

# Trade liberalization, industrialization and specialization in a North / South model

Corinne Bagoulla<sup>1</sup>  
Economic Laboratory of Nantes (LEN)  
University of Nantes

Version: February 11, 2005

This paper aims to analyse the relationship between international trade theory and economic geography models. We simultaneously introduce countries specialization in an imperfect competition sector and the agglomeration process.

We suggest an extension of Ricci's model (1999) including two countries, two production factors (capital and labour) and three sectors (two industrial sectors and an agricultural sector). The introduction in the model of a Ricardian comparative advantages encompassing a difference in productivity per sector/country and a difference in wages per country gives rise to a "market size effect". It also permit to take into account separately the impact of productivity and of wages on firms' location.

Trade liberalization increases agglomeration and specialization effects. Indeed, to be more diversified and to attract firms, the South has to increase its market size (its wage) and to make up for this loss of "advantage in terms of low wages" by an improvement of its industrial productivity.

*Key Words:* economic geography, economic integration, imperfect competition and increasing returns model, industry, comparative advantage.

---

<sup>1</sup>Faculté des sciences économiques et de gestion b.p.52231-F-44322 Nantes cedex 3 - Tel : + 33 (0) 2.40.14.17.41-E-Mail :corinne.bagoulla@sc-eco.univ-nantes.fr.

## 1. INTRODUCTION

In the last few years, many free trade agreements have been made between unequally developed countries (The Elargement of the European union, the Euromed liberalization process...). This kind of agreement has always envisaged the lowering of tariff and non-tariff barriers as regards the exchange of manufactured goods. Such cutting of the "costs of exchange" is likely to weigh upon the choice of location of the firms and will thus have an impact on the industrial framework of the countries concerned by these agreements.

The traditional international trade theories underline the countries' interest in liberalizing their exchanges and in specializing according to their comparative advantages. Contrary to this, new theories (trade theories or economic geography) introduce imperfect competition and show the significance of the "market size effect". The companies pursuing free exchange will be concentrated within a single localization. The two above mentioned effects have both a role to play at a time of trade liberalization. It consequently seems necessary to study these various effects in a single model.

This article simultaneously deals with the industrial agglomeration and the specialization of those countries within the economic activity subject to agglomeration effects (activities with increasing returns to scale).

There exists a great deal of literature covering industrial agglomeration. The models in economic geography - Krugman (1991a, 1991b, 1991c), Krugman and Venables (1995) - analyze this type of issue within a framework of imperfect competition (Dixit and Stiglitz, 1977). In these models, the confrontation of "centripetal" and "centrifugal" forces explains the dynamics of the spatial agglomeration of the industrial activities. Following a dwindling in the costs of transport, firms are encouraged to locate to a larger market in order to reap benefits from the economies of scale and pecuniary externalities. The origin of the "forces of agglomeration" is however different, depending on the model. It can be related to the mobility of labour and engineer a process of "cumulative causality" (Krugman, (1991,1991b,1991c)) or point to the existence of "interindustrial bonds" (Krugman and Venables (1995), Puga and Venables (1996a, 1996b, 1997). Nevertheless, work remains the only factor necessary for the production of the differentiated goods, and this creates one of the limitations to traditional geographical models.

On the contrary, other models, make capital their prime concern (Martin and Ottaviano (1999), Baldwin and Forslid (2000a, 2000b), Martin and Rogers (1995). They pool the models in economic geography and those of endogenous growth (using the Romer (1990) or Grossman and Helpman models (1991,1995) to start off). The interrelationships between growth (the creation of new varieties of good) and agglomeration are studied and emphasis is placed on the paramount part played by the capital build-up. Capital output determines the choice of the firm's location (Martin and Ottaviano, 2001).

The above models tackle the question of industrial agglomeration by comparing two similar countries. More explicitly, it is advisable to consider the differences between countries within the framework of a North-South agreement. Certain models simultaneously consider the mechanisms of industrial agglomeration and the concept of comparative advantages. Forslid and Wooton (1999) assimilate the comparative advantages through the difference in fixed costs. Others analyse the relative significance of the comparative advantages and inter industrial links with the firms' location (Amiti, 2002).

Contrary to the previously mentioned models, Ricci (1999) hypothesizes the existence of three sectors : an agricultural sector in perfect competition and two industrial sectors, both in monopolistic competition in their own markets. The comparative advantages are represented by differences in the marginal cost between the industrial sectors according to locations. However, this model only considers the existence of a single factor of production, i.e., labour.

Our article is an extension of the Ricci model (1999). Its object is to identify the respective roles

of trade liberalization, of comparative advantages and of market size on industrial agglomeration and the specialization of countries in sectors with monopolistic competition. The model being appraised comprises two countries (“North” and “South”), three goods (two industrial goods and an agricultural good) as well as two factors of production (labour and capital). It differs from Ricci’s model in different ways. First, capital is introduced into the model. The transfer of capital is an essential growth promoter for the developing countries whose capacity to invest remains limited because of their poor rate of saving. It’s the capital output which will determine the location of the firms. Moreover, the two industrial sectors are differentiated, which allows us to study them separately. The comparative advantages used here are different to those used by Ricci. These are illustrated by a difference in labour costs between sectors and countries and simultaneously introduce differences in wages and differences in productivity. Lastly, the market size evaluated by incomes in our model (and not by population) has a substantial impact on this model<sup>2</sup>. We so operate a direct link between specialization (resulting from the international trade theory) and industrial agglomeration.

The construction of the model is described in the second section, while the analysis of the model and the principal results will be referred to in the third section.

## 2. THE PRESENTATION OF THE MODEL

The model is an extension of Ricci’s model (1999). It considers two countries (the North and the South), three sectors (one agricultural and two industrial), and two production factors (labour and capital).

The model is inspired by Madariaga (2001) and Martins and Rogers (1995) for the introduction of the capital factor. Nevertheless, our model doesn’t only study the core-periphery structure. The introduction of two different industrial sectors will make it possible to determine the respective implications of the comparative advantages (and absolute advantages) and of “market size” on firms’ agglomeration and on the degree of specialization of countries in one of the two industrial sectors.

In a situation of perfect competition, the agricultural sector produces a homogeneous good with the labour factor. The industry comprises two sectors with increasing returns to scale. These sectors produce differentiated goods in monopolistic competition (Dixit-Stiglitz, 1977). One of them produces low added value goods (good B) and the second produces high added value goods (good A). These goods incur a Samuelson-type trade cost (1954).

Both countries have the same endowment in capital and labour. Unlike Ricci’s model, labour is only mobile between sectors and not between countries. The capital is introduced into the model and is mobile between countries. Consequently, the owner of this capital could be in the North and invest in the South, yet his profits return to the North<sup>3</sup>. However this assumption draws a distinction between the holding of capital and the using of it<sup>4</sup>. As the capital is mobile, no country can offer higher profits than the other at equilibrium and the industrial spread thus remains stable in the model.

The North has an absolute advantage in the production of the various goods. This advantage is related to the greater labour productivity in the North than in the South, whatever the sector considered. In the North, the techniques of production are more effective and better use is made of the production capacities than in the South. This variation in productivity results in a difference in wages in the agricultural sector between countries. As labour is mobile between the sectors, the wages must be equal in all sectors. Thus in the North, the wages are equal to the unit while in the South they are

---

<sup>2</sup>It’s also worth considering two distinct sectors within an industry. Not all industrial sectors require the same techniques of production and the countries will probably have a comparative advantage in a precise sector rather than in another (particularly in the case of a North-South agreement).

<sup>3</sup>Thus, the South will be able to benefit from the foreign capital in order to industrialize more quickly.

<sup>4</sup>The incomes can be spent in a given area while physical capital is used in the other.

below the unit. This assumption allows us to introduce a difference in income between the countries and thus a market size effect in the model.

Finally, we suppose that the North has a comparative advantage in the production of the high added value good and symmetrically that the South has a comparative advantage in the production of the low added value good. Thus, the North specializes in the production of Good A and the South in Good B. These comparative advantages are represented by a difference in labour costs in the industrial sectors between the North and South. These costs are defined by wages multiplied by the productivity inverse.

The aim is to prove a point often raised in the North-South configuration. The existence of low wages in the South penalizes industries in the North and parallel to this, the productivity raised in the North handicaps the firms in the South. It's thus essential to simultaneously take the productivity and the wages into account and this we do here.

## 2.1. Demand

In this section, we will define both the characteristics and the behavior of the consumers. The preferences of a representative agent are illustrated by a Cobb Douglas utility function. The consumer of area  $k$  (with  $k=N, S$ ), divides its consumption between the agricultural good ( $Y$ ), and the various varieties of the two differentiated goods ( $A$  and  $B$ ).

$$U_k = Y_k^{1-\delta} C_{Ak}^{\delta(\gamma)} C_{Bk}^{\delta(1-\gamma)} \quad 0 < \gamma < 1, 0 \leq 2\delta < 1 \quad (1)$$

$$C_{Ak} = \left( \sum_{i=1}^{n_A} c_{iAk}^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} \quad \text{and} \quad C_{Bk} = \left( \sum_{i=1}^{n_B} c_{iBk}^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} \quad ; \sigma > 1 \quad (2)$$

The agents thus allot a share  $(1 - \delta)$  of their expenditure to the consumption of the agricultural good ( $Y$ ) and a share  $(\delta)$  of their expenditure to the differentiated industrial goods<sup>5</sup>. This share itself is divided between consumption of the varieties produced by both industrial sectors ( $C_{Ak}$  et  $C_{Bk}$ ). The share  $(\gamma)$  is allocated in the consumption of Good ( $A$ ) and Share  $(1-\gamma)$  in Good ( $B$ ).  $n_A$  and  $n_B$  are given in an endogenous way and respectively illustrate the number of produced varieties of Good ( $A$ ) and Good ( $B$ ) on a global level. Lastly,  $\sigma$  represents the elasticity of substitution between the various varieties of the same good<sup>6</sup>. The budgetary constraint of a representative agent in the country ( $k=N, S$ ), is written :

$$p_y Y_k + \sum_{i=1}^{n_A} p_{iAk} C_{iAk} + \sum_{j=1}^{n_B} p_{jBk} C_{jBk} = R_k \quad (3)$$

$$\text{with } R_k = w_k + r_{Ak} \frac{K_{Ak}}{L_{Ak}} + r_{Bk} \frac{K_{Bk}}{L_{Bk}} \quad (4)$$

$p_y, p_{iAk}, p_{jBk}$ , respectively denotes the prices of Goods  $A$  and  $B$  in location  $k$ .

The prices of the differentiated goods include the transport cost when the varieties are imported from one area to another. These costs only affect the industrial sectors and are modelled according to the Samuelson method (1954)<sup>7</sup>.  $w_k$  reflects the salary in location  $k$  and,  $r_{Ak}$  and  $r_{Bk}$ , correspond respectively to the capital returns in sectors A and B in country  $k$ . The capital endowments are identical in both countries and these capital resources are divided between both sectors of each country

<sup>5</sup>Like Ricci (1999), we suppose that the consumers do not allot more than half of total expenditure in the industrial goods, in particular in order to avoid the full specialization of the countries.

<sup>6</sup>The more  $\sigma$  approaches the unit, the less the varieties are substitutable and, contrary.

<sup>7</sup>In order to consume one foreign good unit,  $\tau > 1$  units must be bought.

( $K_k = K_{Ak} + K_{Bk}$  et  $K = K_N + K_S$ ) Each agent therefore has a  $(\frac{K_{fk}}{L_{fk}})$  unit of the capital in each sector  $f$  ( $f=A, B$ ).

By maximizing the utility function under the consumer's budgetary constraint and supposing that the preferences are the same for all agents, we obtain the aggregate demands in each country for the homogeneous good and for a typical variety of both differentiated goods ( $f$ ) :

$$Y_k^d = (1 - \delta) * R_k * L_k, \quad f = A, B, k = N, S \quad (5)$$

$$x_{fN}^d = \frac{p_{fN}^{-\sigma}}{n_{fN}p_{fN}^{1-\sigma} + n_{fS}(p_{fS}\tau)^{1-\sigma}} \delta_\gamma R_N L_N + \frac{\tau(p_{fN}\tau)^{-\sigma}}{n_{fN}(\tau p_{fN})^{1-\sigma} + n_{fS}(p_{fS})^{1-\sigma}} \delta_\gamma R_S L_S \quad (6)$$

$$x_{fS}^d = \frac{\tau(p_{fS}\tau)^{-\sigma}}{n_{fN}p_{fN}^{1-\sigma} + n_{fS}(p_{fS}\tau)^{1-\sigma}} \delta_\gamma R_N L_N + \frac{p_{fS}^{-\sigma}}{n_{fN}(\tau p_{fN})^{1-\sigma} + n_{fS}(p_{fS})^{1-\sigma}} \delta_\gamma R_S L_S \quad (7)$$

The demand in each country ( $k$ ) for the differentiated goods ( $f$ ) produced in this country is thus equal to the sum of the demands from the North and the South for this good ( $f$ ) produced in  $k$ <sup>8</sup>.

## 2.2. Supply

The supply is made up of three distinct sectors, i.e., an agricultural sector and two industrial sectors. All of them have particular characteristics.

### 2.2.1. The agricultural sector

Work is the only necessary factor for the production of the agricultural good. This good is a homogeneous good, product with constant returns to scale and freely traded. In this sector, the demand is sufficiently important that the production remains in each country<sup>9</sup>. One labour unit is required to produce one unit of good ( $Y$ ). Given that the wages are different in each country :

$$Y_N = L_{Yk} \quad \text{and} \quad Y_S = \mu L_{Yk} \quad k = N, S \quad (8)$$

### 2.2.2. Industry

The industry is made up of two different sectors. Sector  $A$  produces high added value differentiated goods and sector  $B$  produces low added value differentiated goods<sup>10</sup>. A typical firm produces a unique variety of one of the two goods, with increasing returns to scales. Nevertheless, the capital assists only in the fixed costs and the variable costs are expressed in labour. Each variety of industrial good ( $A$  or  $B$ ) requires a unit of capital. As a result, the share of industries in an area is equal to the share of global capital used in this area. In the same way, the total number of varieties of each good produced in each country depends on the units of capital used in this country ( $K_k = n_{Ak} + n_{Bk}$ ). The total production cost for a standard variety of good of the sector  $f$  produced in  $k$  ( $x_{fk}$ ) is given by :

$$CT_{fk} = r_{fk} + w_{fk} \beta_{fk} x_{fk}, \quad f = A, B, k = 1, 2 \quad (9)$$

With,  $(\beta_{fk} w_{fk})$ , the marginal production cost of a unit of Good  $f$  in  $k$  (where  $w_{fk}$  illustrates the wages in sector  $f$  and in country  $k$  and,  $\beta_{fk}$ , the labour requirements).  $r_{fk}$  denotes the return on

<sup>8</sup>With :  $L_k = L_{Yk} + L_{Ak} + L_{Bk}$ ,  $\bar{L} = L_N + L_S$  et  $L = L_N = L_S$

<sup>9</sup>This assumption fails to consider that the agricultural good is produced only in one of the two studied countries.

<sup>10</sup>We assume that both countries produce the two differentiated goods, thus neither countries is totally specialized in one sector. We will subsequently reconsider this fundamental assumption in a more precise way (c.f. Appendix 1).

the invested capital<sup>11</sup>. Let us also note that the total cost corresponds to the quantities of work  $L_{fk}$  required for production<sup>12</sup>.

In this model, the North has a comparative advantage in the production of good A and the South has a comparative advantage in the production of good B. The comparative advantage simultaneously incorporates differences in wages and manufacturing productivities such as :

$$\frac{v\beta_{AN}}{v\beta_{BN}} < \frac{\mu\beta_{AS}}{\mu\beta_{BS}} \quad \beta_{fk} > 0, \quad f = A, B, \quad k = 1, 2 \quad (10)$$

$$\text{With } w_{YN} = w_{fN} = v = 1 \quad \text{and} \quad w_{YS} = w_{fN} = \mu, \quad 0 < \mu < 1 \quad (11)$$

### 2.2.3. Firms' behavior

Within each industrial sector ( $f$ ), firms (in monopolistic competition) maximize their profits by differentiating total revenue and labour costs :

$$\pi_{fk} = p_{fk}x_{fk} - w_{fk}\beta_{fk}x_{fk} \quad f = A, B, \quad k = 1, 2 \quad (12)$$

The maximization of profits establishes the producer prices<sup>13</sup> for a sector  $f$  and in a given country<sup>14</sup> :

$$p_{fk} = \frac{\sigma}{(\sigma - 1)} \beta_{fk} w_{fk} \quad (13)$$

The firms possessing a comparative disadvantage in a sector ( $A$  or  $B$ ) charge a higher price for this good. The prices in the North (South) are thus higher (lower) in sector B (A) than in sector A (B), ( $\beta_{AN} < \beta_{BN}$  et  $\beta_{AS}\mu > \beta_{BS}\mu$ ).

### 2.2.4. The production equilibrium

The introduction of producer prices in the firm's profit equation makes it possible to determine the expressions of the capital return for each good ( $f$ ) and each location  $k$ <sup>15</sup>:

$$\pi_{fk} = \frac{1}{(\sigma - 1)} w_{fk} \beta_{fk} x_{fk} \quad f = A, B, \quad k = 1, 2 \quad (14)$$

With constant production, the firms which suffer a comparative disadvantage in sectors A or B can produce a higher profit in this sector.

## 2.3. The equilibrium of the model

The comparison between autarky and the opening of the exchange will determine the firms' location. In autarky, the country's industrialization depends on its capital endowment. When the country opens up, although the countries' endowment in capital remains identical, its physical location can vary.

<sup>11</sup>And also the reward of the injected capital, and the profit.

<sup>12</sup>The two industrial sectors are identical concerning all the other parameters (elasticity of production, etc).

<sup>13</sup>The marginal cost increased by the "mark up".

<sup>14</sup>For the North :  $p_{AN} = \frac{\sigma}{(\sigma-1)} \beta_{AN}$  et  $p_{BN} = \frac{\sigma}{(\sigma-1)} \beta_{BN}$   
For the South :  $p_{AS} = \frac{\sigma}{(\sigma-1)} \beta_{AS}\mu$  et  $p_{BS} = \frac{\sigma}{(\sigma-1)} \beta_{BS}\mu$ .

<sup>15</sup>We obtain per sector and countries :

$\pi_{AN} = \frac{1}{(\sigma-1)} \beta_{AN} x_{AN}$  et  $\pi_{BN} = \frac{1}{(\sigma-1)} \beta_{BN} x_{BN}$ ,  
 $\pi_{AS} = \frac{1}{(\sigma-1)} \mu \beta_{AS} x_{AS}$  et  $\pi_{BS} = \frac{1}{(\sigma-1)} \mu \beta_{BS} x_{BS}$ .

The demand for goods differentiated in each sector ( $A$  and  $B$ ) and its local (and foreign) supply must be balanced. From *Equations 6 et 7* and by replacing the prices ( $p_{fk}$ ) by their expression in the model (c.f. *Equation 13*), we obtain :

$$x_{fN}^* = x_{fN}^d = \frac{\delta\gamma(\sigma-1)}{\sigma} \left[ \frac{R_N L_N}{\beta_{fN} [n_{fN} + n_{fS} (\beta_f \tau)^{1-\sigma}]} + \frac{L_S R_S \tau^{1-\sigma} (\beta_f)^\sigma}{\beta_{fS} \mu [n_{fN} (\tau/\beta_f)^{1-\sigma} + n_{fS}]} \right] \quad (15)$$

$$x_{fS}^* = x_{fS}^d = \frac{\delta\gamma(\sigma-1)}{\sigma} \left[ \frac{L_N R_N \tau^{1-\sigma} (\beta_f)^{-\sigma}}{\beta_{fN} [n_{fN} + n_{fS} (\beta_f \tau)^{1-\sigma}]} + \frac{L_S R_S}{\beta_{fS} \mu [n_{fN} (\tau/\beta_f)^{1-\sigma} + n_{fS}]} \right] \quad (16)$$

With  $\beta_f = \frac{\mu\beta_{fS}}{\beta_{fN}}$ .

To obtain the equilibrium in production and firm location, profits by sectors ( $A$  and  $B$ ) must be equalized between the two countries :

$$\pi_{AN} = \pi_{AS} \text{ and } \pi_{BN} = \pi_{BS} \quad (17)$$

So, we obtain<sup>16</sup> :

$$x_{AN} = \frac{\beta_{AS}}{\beta_{AN}} \mu x_{AS} \text{ and } x_{BN} = \frac{\beta_{BS}}{\beta_{BN}} \mu x_{BS} \quad (18)$$

By assumption, we know that whatever the sector considered, the marginal cost in the South is higher than the marginal cost in the North ( $\beta_{fN} < \beta_{fS} \mu$ ). At profit equilibrium, the production in the South will be thus higher than the North ( $x_{fN} < x_{fS}$ ). For the two productions to be equal, the "size effect" (linked to higher incomes in the North) must offset the low manufacturing productivity of the South.

The economy's production equilibrium is then defined (after the introduction of the incomes) such as :

$$x_A^* = \left( \frac{\delta\gamma(\sigma-1)}{2K(\sigma-\delta)} \right) \left[ L(1+\mu) \left( \frac{1}{\mu\beta_{AS}} + \frac{1}{\beta_{AN}} \right) \right] \quad (19)$$

$$x_B^* = \left( \frac{\delta(1-\gamma)(\sigma-1)}{2K(\sigma-\delta)} \right) \left[ L(1+\mu) \left( \frac{1}{\mu\beta_{BS}} + \frac{1}{\beta_{BN}} \right) \right] \quad (20)$$

The incomes of the various countries depend on the returns obtained in each sector ( $A$  and  $B$ ). Consequently, the production equilibrium of a sector also depends on the production equilibrium of the second sector. Lastly, incomes expression in the two countries is characterized by :

$$R_N = 1 + \beta_{AN} \left( \frac{(1+\mu)\delta\gamma}{2(\sigma-\delta)} \right) \left( \frac{1}{\mu\beta_{AS}} + \frac{1}{\beta_{AN}} \right) + \beta_{BN} \left( \frac{(1+\mu)(1-\gamma)\delta}{2(\sigma-\delta)} \right) \left( \frac{1}{\mu\beta_{BS}} + \frac{1}{\beta_{BN}} \right) \quad (21)$$

$$R_S = \mu + \beta_{AN} \left( \frac{(1+\mu)\delta\gamma}{2(\sigma-\delta)} \right) \left( \frac{1}{\mu\beta_{AS}} + \frac{1}{\beta_{AN}} \right) + \beta_{BN} \left( \frac{(1+\mu)(1-\gamma)\delta}{2(\sigma-\delta)} \right) \left( \frac{1}{\mu\beta_{BS}} + \frac{1}{\beta_{BN}} \right) \quad (22)$$

At equilibrium, if the returns in the two sectors are equal in both countries, then the differences in

---

<sup>16</sup>By generalization :  $x_{fN} = \frac{\beta_{fS}}{\beta_{fN}} \mu x_{fS}$ .

incomes are only related to a difference in wages between North and South.

### 3. DETERMINATION OF THE LOCATION OF INDUSTRIAL ACTIVITIES

Two main points will be approached in this section. Initially, the analysis of the model can provide an assessment of the concentration of firms from the two industrial sectors within a given area. Subsequently, there will have to be an appraisal of the “degree of the countries’ specialization” in the production of the good for which they have a comparative advantage<sup>17</sup>.

#### 3.1. Sectoral concentration analysis of the activities

At this point, an evaluation will be made on the industrial concentration and the different factors which could influence it.

##### 3.1.1. Evaluation of the firms’ concentration

The production of a variety of industrial good (thus a firm) requires one unit of capital. The number of firms established in a country is thus related to the capital used in this country<sup>18</sup>. Both countries necessarily produce the three goods. This assumption disregards the country’s total specialization in an industrial sector<sup>19</sup>. The concentration of sector  $f$  in location  $k$ , is therefore defined as<sup>20</sup> :

$$C_{fk} = \frac{n_{fk}}{N_f} = \frac{k_{fk}}{K_f} \quad (23)$$

$$\text{with } N_f = n_{fN} + n_{fS} = 1, K_f = k_{fN} + k_{fS} \text{ and } N_f = K_f \quad (24)$$

$$0 \leq C_{fk} \leq 1, C_{fN} + C_{fS} = 1 \quad (25)$$

The equations (15, 16 and 23) make it possible to obtain the proportion of the companies in sector  $f$  established in the North ( $C_{fN}$ ) and relate it to the total number of firms in the sector. In order to obtain this result, it’s necessary to balance the capital returns in the North with the South using the demands for differentiated goods from the countries as a starting point :

$$C_{fN} = \frac{n_{fN}}{N_f} = \frac{\lambda_N \left( (1 - (\beta_f \tau)^{1-\sigma}) + (\beta_f \tau)^{1-\sigma} (1 - (\tau/\beta_f)^{1-\sigma}) \right) - \left( (\beta_f \tau)^{1-\sigma} (1 - (\tau/\beta_f)^{1-\sigma}) \right)}{\left( 1 - (\tau/\beta_f)^{1-\sigma} \right) \left( 1 - (\beta_f \tau)^{1-\sigma} \right)} \quad (26)$$

$\lambda_N$  is the share of global income in the North (with  $\lambda_N + \lambda_S = R$ ). The equation obtained makes it possible to measure the sectoral concentration of firms in the North. The higher  $C_{fN}$ , the more sector  $f$  is concentrated in this area.

<sup>17</sup>The details of calculations are available near the author.

<sup>18</sup>The issue here is not the incomes from the capital but the units of capital used in the countries. In this case, after the opening of the exchange,  $k_{fN}$  can be different from  $k_{fS}$ . The units of capital are mobile between countries although capital ownership does not change.

<sup>19</sup>C.f. Appendix 1 for the necessary conditions for this assumption.

<sup>20</sup>In Ricci’s model, the number of firms present on a market is proportional to the labour employed in this country.

By assumption,  $0 < C_{fN} < 1$ . In this case, the profits by sector are equal and firms are dispersed between the North and South. Conversely,  $C_{fN} = 0$  ( $C_{fN} = 1$ ) appears to correspond to a total concentration of firms of sector  $f$  in the South (North)<sup>21</sup>.

### 3.1.2. *Explanatory factors in the sectoral concentration of the firms.*

This point focuses on the study of various factors which can influence the choice for the firms' location. The aim here is to determine the respective roles of the "market size", "the relative marginal cost of the South", the "relative productivity of North", "wages of the South" and "transport costs" in the variation of the proportion of firms in sector  $f$  ( $f=A, B$ ) set up in the North.

#### 3.1.2.1. The effect of North' market size variation on the choice of location of the firms.

##### **A) Definition of the market size.**

Ricci (1999) defines the country's market size by the share of the world's population present in the area paid to the total population. In this model, the respective incomes of both countries define the size of market.

The income ( which linked the wages to the capital returns at the same time) must however be differentiated from the share of firms operating in a market. Although the capital is mobile, its output returns to its owner<sup>22</sup>. We wish to confirm the significance of the "demand link" as a crucial factor in order to attract firms. The market size is thus :

$$\lambda_k = \frac{R_k}{R_N + R_S} \quad \text{with } \lambda_k > 0, \mathbf{k} = \mathbf{N}, \mathbf{S} \quad (27)$$

##### **B) Consequences of the market size variation on the firms' choice of location.**

The increase in the Northern market's size attracts firms towards this country ( $\frac{dC_{fN}}{d\lambda_N} > 0$ ). Being located in vast markets makes it possible to take advantage of a broad demand and to use economies of scale. It is a traditional result in economic geography models (C.f. Krugman (1991b), Ricci (1999)...). And it is the major role of demand which is underlined here.

In addition, sector  $A$  is prone to greater concentration than Sector  $B$  following the variation in the market size of the North ( $\frac{dC_{AN}}{d\lambda_N} > \frac{dC_{BN}}{d\lambda_N}$ ). The goods produced in the high added value sector offer more advanced and thus more expensive technology, which requires a sizeable demand. This result additionally links up the North' comparative advantage in the production of good  $A$ .

#### 3.1.2.2 The effect of a variation of the relative marginal cost of the South on firms' location.

The firms' location also depends on the level of the relative marginal cost of the South in each sector. This cost also has two distinct components which will undergo successive study, i.e., the relative productivity of the North and the relative wages of the South.

The impact of a variation of this cost on the concentration of the firms from sector  $f$  in the North is evaluated in the following way<sup>23</sup> :

<sup>21</sup>We have deliberately excluded these two cases because they do not allow us to specify the comparative advantage concept and its links with industrial specialization.

<sup>22</sup>In short, a greater number of firms in the South are not necessarily synonymous of higher incomes.

<sup>23</sup>The size of the North's market is an endogenous variable which depends on the relative marginal cost of the South.

$$\frac{dC_{fN}}{d\beta_f} = \frac{\partial C_{fN}}{\partial \beta_f} + \frac{\partial C_{fN}}{\partial \lambda_N} * \frac{d\lambda_N}{d\beta_f} \quad (28)$$

$$\frac{dC_{fN}}{d\beta_f} > 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial C_{fN}}{\partial \lambda_N} > 0 \\ \frac{d\lambda_N}{d\beta_f} > 0 \\ \frac{\partial C_{fN}}{\partial \beta_f} > 0 \end{array} \right\} \quad (29)$$

The hike in the labor cost in the South boosts the concentration of the firms in the North. These relocate towards the area with the weakest production costs. They can thus impose lower prices and take advantage of a higher demand for the relevant good. The relative marginal cost of the South also reflects the North's "absolute advantage"<sup>24</sup>.

The model also reveals that a rise in the relative marginal cost of the South in one of the two sectors extends the concentration of the firms of this sector like the second sector, but to a lesser extent. Indeed, the rise in this cost attains the second sector through the positive variation of the North's market size. It is therefore "size effect" which causes the relocation of the firms of this sector towards the North.

Let us finally note that the relative marginal cost of the South ( $\beta_f = \frac{\mu\beta_{fS}}{\beta_{fN}}$ ) blends the two distinct components of sectoral labor productivity ( $\frac{\beta_{fS}}{\beta_{fN}}$ ) and wages ( $\mu$ ). Each component can independently affect the choice of location of industry.

### 3.1.2.3 The effect of a variation of the relative productivity of the North on firms' location.

How will firms respond to a boost in the North' relative productivity ?

The result depends on the sign of the following derivative :

$$\frac{dC_{fN}}{dJ} = \frac{\partial C_{fN}}{\partial J} + \frac{\partial C_{fN}}{\partial \lambda_N} * \frac{d\lambda_N}{dJ} \quad (30)$$

$$\frac{dC_{fN}}{dJ} > 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial C_{fN}}{\partial J} > 0 \\ \frac{\partial C_{fN}}{\partial \lambda_N} > 0 \\ \frac{d\lambda_N}{dJ} > 0 \end{array} \right\} \quad (31)$$

The concentration of the sector  $f$  in the North increases with the rise in the relative productivity of the North in this sector. As a matter of fact, higher productivity is synonymous of a greater effectiveness in production and thus entails a lower cost for the companies. Consequently, these prefer to set up in the North. This result underlines the essential role of labour productivity in the choice of location by firms.

In addition to these results, simulations of the model show that there is a more rapid agglomeration of the two sectors and that the gap in the concentration levels per sector widens as the relative productivities of the North increase. The more these productivities rise, the less the South is attractive. The low wages in this area no longer manage to offset the North's productivity advantage. These effects are however mitigated when transport costs are fixed at a higher level, or when the goods are highly substitutable. In this case, firms do not move towards the most productive market because of the exorbitant trade costs.

<sup>24</sup>Simulations of the model confirm these results. Moreover, the concentration becomes more marked when the costs of transport are fixed at a lower level or when goods are scarcely differentiated. In addition, the concentration of firms in sector A always remains higher than in B.

Let us note, as previously, that a rise in productivity in one sector fuels the concentration of firms from both sectors in the North because of the "size effect". The South would thus stand to gain from improving its productivity in one of the two sectors and from attracting both types of firm.

### 3.1.2.4 The effect of a variation of the relative wages of the South on firms' localization.

The variation in the South's wages weighs on the choice of location of the firms at various levels. This increase means a rise in the production cost for the Southern firms but also modifies the incomes and the market sizes of the countries. Detailed attention is thus required in order to ascertain the variation in the relative wages of the South.

#### A) The impact of the rise in the South's relative wages on the countries' "market size"

The rise in the wages in the South initially assigns the incomes to various levels in the North just as it does in the South. Firstly, it affects both countries through the returns on capital (which depend on the production equilibrium of the firms). For the South, wages are also included as a labour income.

After a slight fall, the incomes from the North (and South) grow along with the rise in the South's wages<sup>25</sup>. However, this increase occurs for a lower level of the wages for the South than for the North<sup>26</sup>.

Once one wage threshold in the South has been crossed, the incomes will increase in both countries. Below this threshold, the hike in wages isn't sufficient and is merely perceived as a rise in the production cost for firms.

If the incomes seesaw according to the rise in the wages in the South, the countries' market size will also change. After calculations :

$$\frac{d\lambda_N}{d\mu} < 0 \Rightarrow \left\{ \begin{array}{l} \text{si } \mu > 0.4142 \\ \text{or if } \mu > \left(\frac{\delta}{2(\sigma-\delta)}\right) \left[ \left(\frac{\beta_{AN}\gamma}{\beta_{AS}} + \frac{\beta_{BN}(1-\gamma)}{\beta_{BS}}\right) \left(\frac{2\mu+\mu^2-1}{\mu^2}\right) + 2 \right] + 1 \end{array} \right\} \quad (32)$$

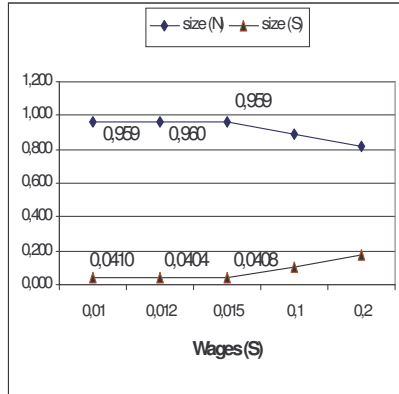
$$\frac{d\lambda_S}{d\mu} > 0 \Rightarrow \left\{ \begin{array}{l} \text{si } \mu > 0.4142 \\ \text{or if } \mu > \left(\frac{\delta}{2(\sigma-\delta)}\right) \left[ \left(\frac{\beta_{AN}\gamma}{\beta_{AS}} + \frac{\beta_{BN}(1-\gamma)}{\beta_{BS}}\right) \left(\frac{-2\mu-\mu^2+1}{\mu^2}\right) - 2 \right] - 1 \end{array} \right\} \quad (33)$$

The Southern (Northern) market size will increase (decrease) with the rise in wages only if these wages hit a certain threshold.

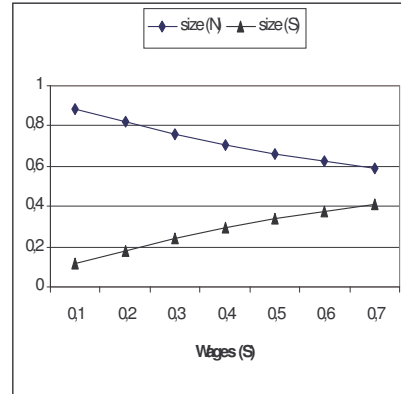
Evolution of North and South market sizes with wages in the South.

Graphic [A]: ( $\tau = 28, \sigma = 9, \beta_{AS} = 43.2, \beta_{AN} = 0.4, \beta_{BS} = 43.1, \beta_{BN} = 0.43$ ).

Graphic [B] : ( $\tau = 6, \sigma = 10, \beta_{AS} = 12, \beta_{AN} = 1.05, \beta_{BS} = 11.1, \beta_{BN} = 1.1$ ).



Graph A



Graph B

<sup>25</sup>After calculation :  $\frac{dRN}{d\mu} > 0$  if  $\mu^2 > \left(\frac{\beta_{AN}\gamma}{\beta_{AS}} + \frac{\beta_{BN}(1-\gamma)}{\beta_{BS}}\right)$  and  $\frac{dRS}{d\mu} > 0$  if  $\mu^2 > \left(\frac{\delta}{2\sigma}\right) \left(\frac{\beta_{AN}\gamma}{\beta_{AS}} + \frac{\beta_{BN}(1-\gamma)}{\beta_{BS}}\right)$ .

<sup>26</sup>Note that in order to obtain these results, wages and other variables have to assume extreme values.

The Northern (Southern) market size will increase (decrease) with the rise in Southern salaries only if these are extremely low and if there exist excessive disparities in productivity between the North and South (c.f. Graph A). The rise in wages (when these are initially low) is initially seen as a rise in the production cost but the South's market size swells after a certain level of wage. The rise in the wages in the South often generates an increase (a decrease) in the South's (North's) market size (C.f. Graphic B).

It's now possible to study the impact of a rise in the wages on the concentration of firms.

**B) The impact of the rise of the South's relative wages on the concentration of the firms in the North.**

This rise in the wages implies both a cost for the firms that have set up in the South and a rise in the market size of this country (if the level of wages is higher than the limiting value calculated previously)<sup>27</sup>. The two previously mentioned effects have an opposed impact on the concentration of the firms in the North :

$$\frac{dC_{fN}}{d\mu} = \frac{\partial C_{fN}}{\partial \mu} + \frac{\partial C_{fN}}{\partial \lambda_N} * \frac{d\lambda_N}{d\mu} \quad (34)$$

After resolving the total derivative :

$$\frac{dC_{fN}}{d\mu} < 0 \left\{ \begin{array}{l} \frac{d\lambda_N}{d\mu} < 0 \Rightarrow \left\{ \begin{array}{l} \text{si } \mu > 0.4142 \\ \text{or if } \mu > \left( \frac{\delta}{2(\sigma-\delta)} \right) \left[ \left( \frac{\beta_{AN}\gamma}{\beta_{AS}} + \frac{\beta_{BN}(1-\gamma)}{\beta_{BS}} \right) \left( \frac{2\mu+\mu^2-1}{\mu^2} \right) + 2 \right] + 1 \end{array} \right\} \\ \frac{\partial C_{fN}}{\partial \mu} > 0, \frac{\partial C_{fN}}{\partial \lambda_N} > 0 \end{array} \right\} \quad (35)$$

$$\frac{dC_{fN}}{d\mu} > 0 \Rightarrow \left\{ \begin{array}{l} \frac{d\lambda_N}{d\mu} > 0 \Rightarrow \left\{ \begin{array}{l} \text{if } \mu < \left( \frac{\delta}{2(\sigma-\delta)} \right) \left[ \left( \frac{\beta_{AN}\gamma}{\beta_{AS}} + \frac{\beta_{BN}(1-\gamma)}{\beta_{BS}} \right) \left( \frac{2\mu+\mu^2-1}{\mu^2} \right) + 2 \right] + 1 \end{array} \right\} \\ \frac{\partial C_{fN}}{\partial \mu} > 0, \frac{\partial C_{fN}}{\partial \lambda_N} > 0 \end{array} \right\} \quad (36)$$

The first part of the derivative ( $\frac{\partial C_{fN}}{\partial \mu}$ ) expresses "the cost effect" resulting from a rise in the wages in the South. Firms therefore prefer to move towards the North and the South waives its main attraction. Indeed, the South's "competitive advantage" compared to North and its comparative advantage in sector B are directly related to the lowness of its wages.

The second part of the derivative ( $\frac{\partial C_{fN}}{\partial \lambda_N} * \frac{d\lambda_N}{d\mu}$ ) illustrates the "market size effect". The rise in the wages in the South can allow the South to boost its market size and to become attractive.

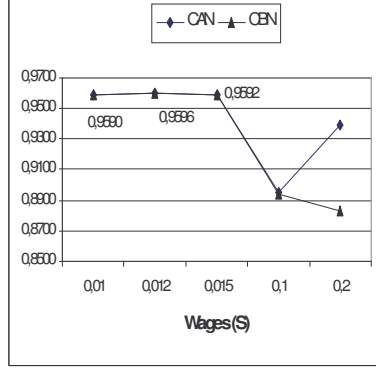
Evolution of the firms' concentration in the North with wages in the South .

Graph [C] : ( $\tau = 28, \sigma = 9, \beta_{AS} = 43.2, \beta_{AN} = 0.4, \beta_{BS} = 43.1, \beta_{BN} = 0.43$ ).

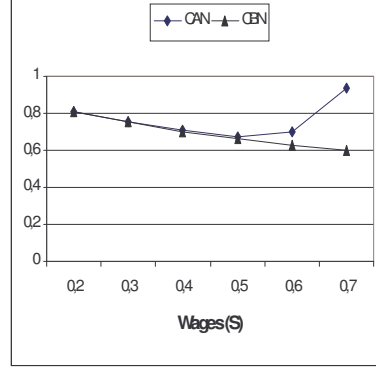
Graph [D] : ( $\tau = 5.5, \sigma = 9, \beta_{AS} = 8, \beta_{AN} = 1.15, \beta_{BS} = 7.6, \beta_{BN} = 1.5$ ).

---

<sup>27</sup>This increase is also synonymous of an improvement in the South's agricultural productivity.



Graph C



Graph D

According to Graph C, for the very low values of wages (and extreme concerning the other variables), the firms' concentration in the two sectors first increases (for  $\mu$  ranging between 0.01 and 0.012), corresponding to a rise in the size of the Northern market, then decreases (for  $\mu$  ranging between 0.012 and 0.1) when the size of the market also decreases (c.f. Graphic A). Eventually, the firms' concentration in the North again increases (for  $\mu$  equal to 0.1), and "the cost effect" prevails over "the market size effect".

The second graph (Graph D) is obtained by using less extreme values of the various variables to start. It shows that the concentration of the firms in North first eases then strengthens ( $\mu = 0.5$ )<sup>28</sup>.

As a result, (albeit higher than the limiting threshold), the concentration of firms in the North decreases and "the market size effect" prevails over "the cost effect" for low values of wages in the South. Firms are more sensitive to the rise in the market size in the South than the increase of cost that such a rise entails. After a certain wage level, the "cost effect" becomes greater than the "market size effect". If the rise in the wages in the South gets too heady, firms will be increasingly sensitive to the progression of the production cost. In fact, the labour cost becomes sizeable in the South but the industrial productivity does not go forward. The firms thus prefer to set up in the North with higher but more productive labour costs. Such findings underline the interest in connecting productivity and wages.

The simulations performed demonstrate that both sectors do not react towards the variation in wages in the same way. In the "high value added sector", the rise in wages is more rapidly considered as a production cost for firms than in the second sector. The "high value added sector" is thus more sensitive to industrial labour productivity than to its cost.

As previously described, the rise in the wages of the South can also be synonymous of a rise in the size of market in this area. In this case, firms in Sector f will relocate themselves to this area ( $\frac{dC_{fN}}{d\lambda_S} < 0$ ). The North then loses its market size advantage and the South becomes more attractive.

The South's relative wage increase thus has two opposite effects pertaining to the firms' choice location. The first is related to the rise in labour costs in the South. The second effect involves a rise in purchasing power and demand in the South and attracts the firms towards this market.

### 3.1.2.5 The effect of trade liberalization on the concentration of the firms in the North

A dip in trade costs is likely to modify the firms' choice of location.

After simplifications, Equation 26 becomes :

$$C_{fN} = \frac{\lambda_N}{\left(1 - k \left(1/\beta_f\right)^{1-\sigma}\right)} + \frac{(\lambda_N - 1) \left(k \left(\beta_f\right)^{1-\sigma}\right)}{\left(1 - k \left(\beta_f\right)^{1-\sigma}\right)} \quad (37)$$

<sup>28</sup>Only the last two described effects appear on this graph.

$$\frac{dC_{fN}}{dk} > 0 \quad \text{if } \lambda_N > 0.5 \quad (38)$$

Let us note that when  $k$  increases,  $\tau$  decreases. When the trade cost decreases (at the time of a trade liberalization), the concentration of firms  $f$  in North increases. However, this result does not provide the conclusive evidence that the North's market size remains higher than the South's<sup>29</sup>.

Simulations of the model make it possible to confirm these results and to compare the effects of lower exchange costs on the two industrial sectors in a different way. The firms' concentration in the North is more substantial if the goods are extremely differentiated or if the relative marginal costs of the South are fixed at a higher level. In the same way, the more transport costs dwindle, the wider the gap between the level of concentration of the two industrial sectors. Whereas the role of the absolute advantages seems to initially prevail, the more transport costs sink, the bigger the role played by the comparative advantages in the firms' sectoral concentration.

Thus, the model reveals the fundamental importance of market size in the firms' location and when measuring their influence. Indeed, the study of market size (through wages) shows that increasing the South's market size is insufficient in order to maintain industries on their market. The South became expensive but its manufacturing productivity doesn't change. If the South wants to attract firms, it will thus be necessary for it, first and foremost, to improve its manufacturing productivity in more of its market size.

The analysis also shows that countries' absolute advantages (here the relative marginal cost of the South and the productivity) are determining factors in the location of industries, particularly if transport costs are low and if the goods are differentiated. Moreover, if the countries manage to improve their cost (their productivity) in one of the two sectors, they will attract both industries. An improvement in the South's manufacturing productivity, even in the low value added sector, can thus allow this country to attract high valueadded firms.

Lastly, liberalization generates a disindustrialization of the South, in particular in the high value added sector. In effect, the absolute advantages and the size gone remain determining to attract the firms from both sectors. On the other hand, the comparative advantages are significant when the costs become very low and largely determine the proportion of firms present in each country.

### 3.2. The development of countries' sectoral specialization

The introduction of comparative advantages in the model naturally raises the question of the countries' specialization. After having defined the comparative advantages and specialization, the second part of this sub-section will focus on the various factors able to influence the degree of specialization in the countries.

#### 3.2.1. An evaluation of comparative advantages and specialization.

By assumption, the North offers a large comparative advantage in the production of good A and the production of good B in the South<sup>30</sup>. In the model, sectoral specialization is measured by the number of firms (and thus the number of capital units) of a sector present on the relevant market.

<sup>29</sup>This result is similar to that obtained in certain traditional models in geographical economics (Krugman, 1991) but however differs from those engineered by Madariaga (2001) and Ricci (1999).

In Ricci's (1999) model this question is more open to debate and depends on the countries' characteristics. According to the author, an increase in the transport costs does not inevitably curb the agglomeration of industries. The result depends on countries' characteristics (population in the market and countries' absolute advantages).

<sup>30</sup>As a consequence, the ratio of the relative marginal costs by Sector (P) is necessarily higher than 1.  $\beta_f$  illustrates the marginal cost ratio in the North and South in Sector  $f$  :

$$P = \frac{\beta_A}{\beta_B} > 1, \text{ with } \beta_f = \frac{\mu\beta_{fS}}{\beta_{fN}}, \quad f = A, B$$

This appreciation of specialization is in keeping with the forementioned respective and comparative advantages of the countries :

$$S_{AN} = \frac{C_{AN}}{C_{BN}} = \frac{K_{AN} K_B}{K_{BN} K_A} \quad \text{and} \quad S_{BS} = \frac{C_{BS}}{C_{AS}} = \frac{K_{BS} K_A}{K_{AS} K_B} \quad (39)$$

These variables evaluate the degree of specialization of the countries in the sector for which it presents a comparative advantage. The country will thus foster its specialization for the production of a good (A or B) if the relative concentration of firms in the given sector increases.

### 3.2.2. *The factor explaining the degree of the countries' specialization*

The aim is to determine the impact of various variables of the model on the degree of the countries' specialization. We want to analyse the capacity of the countries (in particular in the South) to diversify their industrial fabric<sup>31</sup>.

We will thus identify the respective roles of the “market size”, “the relative marginal costs of South”, productivity, wages and finally the fall in the trade costs in relation to the degree of specialization in the countries.

#### 3.2.2.1. The effect of market size variation on the degree of countries' specialization.

In what way does the specialization of the countries evolve when their market size varies ? The degree of specialization of North in the production of Good A (*equation 40*), and of the South in the production of good B (*equation 41*) is given by :

$$S_{AN} = \frac{C_{AN}}{C_{BN}} = \frac{\left[ \frac{\lambda_N((1-(\beta_A\tau)^{1-\sigma})+(\beta_A\tau)^{1-\sigma}(1-(\tau/\beta_A)^{1-\sigma})) - ((\beta_A\tau)^{1-\sigma}(1-(\tau/\beta_A)^{1-\sigma}))}{(1-(\tau/\beta_A)^{1-\sigma})(1-(\beta_A\tau)^{1-\sigma})} \right]}{\left[ \frac{\lambda_N((1-(\beta_B\tau)^{1-\sigma})+(\beta_B\tau)^{1-\sigma}(1-(\tau/\beta_B)^{1-\sigma})) - ((\beta_B\tau)^{1-\sigma}(1-(\tau/\beta_B)^{1-\sigma}))}{(1-(\tau/\beta_B)^{1-\sigma})(1-(\beta_B\tau)^{1-\sigma})} \right]} \quad (40)$$

$$S_{BS} = \frac{C_{BS}}{C_{AS}} = \frac{\left[ \frac{\lambda_S((\tau/\beta_B)^{1-\sigma}(1-(\beta_B\tau)^{1-\sigma})+(1-(\tau/\beta_B)^{1-\sigma})) - ((\tau/\beta_B)^{1-\sigma}(1-(\beta_B\tau)^{1-\sigma}))}{(1-(\tau/\beta_B)^{1-\sigma})(1-(\beta_B\tau)^{1-\sigma})} \right]}{\left[ \frac{\lambda_S((\tau/\beta_A)^{1-\sigma}(1-(\beta_A\tau)^{1-\sigma})+(1-(\tau/\beta_A)^{1-\sigma})) - ((\tau/\beta_A)^{1-\sigma}(1-(\beta_A\tau)^{1-\sigma}))}{(1-(\tau/\beta_A)^{1-\sigma})(1-(\beta_A\tau)^{1-\sigma})} \right]} \quad (41)$$

The specialization of the North (South) in the production of good A (B) narrows when the market size of this country increases ( $\frac{dS_{AN}}{d\lambda_N} < 0$  and  $\frac{dS_{BS}}{d\lambda_S} < 0$ ). This conclusion can also be found in Ricci's model and the introduction of capital as a determining factor in the industrial location therefore does not modify this result. If a country is already highly specialized, an increase in its market size will attract firms from the two industrial sectors. In this context, both sectors will be better represented in each country. It's an important result within the framework of a North-South agreement. If the South increases its market size, it will attract firms with "high added value".

#### 3.2.2.2. The effect of a rise of the relative marginal cost of South on countries' specialization.

Initially, the study features the effect of a rise in the South's relative marginal cost by sector. Thereafter, this cost will be broken up in order to distinguish two distinct factors, i.e., productivity and wages.

#### **A) The effect of a rise of the relative marginal cost of South in Sector A : the impact of a reinforcement in the comparative advantages.**

<sup>31</sup>The exchange of knowledge is seemingly borne by that, trade intensifies and convergence enters the North and South as the final goal.

The rise in the South' relative marginal cost in sector A is also allied to a reinforcement in the countries' comparative advantages. These are accentuated in the model if  $d\beta_A > 0$ <sup>32</sup>. However, in a North-South agreement, is it really preferable for the countries to strengthen their comparative advantages ?

The relation between the degree of specialization in the North and the reinforcement of the comparative advantage is not monotonous :

$$\frac{dS_{AN}}{d\beta_A} = \frac{\partial S_{AN}}{\partial \beta_A} + \frac{\partial S_{AN}}{\partial \lambda_N} * \frac{d\lambda_N}{d\beta_A} \quad (42)$$

$$\frac{dS_{AN}}{d\beta_A} > 0 \text{ ou } < 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial S_{AN}}{\partial \beta_A} > 0, \\ \frac{d\lambda_N}{d\beta_A} > 0 \text{ et } \frac{\partial S_{AN}}{\partial \lambda_N} < 0 \end{array} \right\} \quad (43)$$

Several effects are to be considered. The first part of the derivative highlights the positive bond between specialization and comparative advantages such as it appears in the international trade theories. The second part the derivative illustrates the impact of a decline in comparative advantages on the market size. If the steeling of these advantages positively shapes the North's market size, on the other hand, this increased size attenuates the degree of a country's specialization.

The analysis of the South' specialization is similar :

$$\frac{dS_{BS}}{d\beta_A} = \frac{\partial S_{BS}}{\partial \beta_A} + \frac{\partial S_{BS}}{\partial \lambda_S} * \frac{d\lambda_S}{d\beta_A} \quad (44)$$

$$\frac{dS_{BS}}{d\beta_A} > 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial S_{BS}}{\partial \beta_A} = 0 \\ \frac{\partial S_{BS}}{\partial \lambda_S} < 0 \text{ et } \frac{d\lambda_S}{d\beta_A} < 0 \end{array} \right\} \quad (45)$$

The South's specialization in the production of the good B increases with the strengthening of the countries' respective comparative advantages.

The comparative advantage remains one of the determining factors in the degree of specialization in the South. Nevertheless, this result isn't clearly recognized in the North's case and the market size effet can prompt the opposite report<sup>33</sup>.

#### B) The effect of a rise in the relative marginal cost of South in Sector B.

Let us now suppose that the relative marginal cost of the South increases in the low added value sector (B):

$$\frac{dS_{AN}}{d\beta_B} = \frac{\partial S_{AN}}{\partial \beta_B} + \frac{\partial S_{AN}}{\partial \lambda_N} * \frac{d\lambda_N}{d\beta_B} \quad (46)$$

If the production cost in the low added value sector edges up in the South (against the North's), the North's specialization in the production of the good A dwindles ( $\frac{dS_{AN}}{d\beta_B} < 0$ ). Actually, the North then attracts firms from both sectors and thus specializes relatively less in Good A.

The analysis is similar for the South. When the augmentation of the relative marginal cost of the South occurs in the low added value sector ( $\frac{dS_{BS}}{d\beta_B} = \frac{\partial S_{BS}}{\partial \beta_B} + \frac{\partial S_{BS}}{\partial \lambda_S} * \frac{d\lambda_S}{d\beta_B}$ ), the result is more than ambiguous :

<sup>32</sup>This recess corresponds to a widening of the gap between labour' productivity and wages in both countries.

<sup>33</sup>Let us note that the results collected here differ from those obtained by Ricci (1999). According to his model, the effect of the reinforcement of the comparative advantages over the degree of specialization in countries isn't recognized for either of the two countries being studied.

$$\frac{dS_{BS}}{d\beta_B} < \text{or} > 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial S_{BS}}{\partial \beta_B} < 0 \\ \frac{\partial S_{BS}}{\partial \lambda_S} < 0 \text{ et } \frac{d\lambda_S}{d\beta_B} < 0 \end{array} \right\} \quad (47)$$

Initially, the rise in this cost causes a fall in the South's market size, which reinforces the degree of specialization in this country ("market size effect"). A parallel rise in the production cost in the sector for which the South enjoys a comparative advantage attenuates this advantage and limits its degree of specialization in this sector ("production cost effect"). The final result will depend on the relative weight of these two effects.

As a result, an increase in the relative marginal cost of the South in the sector for which the countries do not enjoy a comparative advantages accentuates the countries' specialization. On the other hand, a rise in this cost in the sector for which the countries enjoy a comparative advantage will either limit their specialization or heighten it according to the respective weighting of the "cost effect" and the "market size effect". Simulations reveal however that the first effect triggers the second one.

The relative marginal cost of the South is both a yardstick for the relative productivity of North and for the countries' relative wages.

### 3.2.2.3. The effect of a rise of the North' relative productivity on countries' specialization.

The impact of a rise in the relative productivity of the North in sector A on the degree of specialization of the North depends on the sign of the following total derivative :

$$\frac{dS_{AN}}{dJ_A} = \frac{\partial S_{AN}}{\partial J_A} + \frac{\partial S_{AN}}{\partial \lambda_N} * \frac{d\lambda_N}{dJ_A} \quad (48)$$

$$\frac{dS_{AN}}{dJ_A} > 0 \text{ or } < 0 \quad \left\{ \begin{array}{l} \frac{\partial S_{AN}}{\partial J_A} > 0 \\ \frac{\partial S_{AN}}{\partial \lambda_N} < 0 \text{ et } \frac{d\lambda_N}{dJ_A} > 0 \end{array} \right\} \quad (49)$$

There remain two effects are to be considered. An increase in relative productivity of the North in sector A has a positive impact on the degree of specialization in the North through "the productivity effect" ( $\frac{\partial S_{AN}}{\partial J_A}$ ). The North becomes more productive in this sector and it is encouraged to produce an even larger quantity of good A. At the same time, this rise in productivity has a positive effect on the North's market size which limits the degree of specialization of the country. The respective weights of both these effects will determine the sign of the total derivative<sup>34</sup>.

The analysis is similar when the rise in productivity applies to the low added value sector :

$$\frac{dS_{AN}}{dJ_B} = \frac{\partial S_{AN}}{\partial J_B} + \frac{\partial S_{AN}}{\partial \lambda_N} * \frac{d\lambda_N}{dJ_B} \quad (50)$$

$$\frac{dS_{AN}}{dJ_B} < 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial S_{AN}}{\partial J_B} = 0 \\ \frac{\partial S_{AN}}{\partial \lambda_N} < 0 \text{ et } \frac{d\lambda_N}{dJ_B} > 0 \end{array} \right\} \quad (51)$$

An increase in the relative productivity of North in sector B lessens the degree of specialization in this country in the production of good A. Indeed, if the productivity of the North in this sector increases (or that of the South decreases), it becomes more attractive for firms in the low added value sector to relocate to the North. This area then is less specialized in the high added value sector<sup>35</sup>. This

<sup>34</sup>The simulations carried out show that the "productivity effect" seems stronger than the "market size effect" and specialization intensifies with the rise in the North's relative productivity.

<sup>35</sup>Simulations match these results. The degree of specialization in the North will be less when transport costs are high or when the goods are not very substitutable.

same analysis of productivities can be carried out for the South :

$$\frac{dS_{BS}}{dJ_A} = \frac{\partial S_{BS}}{\partial J_A} + \frac{\partial S_{BS}}{\partial \lambda_S} * \frac{d\lambda_S}{dJ_A} \quad (52)$$

$$\frac{dS_{BS}}{dJ_A} > 0 \Rightarrow \left\{ \begin{array}{l} \frac{\partial S_{BS}}{\partial J_A} = 0 \\ \frac{\partial S_{BS}}{\partial \lambda_S} < 0 \text{ et } \frac{d\lambda_S}{dJ_A} < 0 \end{array} \right\} \quad (53)$$

The more the productivity of North in Sector A increases (or that of the South decreases), the more the South specializes in the production of a low added value good. Simulations corroborate this result<sup>36</sup>.

In a similar way for Sector B :

$$\frac{dS_{BS}}{dJ_B} = \frac{\partial S_{BS}}{\partial J_B} + \frac{\partial S_{BS}}{\partial \lambda_S} * \frac{d\lambda_S}{dJ_B} \quad (54)$$

$$\frac{dS_{BS}}{dJ_B} > 0 \text{ or } < 0 \left\{ \begin{array}{l} \frac{dS_{BS}}{dJ_B} < 0 \\ \frac{\partial S_{BS}}{\partial \lambda_S} < 0 \text{ et } \frac{d\lambda_S}{dJ_B} < 0 \end{array} \right\} \quad (55)$$

If the South becomes less productive in the production of good B its comparative advantage in this sector decrease in the same way as its degree of specialization (“productivity effect”). Moreover, an increase in Northern, productivity in Sector B (or a waning of that of the South) reduces the South’ market size, which reforces its specialization in the production of Good B (“market size effect”)<sup>37</sup>.

The rise in the relative productivity of North does not hamper the increase in specialization of the countries when this rise occurs in the sector in which countries do not hold a comparative advantage. In the contrary case, the respective weighting of “size effect” and “productivity effect” determine the final result.

#### 3.2.2.4. The effect of a rise of South’ wages on the degree of countries’ specialization.

Given that analytical calculations are too complex, we proceeded with a certain number of simulations. It seems that the rise in the wages in the South accentuates the degree of specialization of the North as of the South in the production of the good for which they offer a comparative advantage. The more the wages increase the greater the specialization of the countries.

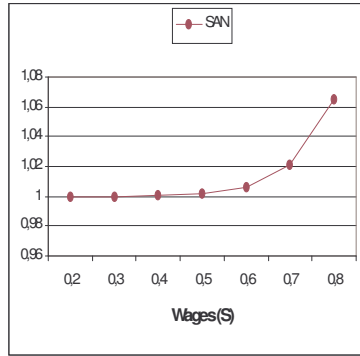
Evolution of countries’ specialization with wages in the South .

Graph [E]: ( $\tau = 7, \sigma = 9, \beta_{AS} = 8.2, \beta_{AN} = 1.3, \beta_{BS} = 8.05, \beta_{BN} = 1.6$ ).

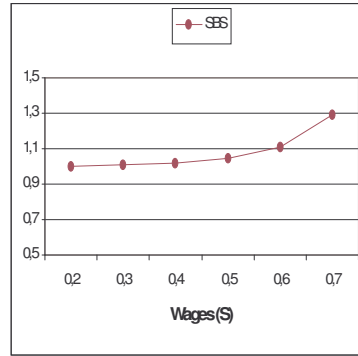
Graph [F] : ( $\tau = 8, \sigma = 6, \beta_{AS} = 9, \beta_{AN} = 1.1, \beta_{BS} = 8, \beta_{BN} = 1.5$ ).

<sup>36</sup>The level of the South’s specialization will also be higher if the goods are scarcely differentiated and if the transport costs are low.

<sup>37</sup>In the simulations carried out, the ” market size effect” seems stronger than ”productivity effect” for low values of the productivity in Sector B. The tendency is reversed and specialization decreases as this productivity increases.



Graph E



Graph F

3.2.2.5. The effect of trade liberalization on the degree of the countries' specialization.

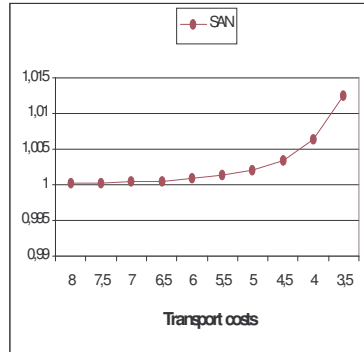
Analytical calculation is also too complex in this context. Nevertheless, a certain number of simulations will allow us to refer to certain patterns.

The specialization of the North (South) in the production of Good A (B) becomes greater with the liberalization of trade. However, specialization is less if the goods are substitutable and greater if the relative marginal costs of the South are high and if the variations of costs between the two industrial sectors are substantial.

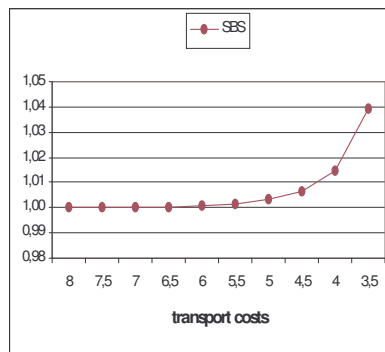
Evolution of the firms' specialization in the North with trade liberalization.

Graph [G] : ( $\sigma = 6, \beta_A = 1.67, \beta_B = 1.46, \gamma = 0.5, \delta = 0.3$ ).

Graph [H] : ( $\sigma = 8, \beta_A = 1.8, \beta_B = 1.2, \gamma = 0.5, \delta = 0.3$ ).



Graph G



Graph H

The rise of the market size reduces their degree of specialization. The North then preserves a certain number of firms producing slightly technological goods and the South, experiences the relocation of high added value firms onto its market. This surge allows the South to accelerate its "technological learning" and to have a firmer standing as regards global demand.

The impact of the reinforcement of the comparative advantages over specialization will be positive only for the South. This country affords scarcely attractive comparative advantages which remain very specific to a precise type of industry. On the other hand, the North will attract any type of firms while recessing its comparative advantages. The South may thus find it beneficial to modify the structure of its comparative advantages at the risk of having only low added value firms on its market.

If the marginal cost of the South increases in the sector for which the countries have a comparative advantage, two effects are to be considered. "The cost effect" reinforces (decreases) the specialization of the North (South) and "the market size effect" which decreases (increases) it.

Lastly, it seems that trade liberalization accentuates the countries' specialization, which works against the South which is likely to see an increasing flow of firms due to the low added value of its market.

#### 4. CONCLUSION

By introducing the comparative advantages into a economic geography model it is possible to simultaneously study the phenomena of industrial integration and specialization in a precise sector.

The analysis of the firms' sectoral concentration underlines the role of "market size" in the same manner as the country's absolute advantage in the model. Firms will set up in a country which offers the vastest market and the lowest production costs. The market size effect is however too moderate. The rise in the wages in the South will increase the South's "market size" only if the level of wages attained is sufficiently high. In addition, the rise in the South's market size alone does not make it possible for this country to keep the firms in the market. This rise in the wages (and the market size) must be accompanied by an improvement in the industrial productivity of this country. On the other hand, a rise in manufacturing productivity in one of the two sectors allows the countries to attract both industries.

In the same way, the effect of lower trade costs is not favorable to the South. In our model, the North enjoys a larger market size than the South, and in this case, trade liberalization accentuates the concentration of firms in the North and thus gradually disindustrializes the South. The absolute advantages seem to exert greater influence following trade liberalization, and comparative advantages are more pertinent when the costs plunge and mainly apply when determining the proportion of firms from each sector that are present on a market.

Thus, if the South doesn't make up for its delay in industrial productivity compared to the North it has a little chance to attract firms, especially firms producing high added value goods. In this case, the South will gradually disindustrialize and the firms which remain most present on this market will be those which produce low added value goods.

The question of specialization is also tackled in this model. The countries will be able to diversify their industrial fabric if they manage to increase "their market size". On the other hand, the rise in the relative marginal cost of the South (or the productivity) and the reinforcement of the comparative advantages increases (decreases) the South's (North's) specialization only if this increase appears in the sector in which countries does not present a comparative advantage. In the contrary case, the rise (drops) in Northern (Southern) market size and its negative effect (positive) on specialization is to be considered. On the contrary, an increase in the size of market of the countries is synonymous of lower specialization in the areas producing the good for which they have a comparative advantage. Lastly, trade liberalization will rather accentuate the degree of specialization of the countries.

In short, in the model, trade openness generates an agglomeration of firms in the North. If the South wishes to catch the North up by attracting the firms, there are several possibilities. The South can raise its labour productivity in the agricultural sector (by increasing its wages and thus its size of market) and improve industrial labour productivity. If the South loses its advantage in terms of "low wages" it will have to make up for this loss by an improvement in productivity in the industrial sector. Without this, this area is likely to be found on the edge of the industrialization process.

In the same way, the choice of specialization of the South will determine the process. In fact, in the event that following a trade liberalization, the South intensifies its specialization in the production of the low added value good (what is the case here), it is extremely likely not to experience strong long-term growth. Indeed, this type of specialization does not allow the country to assimilate new

technologies or to occupy an important position within the world request. As a consequence, the South must try not to reinforce its comparative advantages but, on the contrary, to develop them. In these diverse conditions trade liberalization will be able to constitute a preliminary factor of convergence between the North and South.

**Appendix.1** Many calculations are not developed here but are available on the autor.

In the model we suppose that industrial goods are produce in the two countries, the necessary and sufficient conditions are :

$$(\beta_f \tau)^{1-\sigma} < 1, (\tau/\beta_f)^{1-\sigma} < 1 \quad \text{et}$$

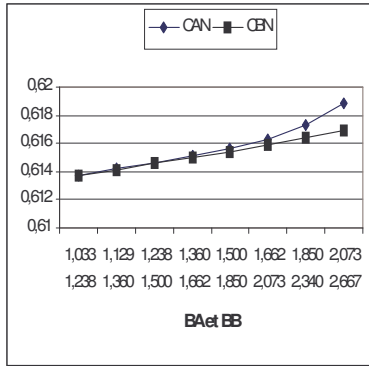
$$\frac{(\beta_f \tau)^{1-\sigma} (1 - (\tau/\beta_f))^{1-\sigma}}{(1 - \tau^2(1-\sigma))} < \lambda_N < \frac{(1 - (\tau/\beta_f))^{1-\sigma}}{(1 - \tau^2(1-\sigma))}$$

$$\text{and } \frac{(1 - (\tau * \beta_f))^{1-\sigma}}{(1 - \tau^2(1-\sigma))} > \lambda_S > \frac{(\tau/\beta_f)^{1-\sigma} (1 - (\tau * \beta_f))^{1-\sigma}}{(1 - \tau^2(1-\sigma))}$$

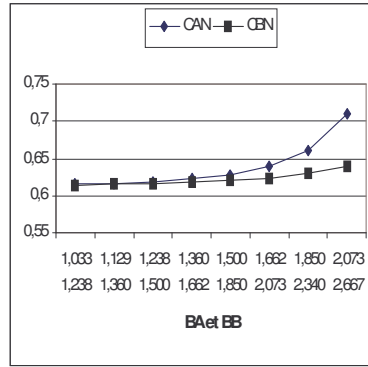
## 2. Results of the simulations.

**Appendix 2.1** :Variation of the sectoral concentration of firms in the North with a rise of the relative marginal cost of the South .

*Graphs 1, 2* : Variation of  $C_{AN}$  and  $C_{BN}$  following  $\beta_A$  and  $\beta_B$ , with,  $\delta = 0.3, \gamma = 0.5, \sigma = 6$ .



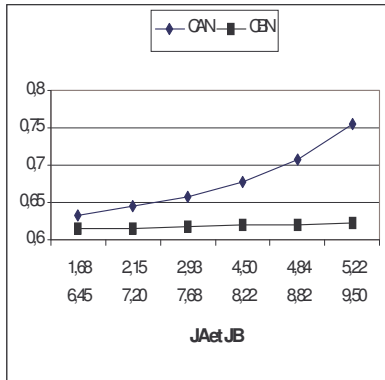
Graph 1,  $\tau = 8$ .



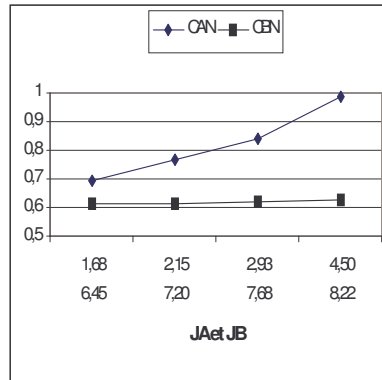
Graph 2,  $\tau = 4$ .

**Appendix 2.2** Variation of the sectoral concentration of firms in the North with a rise of the relative productivity of the North.

*Graphs 3 and 4* : Variation of  $C_{AN}$  and  $C_{BN}$  following  $J_A$  et  $J_B$ , with, *graphs 4 and 5*  $\mu = 0.6$  and  $\delta = 0.3, \gamma = 0.5, \sigma = 6$ .



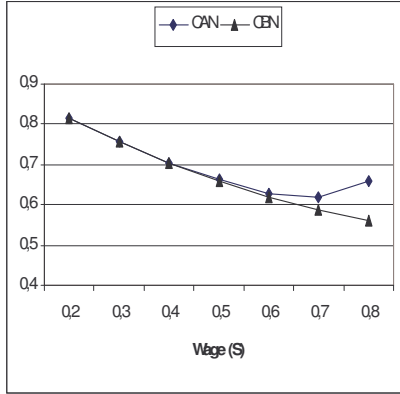
Graph 3,  $\tau = 8$ .



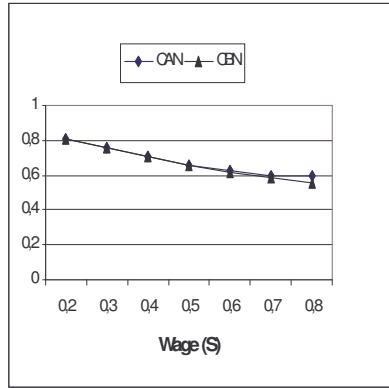
Graph 4,  $\tau = 6$ .

**Appendix 2.3** Variation of the sectoral concentration of firms in the North with a rise of the wages in the South.

*Graphs 5 et 6* : Variation of  $C_{AN}$  and  $C_{BN}$  following  $\mu$ , with, *graph 5*  $\beta_{AS} = 8, \beta_{BS} = 7.6, \beta_{AN} = 1.15, \beta_{BN} = 1.5, \gamma = 0.5, \delta = 0.3, \tau = 7$  and  $\sigma = 9$  and *graph 6*,  $\beta_{AS} = 8.2, \beta_{BS} = 8.05, \beta_{AN} = 1.3, \beta_{BN} = 1.6$ .



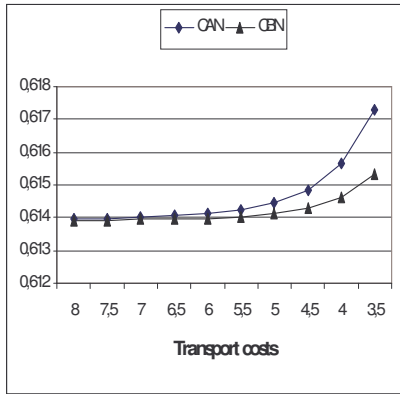
Graph 5



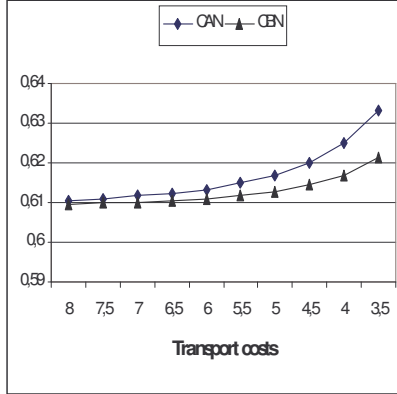
Graph 6

Appendix 2.4 Variation of the sectoral concentration of firms in the North with a decrease of trade costs.

Graphs 7 et 8 : Variation of  $C_{AN}$  and  $C_{BN}$  following  $\tau$ , with  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\beta_A = 1.25$ ,  $\beta_B = 1.1$ ,  $\mu = 0.6$ .

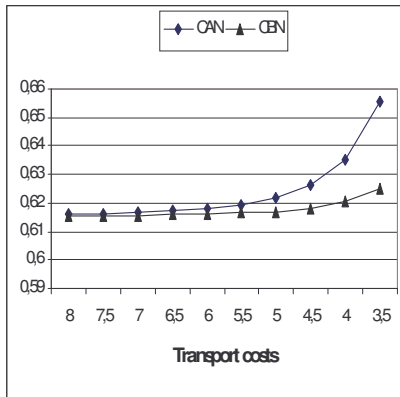


Graph 7,  $\sigma = 6$

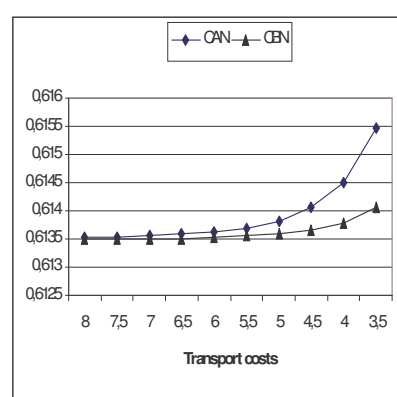


Graph 8,  $\sigma = 4$ .

Graphs 9 and 10 : Variation of  $C_{AN}$  and  $C_{BN}$  following  $\tau$ , with  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\mu = 0.6$ .



Graph 9,  $\beta_A = 2$ ,  $\beta_B = 1.52$ .

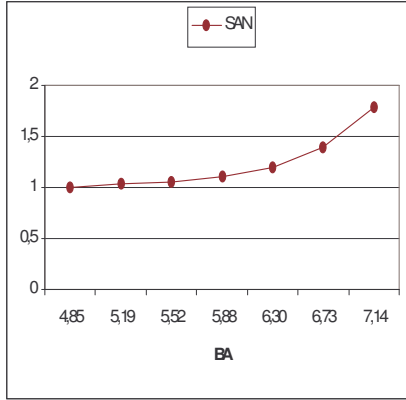


Graph 10,  $\beta_A = 1.15$ ,  $\beta_B = 1.015$ .

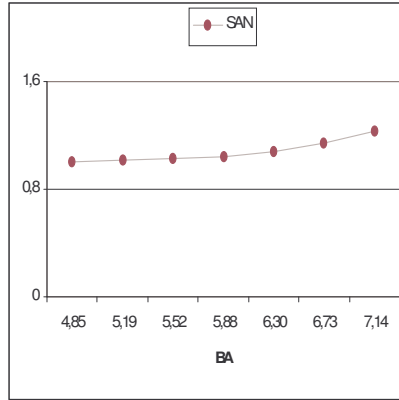
Appendix 2.5a Variation of the degree of specialization of the North with a reinforcement of countries' comparative advantages.

Graph 11 : Variation of  $S_{AN}$  following  $\beta_A$ , with  $\sigma = 8$  and  $\tau = 8$ ,  $\gamma = 0.5$ ,  $\delta = 0.3$ ,  $\mu = 0.5$ ,  $\beta_B = 4.64$ .

Graph 12 :  $\mu = 0.5$ ,  $\beta_B = 4.64$ ,  $\gamma = 0.5$ ,  $\delta = 0.3$ ,  $\sigma = 8$ ,  $\tau = 9$ .



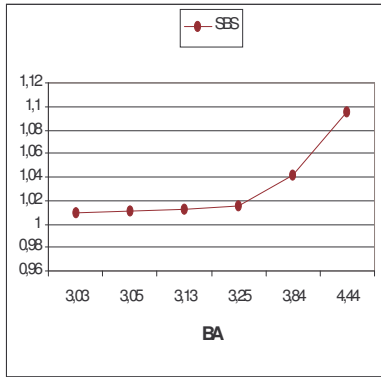
Graph 11



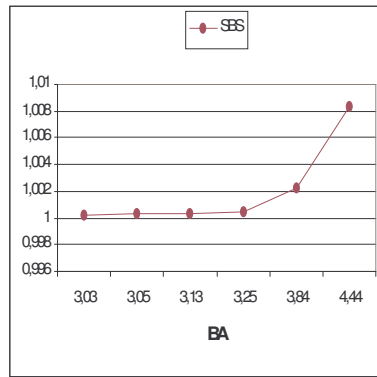
Graph 12.

Appendix 2.5b Variation of the degree of specialization of the South with a reinforcement of countries' comparative advantages.

Graphs 13 and 14: Variation of  $S_{BS}$  following  $\beta_A$ , with  $\tau = 8, \beta_B = 2.23; \delta = 0.3, \gamma = 0.5, \mu = 0.6$



Graph 13,  $\sigma = 6$ .

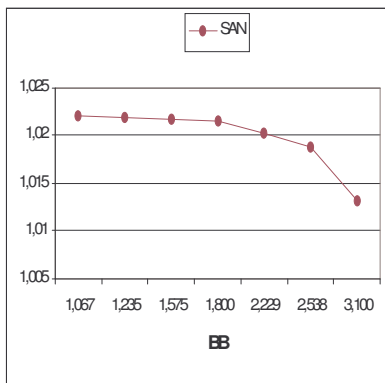


Graph 14,  $\sigma = 10$ .

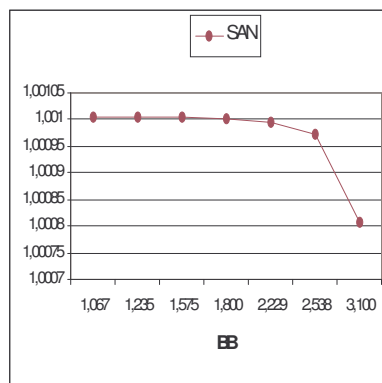
Appendix 2.6a Variation of the degree of specialization of the North with a rise of relative marginal cost industrial sectors.

Graph 15 : Variation of  $S_{AN}$  following  $\beta_B$ , with  $\sigma = 6, \delta = 0.3, \gamma = 0.5, \mu = 0.6, \tau = 8, \beta_A = 3.714$ .

Graph 16 :  $\delta = 0.3, \gamma = 0.5, \mu = 0.6, \beta_A = 4.33$ .



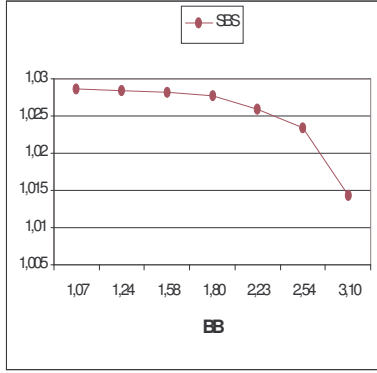
Graph 15.



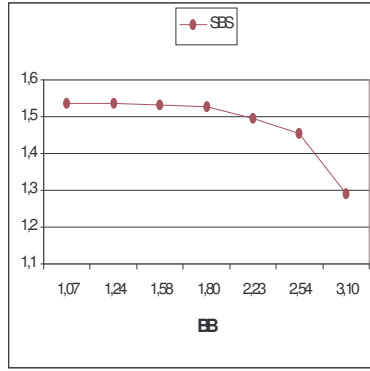
Graph 16,  $\sigma = 10, \tau = 8$ .

Appendix 2.6b Variation of the degree of specialization of the South with a rise of relative marginal cost industrial sectors.

Graphs 17 et 18 : Variation of  $S_{BS}$  following  $\beta_B$ , with  $\delta = 0.3, \gamma = 0.5, \mu = 0.6, \beta_A = 3.55, \sigma = 6$



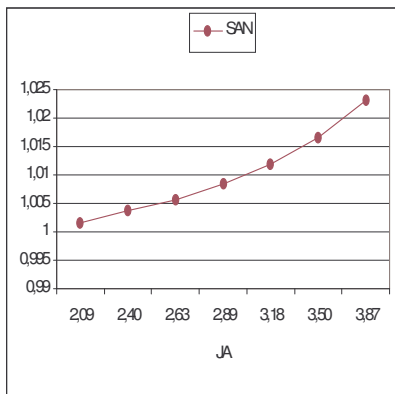
Graph 17,  $\tau = 8$ .



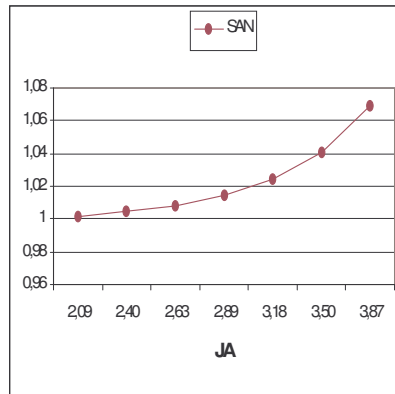
Graph 18,  $\tau = 5$ .

Appendix 2.7a. Variation of the degree of specialization of the North with a rise of the relative productivity of the North.

Graphs 19 et 20 : Variation of  $S_{AN}$  following  $J_A$ , with  $\sigma = 6$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $J_B = 1.83$ ,  $\mu = 0.6$ .

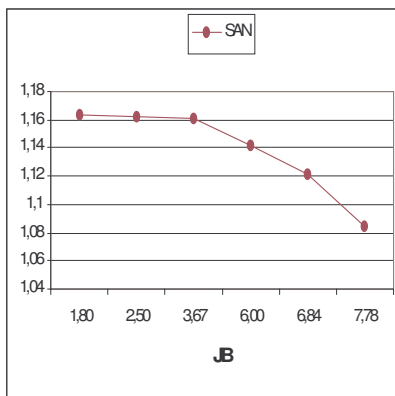


Graph 19,  $\tau = 8$ .

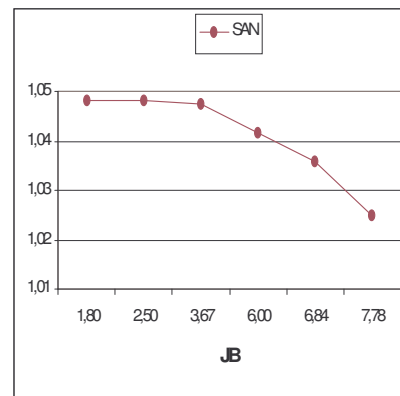


Graph 20,  $\tau = 4$ .

Graphs 21 et 22: Variation of  $S_{AN}$  following  $J_B$  with  $\sigma = 6$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $J_A = 9$ ,  $\mu = 0.6$ .



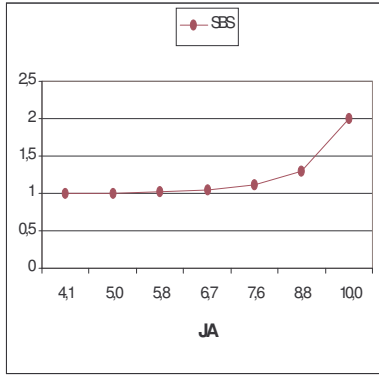
Graph 21,  $\tau = 8$ .



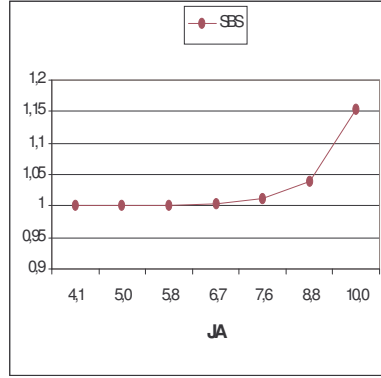
Graph 22,  $\tau = 10$ .

Appendix 2.7b Variation of the degree of specialization of the South with a rise of the relative productivity of the North..

Graphs 23 and 24: Variation of  $S_{BS}$  following  $J_A$  with  $\tau = 8$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\mu = 0.6$ ,  $J_B = 3.3$ .

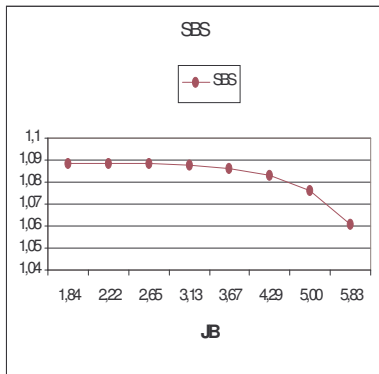


Graph 23,  $\sigma = 6$ .

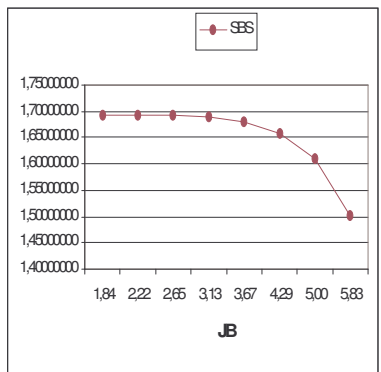


Graph 24,  $\sigma = 10$ .

Graphs 25 and 26: Variation of  $S_{BS}$  following  $J_B$  with,  $\sigma = 6$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\mu = 0.6$ ,  $J_A = 7.27$ .



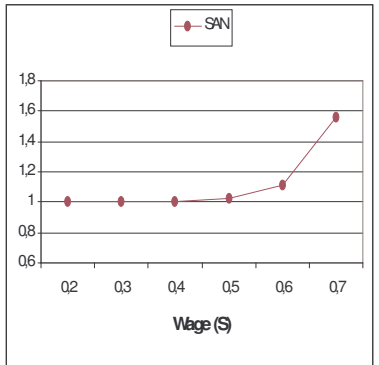
Graph 25,  $\tau = 8$ .



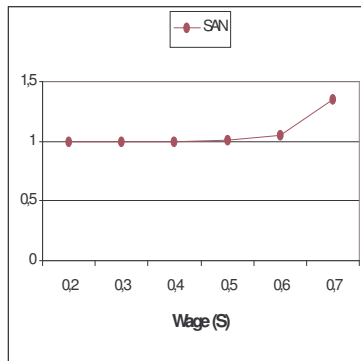
Graph 26,  $\tau = 6$ .

Appendix 2.8a. Variation of the degree of specialization of the North with a rise of the wages in the South.

Graphs 27 and 28: Variation of  $S_{AN}$  following  $\mu$ , with,  $\tau = 5.5$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\beta_{AN} = 1.15$ ,  $\beta_{BN} = 1.5$ ,  $\beta_{AS} = 8$ ,  $\beta_{BS} = 7.6$ .



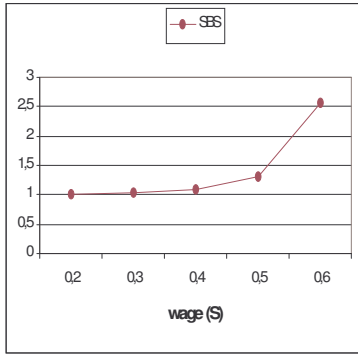
Graph 27,  $\sigma = 9$ .



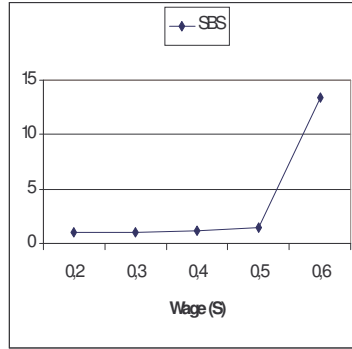
Graph 28,  $\sigma = 12$ .

Appendix 2.8b. Variation of the degree of specialization of the South with a rise of the wages in the South

Graphs 29 et 30 : Variation of  $S_{BS}$  following  $\mu$ , with  $\sigma = 6$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\beta_{AN} = 1.1$ ,  $\beta_{BN} = 1.2$ ,  $\beta_{AS} = 9$ ,  $\beta_{BS} = 7$ .



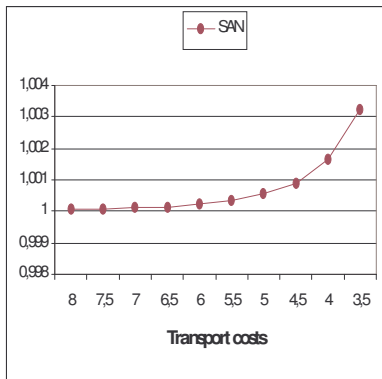
Graph 29,  $\tau = 8$ .



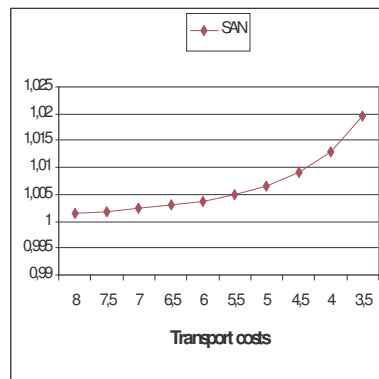
Graph 30,  $\tau = 6$ .

Appendix 2.9a Variation of the degree of specialization of the North with a decrease of trade costs.

Graphs 31 and 32 :Variation of  $S_{AN}$  following  $\tau$ , with  $\beta_A = 1.67$ ,  $\beta_B = 1.46$ ,  $\sigma = 2$ ,  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\mu = 0.6$ .



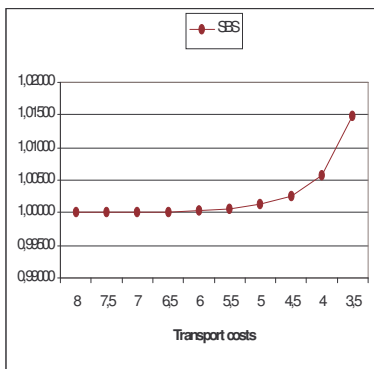
Graph 31,  $\sigma = 6$ .



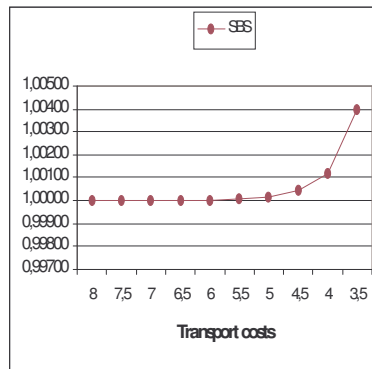
Graph 32,  $\sigma = 4$ .

Appendix 2.9b Variation of the degree of specialization of the South with a decrease of trade costs.

Graphs 33 et 34: Variation of  $S_{BS}$  following  $\tau$ , with  $\delta = 0.3$ ,  $\gamma = 0.5$ ,  $\sigma = 8$ ,  $\beta_A = 1.80$  and  $\beta_B = 1.2$ ,  $\mu = 0.6$ .



Graph 33,  $\sigma = 8$ .



Graph 34,  $\sigma = 10$ .

## Bibliography

- Baldwin R. E., Venables A.J., (1995), "Regional Economic Integration", *Handbook of international Economics*, vol 3, p.1597-1644.
- Baldwin R.E., Martin P., (2003), "Agglomeration and Regional Growth", *CEPR Discussion Paper* n°3960
- Baldwin R. E., Martin P., Ottaviano G.I.P., (1998), "Global Income Divergence, Trade and Industrialisation: The Geography of Growth Take-Offs", *NBER working paper*, n°6458.
- Baldwin R. E., Forslid R., (2000a) "The Core-Periphery Model and Endogenous Growth: Stabilising and De-Stabilising Integration", *Economica* , n° 67 (3), p. 307-324.
- Baldwin R. E., Forslid R., (2000b), "Trade Liberalisation and Endogenous Growth: A q-Theory Approach" , *Journal of International Economics*, vol. 50, No. 2, p 497-517.
- Darrigues F., Montaud JM., (2001), "Intégration économique et agglomération des activités industrielles dans le Mercosur, les enseignements d'un modèle d'économie géographique", Université Montesquieu Bordeaux IV, *Centre d'économie du développement, document de travail* n°54.
- Forslid, R., Wooton I., (1999), "Comparative advantage and the location of production", *CEPR Discussion Paper* n°2118.
- Fujita M., Thisse J.F., (2002), "Does agglomeration foster economic growth? and who gain and loses from it ?", *CEPR Discussion Paper series* n°3135.
- Hur J., (2001), "Effects of Regional Free Trade Agreements on Industrial Structure: An Extension of Krugman's Economic Geography Model (1991)", National University of Singapore, Department of Economics, *Department Working Papers* 0113.
- Krugman P.R, (1980), "Scale economies, product differentiation, and the pattern of trade", *American Economic Review*, n°70.
- Krugman P., (1991a), "Cities in space : Three Simple Models", *NBER Working paper* 3607.
- Krugman, P., (1991b), "Increasing returns and economic geography", *Journal of political economy*, vol 99, p. 483-499.
- Krugman P., (1991c), "*Geography and trade*", Leuven University press and The MIT Press, Cambridge.
- Krugman P., Venables A.J., (1995), "Globalization and the inequality of nation", *Quarterly journal of economics*, 110.
- Krugman P., Venables A.J, (1996). "Integration, Specialization, and Adjustment", *European Economic Review*, Volume 40, Issue 3-5.
- Madariaga N., (2002), "Localisation Industrielle dans un modèle Nord-Sud", *Cahier de la MSE*.
- Martin P., Ottaviano G.I.P., (1999), "Growing locations: Industry location in a model of endogenous growth", *European Economic Review*, Volume 43 (2), février, p.281-302.
- Martin P., Ottaviano G.I.P., (2001), "Growth and agglomeration", *International Economic Review*, vol 42, n°4.
- Martin P., Rogers C.A., (1995), "Industrial Location and Public Infrastructure", *Journal of International Economics*, n°39.

- Martin P., (2003), *Economic geography and public policy*, Princeton University Press.
- Monfort P., Van Ypersele T. (2003), "Integration, Regional Agglomeration and International Trade", *CEPR Discussion paper* n°3752
- Midelfart Knarvik. H., Steen F., (2000),"Vertical Industry Linkages: Sources of Productivity Gains and Cumulative Causation", *CEPR Discussion Paper* n°2467, May 2000.
- Puga D., (1999), "The rise and fall of regional inequalities", *European Economic Review*, n°43.
- Puga D., Venables A.J., (1996a), "Preferential trading arrangements and industrial location", *Journal of International Economics*, Septembre, n°43, p.347-368.
- Puga D., Venables A., (1996b), "The Spread of Industry: Spatial Agglomeration in Economic Development," Papers 279, London School of Economics, *Centre for Economic Performance*.
- Puga, D., (2001), "European regional policies in light of recent location theories", *CEPR Discussion Paper* n° 2767.
- Ricci, L.A., (1999)," Economic geography and comparative advantage : agglomeration versus specialization", *European Economic Review* 43, p. 357-377.
- Thisse J-F., Ottaviano G.I.P (2003), "Agglomeration and Economic Geography", *CEPR Discussion Paper* n°3838
- Venables (1996), "Equilibrium Location of Vertically Linked Industries", *International Economic Review*, vol 37, n°2.
- Venables A.J., (1999), "Regional integration agreements: a force for convergence or divergence ?", *World Bank and London School of Economics, World Bank, working paper* 2260.
- Venables A.J., Limao, (1999), "Geographical disadvantage: a Heckscher-Ohlin-von Thunen model of international specialisation", *The World Bank, Working paper* n°2256.