, entrepreneurs and workers in the North see their situation improved through the agglomeration of activities, while welfare in the periphery decreases.

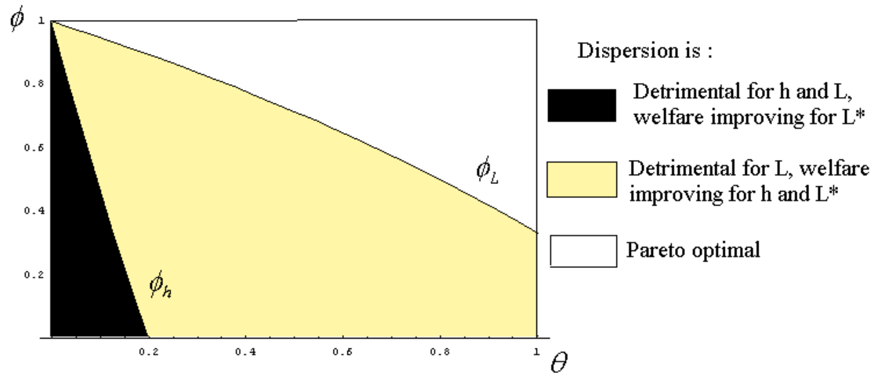

Figure 8 – Dispersion versus agglomeration

These results concerning welfare are less ambiguous than those obtained by Charlot et al. (2006) in the sense that in their model none of the two equilibria Pareto dominates the other.

3.3 Agglomeration rent

Agglomeration is interesting in the North when $\Omega(1, \phi, \theta, L^{\circ}) > 1$, which means that in such a case, an agglomeration rent exists in the North, but what is the shape of this rent? At $h = 1$ the agglomeration rent in the North is given by the following expression:

$$\Omega(1, \phi, \theta, L^{\circ}) = \frac{(\frac{L}{2} + L^{\circ})(1-\theta)\phi^{1-a}}{\frac{L}{2}(2-(1+b)(1-\phi^2))/2 + L^{\circ}\phi(1-b(1-\phi))} \tag{38}$$

To see how this agglomeration rent varies with transactions, we log differentiate it, which gives:

$$\begin{aligned}\frac{d\Omega(1, \phi, \theta, L^{\circ})/\Omega}{d\phi/\phi} &= (1-a)(\frac{L}{2} + L^{\circ})(1-\theta) \\ &\quad - \frac{2\phi^2((1+b)\frac{L}{2} + L^{\circ}/\phi + 2L^{\circ}b)}{\frac{L}{2}(2-(1+b)(1-\phi^2)) + 2L^{\circ}\phi(1-b(1-\phi))}\end{aligned}$$

this expression is increasing and decreasing in ϕ, we thus make some simulations in order to illustrate this.

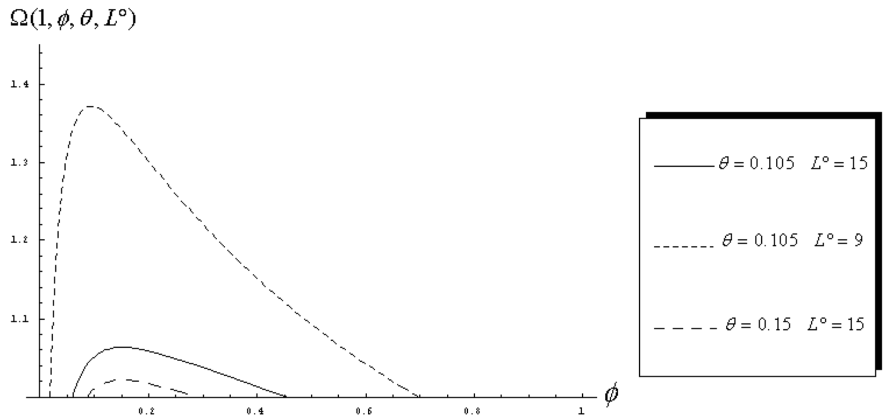

Figure 9 – The agglomeration rent

Figure 9 gives the following proposition:

Proposition 7 *An increase in the size of the external market (small dashed line to regular line) or in commuting costs (regular line to dashed line) decreases the agglomeration rent. However the bell-shaped configuration is not affected.*

4 Trade and governance when activities are agglomerated?

In this section we want to analyze the tax policies of a central government in the case of a total agglomeration of activities, so we henceforth limit ourselves to $\phi \in [\underline{\phi_s}, \overline{\phi_s}]$. Furthermore, we assume that this central government levies a tax t on the nominal income in the Core and in the Periphery:

$$G = tY + t^*Y^*$$

With Andersson and Forslid (2003) we assume that the government consumed the average consumption basket, in other terms a share $1-\mu$ of the tax revenue is spent on agricultural good and a share μ on manufactures. Thus the composition of demand and all the variables that we have analyzed here (wages and prices) are not affected by the tax because the government spends its revenue in the same way as the average consumer[13]. We are going to consider that this central government is totally corrupted since it embezzles all the revenue from taxation. Furthermore, if this government wants to keep the agglomeration of activities

[13] See also Baldwin et al. (2004, p384) for an explanation of this.

in the North (we assume that this government is located in this city), it needs to verify the following condition[14]:

$$\Omega(1, \phi, \theta, L^{\circ}) \geq \frac{(1-t^*)}{(1-t)}$$

According to this expression the higher tax rate, denoted $\bar{t}$, that the government can set in the North is a function of $\Omega(1, \phi)$ and t^* and is given by:

$$t \leq \bar{t} = 1 - \frac{(1-t^*)}{\Omega(1, \phi)}$$

With respect to this upper bound, t and t^* are chosen in order to maximize[15]:

$$\begin{aligned} W &= \Theta c + G \\ \Theta &= (1 - eE(t) - rR(t^*)) \end{aligned}$$

where W can be considered as the expected utility of the power with Θ the government's probability of survival, where $eE(t)$ is the probability of an electoral change of government. The parameter e measures the weight of the electorate and thus a high e indicates democracy. As there is agglomeration in the Northern city, and thus more than half of the total population, the election function is based on the taxes facing the median voter. $rR(t^*)$ is the probability of a revolt of the periphery where r measures the level of instability. This probability of revolt is assumed to be a function of the level of taxation t^*. c is a parameter measuring the value of survival. Because we want an objective function that is general enough to represent the behavior of a corrupted government as well as the objective of a non corrupted government too, we choose Θ such as:

$$\Theta = k - \frac{et^2}{2} - \frac{rt^{*2}}{2}$$

W is thus concave in tax rate since a Leviathan as well as a benevolent government are sucessively risk lover and risk adverse when they increase their tax rate. Indeed in the both cases their objective functions rise with the revenue collected and decline with the tax rate. However because the tax rate also has an impact on the revenue, its shift 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 tax rate increases which is verified here.

Hence, when entrepreneurs are agglomerated in the North, the objective function of the government becomes:

$$W = kc - \frac{et^2}{2}c - \frac{rt^{*2}}{2}c + tY + t^*Y^* \tag{39}$$

[14] The indirect utility net of taxation in the North needs to be higher than the indirect utility net of taxation in the South: $V(1, \phi)(1-t) \geq V^*(0, \phi)(1-t^*)$

[15] This objective function has been borrowed from Ades and Glaeser (1995)

In such a context the government needs to maximize W with respect to t, t^* under the constraint to keep the Core in the North. The Lagrangian is given by:

$$L = W + \lambda(1 - t + \frac{(1-t^*)}{\Omega})$$

Then the first-order conditions give[16]:

$$t = \frac{Y + \Omega(L^* + rc(\Omega - 1))}{c(e + r\Omega^2)} \tag{40}$$

$$t^* = 1 - (1 - \frac{Y + \Omega(L^* + rc(\Omega - 1))}{c(e + r\Omega^2)})\Omega \tag{41}$$

In order to simplify the analysis we are going to consider two polar cases, the first one assumes that countries are developed in the sense that there is a high degree of democracy and a low level of instability, and the second one considers what happens on the opposite, i.e when countries have a low level of democracy and a high level of instability. Under these assumptions, we can turn to the level of corruption, because this government does not supply any public good, the amount embezzled is equal to:

$$G = tY + t^*Y^*$$

Thanks to this expression we find the following proposition which demonstrates that under a critical value of c (denoted c_1) the amount embezzled is bell-shaped:

Proposition 8 *The way trade liberalization affects corruption depends on parameter c as summarized in the following table:*

	0 — c_1	c_1 — c_2	c_2 — c
Democracy/stability	Bell-Shaped	Bell-Shaped	U-curve
Dictatorship/instability	Bell-Shaped	U-curve	U-curve

Table 4.1: Corruption, trade and power value

Proof. We have:

$$\frac{\partial G}{\partial \phi} = \frac{\partial t}{\partial \phi}Y + \frac{\partial t^*}{\partial \phi}Y^* \tag{42}$$

and in the eq.(40) the only variable that depends on ϕ is Ω thus we get:

$$\frac{\partial t}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}\frac{(L^* + rc)(ce + cr) - (Y + L^*)2cr}{c^2(e + r\Omega^2)^2} \tag{43}$$

[16] If the constraint does not bind, the tax rate in the North is given by $t = \frac{Y}{ec}$ and in the South by $t^* = \frac{Y^*}{rc}$, these two tax rates are thus constant with respect to ϕ

therefore at $e = 1$, $r = 0$:

$$\frac{\partial t}{\partial \phi} = \frac{L^*}{c}\frac{\partial \Omega}{\partial \phi} \tag{44}$$

then the tax rate in the Core follows the shape of the agglomeration rent when trade is liberalized.

Moreover, we know that in order to avoid migration, t^* is given by:

$$t^* = 1 - (1 - t)\Omega$$

thus

$$\frac{\partial t^*}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(t - 1) + \frac{\partial t}{\partial \phi}\Omega \tag{45}$$

and by using (44) we get:

$$\frac{\partial t^*}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(t - 1 + \frac{L^*\Omega}{c}) \tag{46}$$

by inserting t into this equation, which is given at $e = 1$, $r = 0$ by $t = \frac{Y+\Omega L^*}{c}$ we obtain:

$$\frac{\partial t^*}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(\frac{Y + 2\Omega L^* - c}{c}) \tag{47}$$

hence if $c < Y + 2\Omega L^*$ then the tax rate in the Periphery is a bell-shaped function of ϕ.

Then when $e = 1$, $r = 0$ we get by using (44) and (47) in (42):

$$\frac{\partial G}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(\frac{L^*Y + YY^* + 2\Omega L^*Y^* - cY^*}{c})$$

because $Y^* = L^*$ this expression can be simplified as:

$$\frac{\partial G}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(\frac{L^*(2Y + 2\Omega L^* - c)}{c})$$

hence if $c < c_2 = 2Y + 2\Omega L^*$, then the embezzled amount is bell-shaped with respect to ϕ at the reverse if $c > c_2$ the embezzled amount follows a U-curve.

Considering now the case where $e = 0$, $r = 1$ we get:

$$t = \frac{Y + L^* + c(\Omega - 1)}{c\Omega^2} \tag{48}$$

by differentiating this expression we obtain:

$$\frac{\partial t}{\partial \phi} = -\frac{\partial \Omega}{\partial \phi}\left[-c^2\Omega^2(1 - 2L^*) + 2\Omega c(Y - L^*)\right] \tag{49}$$

where the first term into bracket is equal to zero since $L^* = \frac{1}{2}$, and where the second term is positive because $Y = hw_h + L$ with $L = L^*$. The sign of $\frac{\partial t}{\partial \phi}$ is thus the reverse of $\frac{\partial \Omega}{\partial \phi}$, an increase in trade openness first decreases and next increases the tax rate in the Core. Moreover by using (45) and (49) we obtain the variation of t^* with respect to ϕ:

$$\frac{\partial t^*}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(t - 1 - 2\Omega^2 c(Y - L^*))$$

replacing t by (48) yields:

$$\frac{\partial t^*}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}(\frac{c\Omega(1 - \Omega - 2\Omega^3 cY + 2\Omega^3 cL^*) + Y + L^* - c}{c\Omega^2}) \tag{50}$$

the first term in brackets is negative since $\Omega > 1$ and $Y > L^*$ and the second one also if $c > Y + L^*$. Consequently if $c > Y + L^*$ the tax rate in the Periphery follows the sign of $-\frac{\partial \Omega}{\partial \phi}$.

Then when $e = 0$, $r = 1$ we get by using (49) and (50) in (42) :

$$\frac{\partial G}{\partial \phi} = \frac{\partial \Omega}{\partial \phi}\left[\frac{c\Omega(1 - \Omega - 2c\Omega^3(Y - L^*)) + Y + L^* - c}{c\Omega^2}Y^* - 2\Omega c(Y - L^*)Y\right]$$

The terme into bracket is negative if $c > c_1 = \frac{(L+Y)}{2(L-Y)Y\Omega^2 + Y^*(-1+\Omega-\Omega^2+2(L-Y)\Omega^4)}$, in such a case the embezzled amount follows a U-curve, at the reverse if $c < c_1$ then the embezzled amount is bell-shaped with respect to ϕ. ■

We can be more accurate on c by introducing time into the analysis, the intertemporal budget constraint is given by:

$$\begin{aligned} W &= \Theta c + G \\ &= G + \Theta\frac{G}{1+\rho} + \Theta^2\frac{G}{(1+\rho)^2} + ... + \Theta^{t-1}\frac{G}{(1+\rho)^{t-1}} \end{aligned}$$

which gives:

$$c = \left[\frac{\Theta}{1+\rho} - \left(\frac{\Theta}{1+\rho}\right)^t\right]\frac{G}{(1 - \frac{\Theta}{1+\rho})\Theta}$$

where ρ is the discount rate. The main difference between a corrupted government in a democracy and in a dictatorship concerns their time of living, in a democracy, for instance in USA or in France, the time of living cannot exceed two periods, while expected survival in a dictatorship is infinite, then we get:

$$\begin{aligned} c_{dem} &= \frac{G}{1+\rho} \\ c_{dic} &= \frac{G}{1+\rho-\Theta} \end{aligned}$$

and by using the equation of tax rates (40) and (41) and the fact that in stable democracy $e = 1$, $r = 0$ while in unstable dictatorship $e = 0$, $r = 1$ we obtain:

$$c_{dem} = \frac{Y^* - Y^*\Omega + \sqrt{Y^{*2}(\Omega-1)^2 + 4(1+\rho)(Y+L\Omega)(Y+Y^*\Omega)}}{2(1+\rho)} \tag{51}$$

$$c_{dic} = \frac{Y(\Omega-1)\Omega + \sqrt{Y^2(\Omega-1)^2 - 4\rho\Omega^3(L-Y^*)(Y+L\Omega)}}{2\rho\Omega^2} \tag{52}$$

We rely on simulation in order to know where c_{dem} and c_{dic} are ranked in comparison with c_1 and c_2.

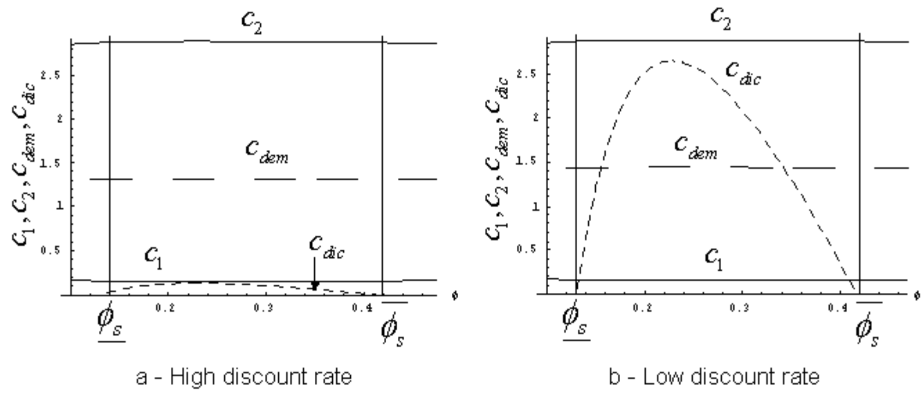

Figure 10 – Discount rate and the value of surviving

In the Figure 10.a we plot c_{dem}, c_{dic}, c_1 and c_2 under a high interest rate (equal to 0.2), and then we observe that c_{dem} belong to the interval $[c_1, c_2]$ for every value of trade costs, while c_{dic} is smaller than c_1. Thanks to the Table 1 this gives the following result : *bad governance is bell-shaped in stable democracy and in unstable dictatorship with respect to trade liberalisation when the discount rate is high.*

Interestingly, the Corruption Perception Index reported in the introduction for countries which differ hugely by theirs institution does seem to have followed such a pattern over the period 1980-2004. However when the discount rate is low (see Figure 10.b, $\rho = 0.01$) this result vanish for unstable and dictatorship regime, indeed in such a case c_{dic} belong to the interval $[c_1, c_2]$ for a wide range of trade costs, and then (see Table 1) corruption becomes a U-curve.

5 Concluding remarks

Recent empirical studies reveal that spatial concentration follows a bell-curve with trade liberalization. The model that we have developed here, follows these empirical findings, and is in accordance with Tabuchi (1998), Puga (1999) and Ottaviano et al. (2002)'s conclusion, indeed we have shown that trade liberalization brings the spatial pattern from dispersion to agglomeration, and from agglomeration to dispersion. Furthermore, we have demonstrated that dispersion is the better social outcome under some conditions, indeed the transition from agglomeration to dispersion is Pareto improving when commuting costs are high and trade costs low.

Concerning corruption, in his book untitled "With a little help from my friends, planning corruption in Ireland", Paul Cullen describes how the Celtic tiger has generated bribery during the last thirty years and in a more academic way, Ades and Glaeser (1995) also show how bad governance and trade were linked in the origin of urban giants such as Rome (50 B.C.E), London (1670 C.E), and Buenos Aires (1900 C.E). In the present model, we have seen that under democracy and stable regimes or in dictatorships and unstable regimes, this bad governance can first increase and next decrease with trade freeness. Accordingly, this result suggests that linear econometric methods are not adapted to study the link between corruption and trade, and that estimation based on historical data may provide a misleading picture concerning the future impact of trade liberalization on institutional change.

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