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COUNTRIES, REGIONS AND TRADE: ON THE WELFARE IMPACTS OF ECONOMIC INTEGRATION

BY

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Countries, regions and trade: on the welfare impacts of economic integration*

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Abstract

We study the impact of falling international trade costs and falling national transport costs on the economic geography of countries involved in an integration process. Each country is formed by two regions between which labor is mobile, whereas there is no international mobility. Commodities can be traded both nationally and internationally at positive, but different, costs. A decrease in trade costs and/or in transport costs has a direct impact on prices and wages in both countries. This allows us to account for the impact of changes in these parameters on the economic geography and welfare of each country. We show that, as trade barriers fall, the benefits of integration come after its costs. We also show that national transport policies are of the beggar-thy-neighbour type. On both counts, policy coordination is required in the process of economic integration.

Keywords: agglomeration; economic geography; regional integration; trade costs; transport costs

JEL Classification: F12; F16; R12

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1 Introduction

It is a well-documented fact that the growing openness of national economies to international trade has a significant impact on the location of economic activities within countries. First, using a cross-section of 85 countries, Ades and Glaeser (1995) show that higher tariff barriers lead to a higher degree of urban primacy. Their findings have been confirmed and extended by Henderson (2003). Second, studying the "cohesion group" of the European Union (Greece, Ireland, Portugal and Spain, but no regional data are available for Ireland), Quah (1996) notes that the two countries that have reached the highest rates of economic growth, Spain and Portugal, are those that have experienced the most striking rise in regional imbalances. This is consistent with the evidence reported by de la Fuente and Vives (1995) who observe that the process of economic integration within the European Union fosters international convergence *across* countries rather than interregional convergence across regions *within* countries. Indeed, about half of the divergence across European regions is due to an increased polarization within some member-states. Finally, Hayward (1995) notes that the impact of European integration on the US might differ from state to state. In particular, he shows that, while some US states could thrive, others might suffer from stronger import competition.

All this evidence raises crucial policy issues that are often neglected when countries decide on trade agreements and the development of transportation infrastructure. For example, it suggests that the recent enlargement of the European Union to 10 new countries and the planned infrastructural improvements are very unlikely to leave the economic geography of the new and old members unaffected. Moreover, the ensuing changes will probably differ across countries, depending on their degree of internal integration and the quality of their already existing transportation infrastructure. Thus, some anticipation of the likely outcomes is required to avoid major political disturbances and social turmoils, triggered by a potentially uneven distribution of the gains and losses from enlargement as the geography of competition and employment changes. This points to the same direction as Anderson and van Wincoop (2004, p. 748) for whom "[t]here is undoubtedly a rich relationship between domestic and international trade costs, market structure, and political economy." The practical importance of those outcomes should make it clear that the questions that motivate us are both relevant and important for circles that are not just academic.

In this paper we provide a theoretical framework to address the foregoing issues by developing an integrated model of interregional and international trade. The specific framework we adopt is borrowed from the so-called 'new economic geography' (Krugman, 1991; Fujita *et al.*, 1999). In particular, we model the endogenous formation of the economic landscape in a spatial economy consisting of two countries each made of two regions. Countries and regions are distinguished from each other by differences in both barriers to trade and factor mobility. Specifically, while goods are assumed to be mobile between both countries and regions, factors move only between regions within the same country. Moreover, trade is hampered by 'transport' costs between regions and by 'trade' costs between countries. Albeit particular and simple, this framework is sufficient to study how changing transport and/or trade costs affect the distribution of activities within and between countries and how the resulting economic geography of countries influences the type as well as the intensity of international trade.

Section 2 presents the model as an extension of the approach developed by Ottaviano *et al.* (2002) to the richer spatial context described above. Production takes place in two sectors, a perfectly competitive sector and a monopolistically competitive one. The former employs only unskilled labor, which is immobile both between and within countries, whereas the latter employs only skilled labor, which is immobile between countries but mobile within them. The fact that we build on Ottaviano *et al.* (2002) allows us to highlight two *direct competition effects*: (i) local prices decrease with the number of local producers, in accordance with the theory of industrial organization; and (ii) lower transport and/or trade costs lead to lower prices, as suggested by Hotelling (1929, p. 50) for whom "merchants would do well, instead of organizing improvement clubs and booster associations to better the road, to make transportation as difficult as possible". Thus, even though our monopolistic competition model abstracts from direct strategic interactions between individual firms, we will see that it captures most of the main features of oligopolistic competition through mark-ups that vary with the number of firms and the level of trade barriers. As recently argued by Winters and Chang (2000), Chang and Winters (2002), and Lai and Trefler (2002), such effects seem to be crucial for measuring the impact and welfare consequences of trade liberalization.

In Section 3, we show that lowering international trade costs may lead to the dispersion of skilled labor within each country, while reducing interregional transport costs is likely to foster its agglomeration, starting with the country having the lower initial level of transport costs. Accordingly, inserting a country in a network of international exchanges yields a richer set of conditions for agglomeration to arise than in the case of an isolated country. In particular, *common changes in internal and external barriers to* *goods mobility may have very different impacts on the spatial structure of different countries.* Most interestingly, our findings agree with some of the conclusions obtained by Head and Mayer (2004, p. 2632) in their survey of the empirics of agglomeration and trade: "these results point to the empirical relevance of agglomeration forces operating through forward linkages, but these forces are likely to stay very localized, *unable to generate core-periphery patterns in Europe at a large geographical level* at least as long as labor remains so sensitive to migration costs" (emphasis in the original).[1]

The gains from building on Ottaviano *et al.* (2002) are reaped in the next three sections, where we perform a detailed analysis of the welfare impacts of interregional and international integration. Even though decreasing shipping costs of commodities reduce equilibrium prices and, thus, raise consumers' surplus, the welfare may decline since lower prices decrease operating profits and, hence, wages. Hence, *the internal geography of the trading partners matters for the level of welfare within each country as well as for the global welfare level.* This happens because both the nature and the intensity of trade change with the geography of the trading partners. Our framework therefore appears to be well suited to separately assess the impacts of falling international trade costs and of falling interregional transport costs.

Three results of our welfare analysis stand out. First, as in Brander and Krugman (1983), there can be 'excessive trade' even though trade makes a wider variety of products available to consumers. Specifically, deeper integration decreases welfare when trade costs are high. By contrast, it increases welfare when trade costs have fallen below some threshold value. Second, each country has always an incentive to reduce its own interregional transport costs. However, such reduction is always harmful to the other country and constitutes, therefore, a *beggar-thy-neighbor policy.* The reason is that, by improving its own transportation infrastructure, a country makes its domestic market more competitive and, therefore, reduces the operating profits of foreign firms as well as the wages they pay to their workers. Hence, there is a *negative transport externality* that materializes through the channel of internal trade. Third, as a consequence, *both countries may end up being trapped into a prisoner's dilemma.* This calls for the international coordination of national transport policies as envisaged by the Rome Treaty (Articles 3 and 71): "a common policy in the sphere of transport [...] to or from the territory of a Member State or passing across the territory of one or more Member States". It also calls for the coordination of transport

[1] Our findings also agree with the empirical analyses conducted by Davis and Weinstein (1998, 1999) for OECD countries and for Japanese prefectures, respectively.

policies with trade, competition, and regional policies along the process of economic integration.

Related literature. There are only few contributions related to the main issues motivating the present paper. They all use the Dixit-Stiglitz-Krugman (henceforth, DSK) framework. Martin and Rogers (1995) argue that a major determinant of national market size is the degree of interregional integration. However, by ruling out interregional factor mobility between ex ante identical regions, these authors do not allow for a genuine distinction between regions and countries. Therefore, the closest contributions to ours are those based on Krugman (1991). In a two-country three-region setting involving congestion costs as a dispersion force, Krugman and Livas Elizondo (1996) as well as Fujita *et al.* (1999, ch.18) argue that lower international trade costs foster dispersion in the country opening to trade. Paluzie (2001) obtains the opposite result in a setting in which the dispersion force is given by partially immobile demand: trade openness fosters agglomeration. Such different results stem from the fact that changes in trade costs do not affect the dispersion force in Krugman and Livas Elizondo (1996), whereas they do in Paluzie (2001). In a two-country four-region setting, Monfort and Nicolini (2000) show through simulations that international trade liberalization between countries leads to more agglomeration within each country. This concurs with Paluzie (2001) but disagrees with what we will show in this paper. The reasons for such a difference in results will be explained in our concluding section. More importantly perhaps, none of the above-mentioned papers study the welfare impacts of changing trade and/or transport costs. In this respect, it is worth noting that some of our results are reminiscent of findings obtained in the debate on unilateral versus multilateral trade agreements. Interestingly, however, our assumptions on factor mobility and market structure are quite different (see, e.g. Bagwell and Staiger, 1998 and 1999).

2 The model

The economy consists of two countries, labeled $r = H, F$, each having two regions, labeled $i = 1, 2$. When needed, variables associated with each country and each region will be subscripted accordingly. Because we want to focus on countries having similar technologies and similar factor endowments such as members of the EU-15, we abstract from comparative advantage of both the Ricardian and Heckscher-Ohlin types. Specifically, we assume that there are two production factors, skilled and unskilled labor. We denote by L the mass of skilled and by A the mass of unskilled workers in each country. Each individual works and consumes in the region she is established in. Unskilled workers are immobile and evenly split between regions so that each region accommodates a mass $A/2$ of them. Skilled workers are *mobile within* but *immobile between countries*; we denote by $\lambda_r \in [0, 1]$ their share in region 1 of country r. This means that the mass of skilled workers living in country r is constant but that its interregional distribution is endogenous. Note that the relative immobility of unskilled with respect to skilled workers fits empirical observation (SOPEMI, 1998).

Production takes place in two sectors. The 'traditional' sector supplies a homogenous good under perfect competition using unskilled labor as the only input of a constant-returns technology. The unit input requirement is set to one by choice of units. In the 'modern' sector monopolistically competitive firms offer a mass N of varieties of a horizontally differentiated good employing both factors under increasing returns to scale. There is a one-to-one correspondence between firms and varieties, so that N is also the mass of available varieties. Specifically, the firm producing variety v incurs a fixed cost of $\phi > 0$ units of skilled labor.[2]

All goods can be shipped across countries and regions. They are, however, subject to different shipping costs. On the one hand, all shipments of the homogenous good are free. Though restrictive, this assumption does not strongly affect the main conclusions that can be derived from the core-periphery model of the linear genre considered here (see, Picard and Zeng, 2005, for more details). In addition, this makes that good the natural choice for the numéraire, thus implying that in equilibrium the unskilled wage is equal to one everywhere. On the other hand, both international and interregional shipments of the differentiated varieties are costly. Specifically, international shipments face the same cost per unit shipped of $\tau > 0$ units of the numéraire regardless of the regions of origin and destination. This assumption implies that any region of a country has the same access to each region of the other country. In other words, we abstract from physical geography considerations such as the existence of gated and landlocked regions. By contrast, interregional shipments may face different costs: shipping one unit within country $r = H, F$ requires $t_r > 0$ units of the numéraire. For the ease of exposition, henceforth we refer to the international cost τ as the *trade cost* and to the interregional cost t_r as the *transport cost* of country

[2] The model can easily been extended to the case in which the production of $q(v)$ units of variety v requires $m\,q(v)$ units of unskilled labor. What follows holds true provided that α is replaced by $\alpha - m$ in the demand functions.

$r = H, F$. Conceptually, the difference between the two shipping costs is the following. Since, for our purpose, the standard distinction between tariff and non-tariff barriers is not critical, the cost τ includes all impediments to trade, such as shipping costs per se, but also tariff and non-tariff barriers to trade, different product standards, difficulty of communication, and cultural differences. Differently, t_r stands for the sole costs of shipping the differentiated product between the two regions of the same country r. For example, for the developed countries we have in mind, Anderson and van Wincoop (2004) provide a 'consensus estimate' of the average ad-valorem tax equivalent of total trade barriers equal to 170%. This number breaks down into local distribution costs (our *transport cost*) of 55% and international trade costs (our *trade cost*) of 74% (i.e., $1.7 = 1.55 \cdot 1.74 - 1$). The additional costs faced by international shipments break down into transportation costs of 21% and border costs of 44% (i.e., $0.74 = 1.21 \cdot 1.44 - 1$); the latter finally breaks down into policy barriers (8%), different currencies (14%), different languages (7%), information barriers (6%), and security barriers (3%).

Each worker is endowed with one unit of labor and $\overline{q}_0 > 0$ units of the numéraire. The initial endowment $\overline{q}_0$ is supposed to be large enough for her consumption of the numéraire to be strictly positive at the market outcome. All workers have the same quasi-linear utility with quadratic subutility. A typical resident of region i in country r solves the following consumption problem:

$$\begin{cases} \max\limits_{q_{ri}(v),\, \forall v \in [0,N]} \alpha \displaystyle\int_0^N q_{ri}(v)\mathrm{d}v - \frac{\beta-\gamma}{2} \int_0^N [q_{ri}(v)]^2 \mathrm{d}v - \frac{\gamma}{2}\left[\int_0^N q_{ri}(v)\mathrm{d}v\right]^2 + q_0 \\ \qquad\qquad \text{s.t.} \displaystyle\int_0^N p_{ri}(v) q_{ri}(v)\mathrm{d}v + q_0 = y_{ri} + \overline{q}_0 \end{cases}$$

where $\alpha > 0$, $\beta > \gamma > 0$ are parameters, $p_{ri}(v)$ is the consumer price of variety v in region i of country r and y_{ri} is the resident's income which depends on her skilled or unskilled status.

It is readily verified that solving the consumption problem yields the individual demand functions given by

$$\begin{aligned} q_{rij}(v) &= a - (b + cN)p_{rij}(v) + cP_{rj} \\ q_{rsi}(v) &= a - (b + cN)p_{rsi}(v) + cP_{si} \end{aligned} \tag{1}$$

with

$$a \equiv \frac{\alpha}{\beta + (N-1)\gamma} \qquad b \equiv \frac{1}{\beta + (N-1)\gamma} \qquad c \equiv \frac{\gamma}{(\beta-\gamma)[\beta + (N-1)\gamma]}.$$

In expression (1), $p_{rij}(v)$ is the price firm v located in region i of country r charges to consumers in region j of the same country r, whereas $p_{rsi}(v)$ is the price firm v located in country r charges in region i of the other country $s \neq r$. Note that there is no need to mention the region of origin in country r because all firms located in this country have the same access to region i of country s. Analogously, $q_{rij}(v)$ is the output of firm v located in region i of country r demanded by a consumer in region j of the same country r, whereas $q_{rsi}(v)$ is the output of firm v located in country r demanded by a customer in region i of the other country $s \neq r$. Finally,

$$P_{rj} = \int_0^N p_{rj}(v)\mathrm{d}v \tag{2}$$

is the price index (i.e., N times the average price) of varieties in region j of country r.

Skilled labor market clearing in each country $r = H, F$ implies:

$$n_{r1} = \frac{\lambda_r L}{\phi} \qquad n_{r2} = \frac{(1-\lambda_r)L}{\phi} \qquad n = n_{r1} + n_{r2} = \frac{L}{\phi} \qquad N = 2n \tag{3}$$

where n_{ri} is the mass of modern firms in region i of country r.

Product and labor markets are *segmented* and entry as well as exit are free. The first assumption means that each firm is free to set a price specific to the region and the country in which it sells its output. Whereas there is a vast amount of empirical evidence suggesting that international markets are segmented (see, e.g., Engel and Rogers, 1996; Haskel and Wolf, 2001), one might think of national markets as being more integrated in that firms would be mill pricers. While this is true to some extent, even within fairly well-integrated regional blocks, such as the EU or Canada/US, border effects remain strong (Head and Mayer, 2000; Engel and Rogers, 1996). Even more surprising, spatial price discrimination and border effects are pervasive *within* major industrialized countries (see, e.g., Greenhut, 1981; Wolf, 2000). In addition to largely contradicting the empirical evidence, using mill pricing would also render the formal analysis somewhat more complex without adding much to our main results. The second assumption means that skilled wages are determined by the zero-profit condition implied by free entry and exit of firms in each region. More precisely, the equilibrium wages of the skilled are determined by a local bidding process in which firms compete for workers by offering higher wages until no firm can profitably enter or exit the market. We denote by w_{ri} the resulting skilled wage rate prevailing in region i of country r.

Market segmentation implies that, as firms bear all transport and trade costs, a firm located in region 1 of country H maximizes profits given by:

$$\begin{aligned}
\pi_{H1} \quad = \quad & p_{H11}q_{H11}\left[\frac{A}{2}+\lambda_H L\right]+(p_{H12}-t_H)q_{H12}\left[\frac{A}{2}+(1-\lambda_H)L\right] \\
& + (p_{HF1}-\tau)q_{HF1}\left[\frac{A}{2}+\lambda_F L\right] \\
& + (p_{HF2}-\tau)q_{HF2}\left[\frac{A}{2}+(1-\lambda_F)L\right]-\phi w_{H1}. \qquad (4)
\end{aligned}$$

A firms located in other regions solves a symmetric maximization problem. Then, free entry and exit imply that in each region skilled wages absorb all operating profits of local firms: $\pi_{H1}=0$.

Throughout this paper, we focus on the meaningful case in which transport costs t_r and trade costs τ are sufficiently low for interregional and international trade to be bilateral, regardless of the (interior) firm distributions λ_H and λ_F. When this is the case (details are given below), the profit-maximizing prices are as follows:
(i) *intraregional* prices

$$p^*_{rii}=\frac{2a+c(n_{rj}t_r+n\tau)}{4(b+cn)} \qquad r=H,F \qquad (5)$$

(ii) *interregional* prices

$$p^*_{rij}=p^*_{rjj}+\frac{t_r}{2} \qquad i\neq j \qquad (6)$$

(iii) *international* prices

$$p^*_{rsi}=p^*_{sii}+\frac{\tau}{2} \qquad r\neq s. \qquad (7)$$

As stated above, the profit-maximizing price that country-s firms set in region i of country r does not depend on the region of country s in which the firm is located; this is because all firms in country s have the same access to each region of country r.[3]

[3] The expressions of the equilibrium prices reveal the crucial difference between the chosen model of monopolistic competition and the DSK framework. In particular, unlike what could be obtained with the DSK model, each of these equilibrium prices decreases with the number of firms located in the corresponding regions (n_{ri}, n_{rj} and n_{si}), thus showing the existence of a *true competition effect* consistent with the industrial organization literature (Tirole, 1988). Hence, firms "weakly" interact in our setting. Clearly, prices

We are now equipped to determine the conditions on τ and t_r for trade to occur between any two regions at these equilibrium prices. Starting with interregional transport costs, it is easy to check that

$$t_r \leq t_{trade}(\tau) \equiv \frac{2a + cn\tau}{2(b + cn)} \qquad r = H, F \tag{8}$$

must hold for interregional trade in each country to take place, regardless of the firm distributions λ_r.[4] Observe that a lower τ leads to a decrease in the threshold value of interregional trade costs t_r for which there is interregional trade. Hence, *lower trade costs in the international marketplace may lead to a break down of internal trade when the regional markets of a country are poorly integrated.* This is because cheaper imported varieties will displace more expensive nationally produced ones.

As to international trade costs, it is readily verified that the condition

$$\tau \leq \frac{2a + cn_{sj}t_s}{2b + cn} \tag{9}$$

must hold for the interregional demands q_{rsi} to be positive. As can be seen from (9), the feasibility of international trade depends on the value of interregional transport costs and on the spatial distribution of industry *within* each country. This is because lower interregional transport costs and the agglomeration of firms exacerbate price competition in local markets, thus making penetration by outside firms more difficult. To avoid a proliferation of subcases we focus on situations in which *international trade occurs for all distributions of firms within countries.* This will be the case when

$$\tau \leq \tau_{trade} \equiv \frac{2a}{2b + cn} \tag{10}$$

holds. Note that the value τ_{trade} does not depend on national transport costs because international trade costs are not region-specific. In what follows, we assume that both conditions (8) and (10) are always satisfied.

As discussed above, the equilibrium wages of the skilled are determined by a bidding process in which all operating profits are absorbed by the wage

also depend positively on transport and trade costs, thus accounting for intranational and international competition. Note, finally, that country r's firms export prices decrease as the market of country s becomes more integrated (i.e. as t_s decreases), showing that prices are 'strategic complements' in our model. This result is consistent with recent estimates obtained by Chang and Winters (2002).

[4] This condition also ensures that interregional prices net of transport costs remain positive.

bill. Therefore, in equilibrium the skilled wage rate in region i of country r satisfies $\pi_{ri}(w_r) = 0$. This wage is determined by a *national component* that depends on the distribution λ_r of firms in country r, as well as by an *export component* that depends on the distribution λ_s of firms in the other country. This separability property will be important in the subsequent equilibrium analysis. Let us write the equilibrium wage as follows:

$$w_{ri}^* = \frac{D_r(\lambda_r) + E_r(\lambda_s)}{\phi} \tag{11}$$

where, by (3) and (4),

$$D_r(\lambda_r) = \left(\frac{A}{2} + \phi n_{ri}\right) p_{rii}^* q_{rii}^* + \left(\frac{A}{2} + \phi n_{rj}\right) (p_{rij}^* - t_r) q_{rij}^*$$

is the revenue from domestic sales of a firm located in country r, whereas

$$E_r(\lambda_s) = \left(\frac{A}{2} + \phi n_{si}\right) (p_{rsi}^* - \tau) q_{rsi}^* + \left(\frac{A}{2} + \phi n_{sj}\right) (p_{rsj}^* - \tau) q_{rsj}^*$$

stands for its export revenue from foreign sales. Substituting these expressions back into (11) and using the equilibrium quantities finally yields

$$\begin{aligned} w_{ri}^* \quad &= \quad \frac{b + cN}{\phi} \left[\left(\frac{A}{2} + \phi n_{ri}\right) (p_{rii}^*)^2 + \left(\frac{A}{2} + \phi n_{rj}\right) \left(p_{rij}^* - t_r\right)^2 \right] \\ &\quad + \frac{b + cN}{\phi} \left[\left(\frac{A}{2} + \phi n_{si}\right) (p_{rsi}^* - \tau)^2 + \left(\frac{A}{2} + \phi n_{sj}\right) \left(p_{rsj}^* - \tau\right)^2 \right]. \end{aligned} \tag{12}$$

The *market equilibrium* for any given spatial distribution of firms (λ_r, λ_s) is then defined by (3), (5), (6), (7) and (12).

3 Interregional and international equilibrium

We first evaluate the indirect utilities of the skilled workers in regions 1 and 2 of country $r = H, F$ at the market equilibrium. The indirect utility in region i of country r is readily shown to be given by

$$V_{ri} = S_{ri} + w_{ri}^* + \overline{q}_0$$

where

$$\begin{aligned} S_{ri} \quad &= \quad \frac{a^2 N}{2b} - a(n_{ri} p_{rii}^* + n_{rj} p_{rji}^* + n_s p_{sri}^*) \\ &\quad + \frac{b + cN}{2} \left[n_{ri} (p_{rii}^*)^2 + n_{rj} (p_{rji}^*)^2 + n_s (p_{sri}^*)^2 \right] \\ &\quad - \frac{c}{2} (n_{ri} p_{rii}^* + n_{rj} p_{rji}^* + n_s p_{sri}^*)^2 \end{aligned} \tag{13}$$

is the individual consumer surplus evaluated at the market outcome, n_s being the number of varieties produced abroad. The indirect utility differential between the two regions of country $r = H, F$ is then defined by

$$\Delta V_r^*(\lambda_r) \equiv V_{r1}^*(\lambda_r) - V_{r2}^*(\lambda_r) \tag{14}$$

which depends only upon the distribution λ_r in country r. This stems from the fact that, as shown by (11), the equilibrium wage w_{ri}^* prevailing in region i of country r is given by the sum of two terms, $D_r(\lambda_r)$ and $E_r(\lambda_s)$, which are respectively independent of λ_s and of λ_r. As a result, $E_r(\lambda_s)$ cancels out in the indirect utility differential ΔV_r^*, which becomes a function of the domestic distribution λ_r only.[5]

A spatial equilibrium is such that, in each country, no skilled worker has an incentive to change location, conditional upon the fact that the product markets clear at the equilibrium prices (5), (6) and (7), while labor markets clear at the equilibrium wages (12). Formally, a *spatial equilibrium* arises at $\lambda_r \in (0,1)$ when $\Delta V_r^*(\lambda_r) = 0$, or at $\lambda_r = 0$ if $\Delta V_r^*(0) \leq 0$, or at $\lambda_r = 1$ if $\Delta V_r^*(1) \geq 0$. An interior equilibrium is *stable* if and only if the slope of the indirect utility differential (14) is negative in a neighborhood of the equilibrium, whereas the two agglomerated equilibria are always stable whenever they exist.

Using (3), (5), (6), (7) and (12) in (14), some cumbersome but standard calculations yield

$$\Delta V_r^*(\lambda_r) = \frac{n(b+2cn)t_r}{4\phi(b+cn)^2}\left(\lambda_r - \frac{1}{2}\right)(\varepsilon_1 t_r + \varepsilon_2 + \varepsilon_3 \tau) \tag{15}$$

where

$$\varepsilon_1 \equiv -(5c^2n^2\phi + 12bcn + 2c^2nA + 6b^2\phi + 2bcA) < 0 \tag{16}$$

$$\varepsilon_2 \equiv 4a\phi(3b + 4cn) > 0 \tag{17}$$

$$\varepsilon_3 \equiv 2cn\phi(2b + 3cn) > 0 \tag{18}$$

are bundles of parameters that are independent of transport and trade costs.

It follows immediately from (15) that $\lambda_r = 1/2$ is always an equilibrium within each country. Since the indirect utility differential is linear with respect to λ_r, the stability of this equilibrium depends on the sign of $\varepsilon_1 t_r + \varepsilon_2 + \varepsilon_3 \tau$. When this expression is negative, dispersion is the unique stable spatial equilibrium in country r; when it is positive, the dispersed

[5] Note that such a property would no longer hold when regions have different access to national markets.

equilibrium is unstable so that agglomeration of all skilled workers of country r is the only stable equilibrium.[6] This implies that *the economic geography of a country depends on its transport costs as well as on trade costs, but not on the transport costs of the other country.* Of course, this result depends on the assumptions made. The first key-assumption is that all firms in a country have the same access to the regional markets of the other country.[7] However, it must be kept in mind that relaxing this assumption may bias the results in favor of the region having a better access to the foreign markets. Our second critical assumption is that international markets are segmented. Assuming that national markets are integrated (i.e., firms must charge the same mill price to all its customers living in the same country) would not affect the foregoing separability property. By contrast, the geography of country r would depend on transport costs in country s if the international markets were integrated. As discussed above, there is little empirical evidence that this is so.

As the indirect utility differential in a country depends only upon its internal distribution of economic activities, a spatial equilibrium in the global economy consists of two independent spatial equilibria (one for each country). As argued previously, agglomeration is a spatial equilibrium in country r if and only if $\varepsilon_1 t_r + \varepsilon_2 + \varepsilon_3 \tau \geq 0$, which means that

$$t_r \leq \frac{\varepsilon_2 + \varepsilon_3 \tau}{-\varepsilon_1} \tag{19}$$

or, alternatively,

$$\tau \geq \frac{-\varepsilon_1 t_r + \varepsilon_2}{\varepsilon_3} \tag{20}$$

yields a necessary and sufficient condition for agglomeration in country r to be a stable spatial equilibrium (recall that ε_1 is negative).

This leads to the following result.

[6] Observe that, for both the agglomerated and dispersed configurations to arise as a spatial equilibrium, it must be that $\tau^*(t_r) < \tau_{trade}$ and $t^*(\tau) < t_{trade}(\tau)$. Because $\varepsilon_2 > 0$, when $\tau = 0$ the latter inequality holds provided that $\varepsilon_1 t_{trade}(0) + \varepsilon_2 < 0$. By continuity, the two configurations will then emerge as equilibria in the vicinity of $\tau = 0$. Because the absolute value of ε_1 rises with A, $\varepsilon_1 t_{trade}(0) + \varepsilon_2 < 0$ holds if and only if A exceeds some threshold value that we denote $\overline{A}$. In particular, some simple calculations show that $\overline{A}$ is larger than $3L$; hence we assume throughout that $A > \bar{A} > 3L$. This reflects the idea that immobile activities represent the larger share of the economy. Note also that $t^*(\tau)$ always exceeds some threshold $T > 0$ when τ is arbitrarily small, whereas $\tau^*(t_r)$ equals 0 as soon as t_r is smaller than T while being strictly positive.

[7] This includes the standard assumption that marginal labor requirements are constant.

Proposition 1 *Agglomeration is a stable spatial equilibrium in country r if and only if*

$$t_r \leq t^*(\tau) \equiv \frac{2\phi\left[2a(3b+4cn)+2cn\phi(2b+3cn)\tau\right]}{5c^2n^2\phi+6b\phi(b+2cn)+2cA(b+cn)}$$

or, equivalently, if and only if

$$\tau \geq \tau^*(t_r) \equiv \frac{\left[5c^2n^2\phi+6b\phi(b+2cn)+2cA(b+cn)\right]t_r - 4a\phi(3b+4cn)}{2cn\phi(2b+3cn)}.$$

The two inequalities identified in the foregoing proposition are 'dual' to the extent that each yields a necessary and sufficient condition to be imposed on transport or on trade costs for agglomeration to arise in a country, each condition depending on the other parameter. Because ε_1 is negative, *for a given τ agglomeration within country r is more likely to be a stable equilibrium when the transport costs in this country are low.* Everything else being equal, more intranational competition leads domestic firms to cluster because they have a larger market (recall that the spatial distribution of consumers within each country is endogenous), which in turn makes the penetration by the foreign firms more difficult. This concurs with the main result of economic geography in which agglomeration arises when trading across places becomes less expensive (Krugman, 1991; Fujita *et al.*, 1999). The novelty is that here the occurrence of agglomeration is lowered, namely $t^*(\tau)$ decreases, as trade costs keep falling.

Because ε_3 is positive, *for a given t_r such that $\tau^*(t_r) > 0$, agglomeration within a country is more likely to be a stable equilibrium when trade costs are high.* Everything else equal, domestic firms react to more international competition by relaxing intranational competition through dispersion. Then, liberalizing trade would foster dispersion within each country, thus providing a rationale for the empirical results of Ades and Glaeser (1995) mentioned in the introduction. Our finding is also in accord with recent work by Brülhart and Traeger (2005), who show that the dispersion of manufacturing activities has significantly increased within the EU member-states in recent years. Among other things, Proposition 1 shows how trade impediments may affect the economic geography of countries involved in the integration process.

As $\tau^*(t_r)$ increases with t_r, it also follows from Proposition 1 that the country with the lower transport costs is agglomerated for a larger range of trade costs. This result suggests that *lowering transport costs inside a country involved in a process of international integration could well trigger* *more regional imbalance within this country*, unless the global economy has reached a fairly high level of integration.

Finally, it remains to investigate the impact of a simultaneous reduction in transport and trade costs. Assuming first the case of a joint and equiproportionate decrease of t_r and τ, we have

$$\mathrm{d}(\varepsilon_1 t_r + \varepsilon_2 + \varepsilon_3 \tau) = \varepsilon_1 \mathrm{d}t_r + \varepsilon_3 \mathrm{d}\tau = (\varepsilon_1 + \varepsilon_3)\mathrm{d}\tau.$$

Because $\varepsilon_1 + \varepsilon_3 < 0$, we thus see that an equiproportionate decrease in both (international) trade and (national) transport costs increases the likelihood of an agglomerated outcome in each country. More generally, because $\varepsilon_2 > 0$, (15) implies that *country r will exhibit agglomeration when both t_r and τ decrease sufficiently.*

4 Trade costs and welfare

Our framework allows for a precise study of the welfare impact of the various parameters expressing the freeness of exchange across regions and countries. For simplicity, in analyzing such impacts, we neglect both the proceeds that governments obtain through tariffs on imports and the infrastructure costs they must incur to make interregional transportation cheaper. Notice, however, that assuming that reductions in trade and/or transport costs require the use of resources would reinforce our main results.

Individual utilities being quasi-linear, the total welfare W_r in country r may be defined as the sum of consumer surpluses and wages across regions:

$$\begin{aligned} W_r(\lambda_r, \lambda_s) &= \lambda_r L[S_{r1}(\lambda_r) + w_{r1}(\lambda_r, \lambda_s)] + (1-\lambda_r)L[S_{r2}(\lambda_r) + w_{r2}(\lambda_r, \lambda_s)] \\ &\quad + \frac{A}{2}[S_{r1}(\lambda_r) + S_{r2}(\lambda_r) + 2] \end{aligned}$$

where S_{ri}, as defined by (13), is the consumer surplus in region $i = 1, 2$ of country $r = H, F$ (recall that unskilled wages are equal to unity by choice of numéraire). The effect of a fall in trade costs on welfare is a priori ambiguous. On the one hand, decreasing trade costs imply a decline in equilibrium prices (see (5)), thus raising consumers' surplus. On the other hand, lower equilibrium prices decrease operating profits and, hence, wages (see (12)).

First, differentiating W_r with respect to τ yields

$$\frac{\partial W_r}{\partial \tau} = \frac{b + 2cn}{16(b + cn)} (\kappa_1 t_r + \kappa_2 t_s + \kappa_3 \tau + \kappa_4)$$

where

$$\begin{aligned}
\kappa_1(\lambda_r) &\equiv 2(b+cn)[4cn^2\phi\lambda_r(\lambda_r-1)-cnA]<0\\
\kappa_2(\lambda_s) &\equiv 4cn^2(b+cn)\phi\lambda_s(\lambda_s-1)-cnA(2b+cn)<0\\
\kappa_3 &\equiv 2(6b^2+8bcn+3c^2n^2)(\phi n+A)>0\\
\kappa_4 &\equiv -2a(3b+2cn)(n\phi+A)<0
\end{aligned}$$

Therefore, we have

$$\frac{\partial W_r}{\partial \tau} \gtreqless 0 \quad \text{if and only if} \quad \tau \gtreqless \widehat{\tau}_r(\lambda_r,\lambda_s)$$

where

$$\widehat{\tau}_r(\lambda_r,\lambda_s) \equiv \frac{-\kappa_1(\lambda_r)t_r-\kappa_2(\lambda_s)t_s-\kappa_4}{\kappa_3} < \tau_{trade}$$

for all admissible values of λ_r and t_r.

In general, we have $\widehat{\tau}_r(\lambda_r,\lambda_s) \neq \widehat{\tau}_s(\lambda_r,\lambda_s)$. Without loss of generality, we may assume that $t_r \leq t_s$ so that $\widehat{\tau}_r(\lambda_r,\lambda_s) \leq \widehat{\tau}_s(\lambda_r,\lambda_s)$ for all spatial equilibria. When τ starts decreasing from τ_{trade}, our results then show that *lowering trade costs makes each country worse off when these costs are sufficiently high*, i.e. when $\tau > \widehat{\tau}_s(\lambda_r,\lambda_s)$. Then, as τ falls below $\widehat{\tau}_s(\lambda_r,\lambda_s)$, there is a first reversal in that welfare starts increasing in country s, whereas it keeps decreasing in r. Finally, when τ is sufficiently low (i.e. when $\tau < \widehat{\tau}_r(\lambda_r,\lambda_s)$), welfare levels rise in both countries when trade costs decrease further. These results show that integrating two economies leads to a $\cup$-shaped relationship between national welfare and trade costs, with welfare being lowest for some intermediate degree of international integration.[8] *Stated differently, the benefits of integration come after its costs.*

To sum-up, we have:

Proposition 2 *Assume a fixed distribution* (λ_H,λ_F). *When trade costs gradually decrease, the global economy goes through three phases: (i) the level of welfare in each country decreases; (ii) the less integrated country enjoys a welfare improvement, whereas the welfare of the other country keeps falling; and (iii) both countries are better off.*

This result partly stems from the fact that firms absorb shipping costs so that there is too much trade going on. This is reminiscent of the inefficiency of 'dumping' pointed out by Brander and Krugman (1983): lower trade

[8] Provided that varieties are not too close substitutes, the welfare level under zero trade costs will exceed the welfare level under autarky.

costs may reduce welfare when they remain sufficiently high because the resource waste due to dumping offsets the gains from tougher competition ("pro-competitive effect"). However, as these costs fall less resources are wasted in inefficient transportation and the benefits of consuming more at lower prices take over. Here, the same line of reasoning applies due to freight absorption as the equilibrium prices (5), (6) and (7) make clear.

Observe that Proposition 2 rests on the assumption that both distributions λ_H and λ_F are unaffected by the fall in trade costs. However, we know from Proposition 1 that lowering trade costs fosters the dispersion of activities within each country. Thus, we may expect both λ_H and λ_F to vary from 1 to 1/2. In this case, the absolute value of both $\kappa_1(\lambda_r)$ and $\kappa_2(\lambda_s)$ increases, thus implying that both $\widehat{\tau}_H$ and $\widehat{\tau}_F$ rise. In other words, by changing the internal geography of each country, a steady decrease of trade costs leads to a shrinking of the domain over which more economic integration appears to be harmful to each country. This result also shows that the welfare loss due to international integration is less likely when the national economies exhibit a dispersed spatial pattern, thus providing a rational for the EU's regional development policies within the different member-states.

5 Transport costs and welfare

Consider now a gradual decrease in transport costs in country r. As the welfare impact may vary across countries, it is useful to distinguish between the *national* and the *global effects* of lower t_r.

5.1 National welfare

Some tedious but standard calculations show that, regardless of the equilibrium configuration in either country, we have:

$$\frac{\partial W_r}{\partial t_r} < 0 \qquad r = H, F.$$

Hence, *the welfare of country r always increases when its transport costs are lowered*. This shows that the resource waste effect is always more than offset by the pro-competitive effect as the latter is amplified by a 'home market effect' (Krugman, 1980): domestic firms increase their market shares at the expense of foreign firms.

Consider now the impact on country $s \neq r$. Because a decrease in t_r, by exacerbating the degree of price competition in country r, affects adversely the export prices of the firms located in country $s \neq r$ and because this effect is the only one that impacts on the welfare of this country, we immediately have

$$\frac{\partial W_s}{\partial t_r} > 0 \qquad r = H, F \quad \text{and} \quad s \neq r.$$

In words, we see that a country is always worse off when the foreign country improves upon the quality of its transportation infrastructure, thus showing that such a move is a beggar-thy-neighbor policy. Put differently, we have something like a "fortress effect" in that accessing the increasingly integrated market becomes more and more difficult. In the case of country s the resource waste effect more than offsets the pro-competitive effect as it is now the former that is supported by the 'home market effect'. Such a finding might explain the negative empirical relationship between domestic transport infrastructure investment and foreign income obtained by Bougheas *et al.* (2003) from data on 16 European countries over the period 1987-95.

A first conclusion therefore emerges: *each country has an unambiguous incentive to decrease its transport costs but this affects adversely the foreign country.* The reason is rent shifting which leads to a potential conflict of interests between countries.

5.2 Global welfare

The analysis of the impact of a change in t_r on global welfare is more convoluted as the total effect varies with the internal geography of the trading partners. Therefore, for simplicity, we restrict ourselves to two special, but relevant, cases: (i) transport costs t_r vary whereas t_s is kept constant, the resulting effect being evaluated when both costs are equal ($t_H = t_F = t$); and (ii) transport costs are the same in both countries $t_H = t_F = t$ and we evaluate the effect of a joint variation in t (which now corresponds to a *joint equiproportionate* variation of t_H and t_F).

Let

$$\Omega_r(\lambda_r, \lambda_s) \equiv \frac{\partial W_r}{\partial t_r} + \frac{\partial W_s}{\partial t_r} \qquad \text{with } s \neq r \tag{21}$$

so that the evolution of $W_r + W_s$ is given by the sign of $\Omega_r(\lambda_r, \lambda_s)$. When $\Omega_r(\lambda_r, \lambda_s) < 0$ (resp. $\Omega_r(\lambda_r, \lambda_s) > 0$), the global welfare rises (resp. falls) when transport costs in country r decrease. Interestingly enough, we will see that the sign of $\Omega_r(\lambda_r, \lambda_s)$ varies with the value of t and, therefore, with the internal geography of countries H and F. Because of symmetry, only two spatial patterns may arise in equilibrium, namely the two economies are dispersed ($\lambda_H = \lambda_F = 1/2$) or agglomerated (without loss of generality, we let $\lambda_H = \lambda_F = 1$ in this case).

Consider first the case in which dispersion prevails in either country, that is, $t > t^*(\tau)$. We then have

$$\Omega_r(1/2, 1/2) = \frac{n(L+A)(b+cn)}{16(2b+cn)^2}\left(\delta_1 t + \delta_2 + \delta_3 \tau\right)$$

where

$$\begin{aligned} \delta_1 &\equiv 12b^2 + 20bcn + 9c^2n^2 > 0 \qquad \delta_2 \equiv -4a(3b+2cn) < 0 \\ \delta_3 &\equiv -2cn(4b+3cn) < 0. \end{aligned}$$

Let

$$\widetilde{t}_d(\tau) \equiv -\frac{\delta_2 + \delta_3\tau}{\delta_1} > 0$$

be the solution to $\delta_1 t + \delta_2 + \delta_3\tau = 0$ with respect to t. Then, we have $\Omega_r(1/2, 1/2) > 0$ (resp. $\Omega_r(1/2, 1/2) < 0$) if and only if $t > \widetilde{t}_d$ (resp. $t < \widetilde{t}_d$).

In the appendix, we show that the global welfare impact of a unilateral decrease in transport costs depends on the initial value of these costs. Specifically, *global welfare decreases when $t > \widetilde{t}_d > t^*(\tau)$ and increases when $\widetilde{t}_d > t > t^*(\tau)$*. This occurs when trade costs are high or the mass of unskilled workers is large. Further, *when both trade costs are low and the mass of unskilled is small, decreasing transport costs within a country is always inefficient.*

We now come to the case in which $t < t^*(\tau)$ so that agglomeration prevails in the two national economies. The analysis is similar to the one above but the results are more clear-cut. We must now evaluate the sign of

$$\Omega_r(1, 1) = \frac{n(b+2cn)A}{16(b+cn)^2}\left(\eta_1 t + \eta_2 + \eta_3\tau\right)$$

where

$$\begin{aligned} \eta_1 &\equiv 6b^2 + 8bcn + 3c^2n^2 > 0 \qquad \eta_2 \equiv -cn(4b+3cn) < 0 \\ \eta_3 &\equiv -2a(3b+2cn) < 0 \end{aligned}$$

Let $\widetilde{t}_a$ be the solution of $\eta_1 t + \eta_2 + \eta_3\tau = 0$ with respect to t, namely

$$\widetilde{t}_a \equiv -\frac{\eta_2 + \eta_3\tau}{\eta_1} > 0$$

Clearly, $\Omega_r(1, 1) < 0$ (resp. $\Omega_r(1, 1) > 0$) if and only if $t > \widetilde{t}_a$ (resp. $t < \widetilde{t}_a$). To rank $\widetilde{t}_a$ and $t^*(\tau)$, we set $\Delta_a \equiv \widetilde{t}_a - t^*(\tau)$. Again, $\widetilde{t}_a$ is independent of

A whereas $t^*(\tau)$ is a decreasing function of A, so that Δ_a is an increasing function of A. Because $\Delta_a(\overline{A}) > 0$, where $\overline{A}$ is given as in footnote 6, Δ_a is positive for all $A > \overline{A}$ thus implying that $\Omega_r(1,1)$ is always positive. In words, when the two countries are agglomerated, any reduction of transport costs by one country is always beneficial to this country and to the global economy.

Our analysis may then be summarized as follows.

Proposition 3 *Assume that both countries have the same transport costs. When both trade costs are sufficiently low and the mass of unskilled workers is small enough, a unilateral decrease of its transport costs by one country is socially undesirable as long as $t > t^*(\tau)$ and becomes desirable for $t < t^*(\tau)$. In the remaining cases, it is undesirable for $t > \widetilde{t}_d$ and desirable for $t < \widetilde{t}_d$.*

Hence, for high trade and transport costs the resource waste effect dominates the pro-competitive effect of reduced transport costs.

6 Is there a need to coordinate transport policies?

As varying trade (τ) and national transport (t_r) costs have different impacts on welfare (see Propositions 2 and 3), the following question suggests itself: *should national and international transport policies be coordinated?*

As our setting is symmetric, we have

$$\left.\frac{\partial W_s}{\partial t_r}\right|_{t_r=t_s} = \left.\frac{\partial W_r}{\partial t_s}\right|_{t_r=t_s} \qquad \text{with } s \neq r. \tag{22}$$

Thus, substituting (22) into (21) shows that

$$\Omega_r(\lambda_r, \lambda_s) \equiv \left.\frac{\partial W_r}{\partial t_r}\right|_{t_r=t_s} + \left.\frac{\partial W_r}{\partial t_s}\right|_{t_r=t_s} \qquad \text{with } s \neq r$$

measures the impact on the welfare of country r of a simultaneous and identical variation of t_r and t_s. We know that each country has incentives to improve its welfare by decreasing its own transport costs. However, when both countries simultaneously decrease their transport costs, we may reinterpret the results of the foregoing section as follows. First, when $t > \widetilde{t}_d$ regardless of the values of A and τ, each country ends up being worse off because the negative effect inflicted by the other is dominant. Put differently, the two countries are in a *prisoner's dilemma situation.* This result can be explained as follows. Lowering simultaneously both transport costs leads domestic and foreign firms to decrease their prices. Yet, because the international price difference remains the same whereas the interregional price difference decreases, consumers substitute national varieties for foreign varieties. When transport costs are initially high, firms price in the elastic part of their demand so that the revenues earned from exports fall substantially. This in turn yields lower operating profits and, hence, lower wages. Such a result can be established only in a setting involving several countries because the direct effects of improving national transport infrastructure are always positive. It also uncovers a case in which international cooperation in choosing a transportation policy is desirable. Second, as in the foregoing, when $t < \widetilde{t}_d$ both countries are better off except when both trade costs are low and the mass of unskilled is small, which implies that the welfare of each country can still decrease. All of this shows that *uncoordinated transport policies may have diverging consequences on the welfare level of each country according to the initial level of the corresponding costs.* That coordinating transport policies is globally desirable should not come as a surprise in a setting replete with external effects. What is surprising is the fact that both countries can be hurt by the absence of cooperation in designing their transportation policies.

In the foregoing, we have kept trade costs (τ) constant when studying the impact of national transport costs on welfare. It remains to consider how a joint variation of τ, t_H and t_F may affect the relationship between those costs and welfare. For τ and t_r given, we have seen that a fall in t_s decreases the revenues from export sales but does not affect the surplus in country s. When τ varies in the same direction as t_s, the surplus of country s' workers does rise due to lower prices. Hence, reducing simultaneously trade and national transport costs could well be welfare-enhancing. To check it, we assume that $T \equiv \tau = t_H = t_F$ and study the sign of $\partial W_r / \partial T$:

$$\text{sign}\left\{\frac{\partial W_r}{\partial T}\right\} = \text{sign}\left\{(2\kappa_1 + 2\kappa_2 + \kappa_3)T + \kappa_4\right\}$$

where κ_1, κ_2, κ_3 and κ_4 are defined in Section 4. Since countries are now symmetric, they exhibit the same economic geography given by $\lambda_H^* = \lambda_F^* = 1$ or by $\lambda_H^* = \lambda_F^* = 1/2$. It is readily verified that, whatever the equilibrium spatial configuration, $\partial W_r / \partial T < 0$ when $T < \tau_{trade}$. Hence, *improving both international and national transportation infrastructures may be desirable*, even when countries are weakly integrated. Furthermore, we have seen in Section 5 that the welfare of a country may be negatively affected by a decrease in trade costs. When national transport costs change in the same direction as trade costs, this negative effect vanishes. All these results suggest that *there is a case for coordinating intranational and international transport policies.*

7 Concluding remarks

We have presented a model that shows how changes in the transportability of commodities as well as in the mobility of factors *between and within* countries affect the location of economic activities, the distribution of factors, the geography of demand and, therefore, the pattern of trade as well as welfare.

Our key result is that lower intranational transport costs foster regional divergence when international trade costs are high enough, whereas lower international trade costs promote regional convergence when intranational transport costs are high enough. This clearly shows that, *when production factors have different degrees of mobility at different spatial scales of analysis, international and interregional integration play important, yet distinct, roles in explaining the evolution of economic geography and welfare within a country.* Our model thus provides a possible explanation for the empirical results obtained by de la Fuente and Vives (1995) regarding the impact of the entry of Spain and Portugal on their internal economic geography. Furthermore, it is well known that EU regional policies mainly focus on financing transport infrastructure in lagging regions. Our analysis suggest that such a policy may fail to produce the expected results because its impact critically depends on the degree of international integration as well as on the degree of national integration, both of which are likely to significantly vary across countries within the EU.

Whereas our results concerning *interregional* integration agree with what is known in economic geography, our results concerning *international* integration do not. In particular, they conflict with those obtained in comparable models featuring partially immobile demand as dispersion force (Montfort and Nicolini, 2000; Paluzie, 2001). These studies argue that international trade liberalization fosters regional polarization within countries. How can we explain such different results? The answer lies in an unsuspected by-product of different modeling strategies. While the cited contributions use the DSK framework with CES demands and iceberg costs of transportation, we use instead linear demands and linear costs of transportation. Consequently, trade and transport costs affect prices multiplicatively in the above references, whereas they affect prices additively in our model. In other words, while trade and transport costs are proportional to prices in the DSK setting, their shares in prices vary with the level of prices in ours. This fits reality better. The main message of economic geography is that the internal geography of a country depends on the level of its transport costs. This in turn affects the intensity of competition and the level of prices in the space-economy under consideration. When trade costs are additive, there is no feedback effect from prices to trade costs, but trade costs are affected when they are multiplicative. This clearly shows that *the way trade and transport costs are modeled is not neutral for the nature of the results.*

In this respect, it is worth noting that iceberg costs have more the nature of an ad valorem tariff than that of a standard shipping cost or that of a nontariff barrier, which are not directly related to the value of traded goods. Consequently, if trade liberalization consists mainly in the removal of either tariff barriers or nontariff barriers, its impact on the internal geography of countries may be different. This finding shows that there is great need for more 'realistic' trade cost specifications, where both the additive and the multiplicative components are accounted for. It also suggests that, on the one hand, increasing regional polarization within the EU could well be driven by improvements in member-states' infrastructures combined with the decrease of ad valorem tariff barriers whereas, on the other hand, actual improvements in infrastructures at the EU level would be insufficient to favor a more balanced regional development. These various effects have been overlooked in the literature, where all the impediments to trade are typically collapsed into a single parameter affecting prices in the same way. Such a simplifying approach could explain why different authors obtain contrasted results about the impact of a growing economic integration.

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Appendix: Welfare impact of a unilateral decrease in transport costs

To determine the sign of $\Omega_r(1/2,1/2)$, we have to rank $\widetilde{t}_d$ and t^*. Set $\Delta_d \equiv \widetilde{t}_d - t^*$. As $\widetilde{t}_d$ is independent of A whereas t^* is a decreasing function of A, Δ_d is an increasing function of A. To determine the sign of Δ_d, we evaluate Δ_d at the lowest admissible value of A, which is given by the threshold $\overline{A}$ defined in footnote 6 of Section 3. It is then readily verified that $\Delta_d(\overline{A}) > 0$ if and only if $\tau \in (\widetilde{\tau}, \tau_{trade})$ where

$$\widetilde{\tau} \equiv \frac{2acn(3b+4cn)}{24b^3 + 72b^2cn + 70bc^2n^2 + 21c^3n^3} < \tau_{trade}$$

in which case $\Delta_d > 0$ for all values of $A > \overline{A}$. Hence, $\Omega_r(1/2,1/2) > 0$ as long as $t > \widetilde{t}_d$, thus implying that both countries are worse off when one country unilaterally cuts its own transport costs from high values. By contrast, when $t \in (t^*, \widetilde{t}_d)$, we obtain $\Omega_r(1/2,1/2) < 0$ in which case the domestic country gains more than the foreign country loses.

It remains to describe what happens when $\tau < \widetilde{\tau}$, that is, when $\Delta_d(\overline{A}) \leq 0$. In this case, $\widetilde{A}$ exists such that $\Delta_d(A) > 0$ (resp. $\Delta_d(A) < 0$) when $A > \widetilde{A}$ (resp. $A < \widetilde{A}$), where

$$\widetilde{A} \equiv \frac{\phi}{c}\frac{9a(2b^2 + 21bcn + 13c^2n^2) + (5bc^2n^2 + 6c^3n^3)\tau}{3(2ab + 2cn) + (4cbn + 3c^2n^2)\tau} > \overline{A}$$

When $\tau < \widetilde{\tau}$, two cases may arise when $A > \widetilde{A}$. In the former one, $\Omega_r(1/2,1/2) > 0$ as long as $t > \widetilde{t}_d$ and negative otherwise. In the latter case, we always have $A < \widetilde{A}$ and $\Omega_r(1/2,1/2) > 0$ because $\widetilde{t}_d < t^*$. In other words, a decrease in one country's transport costs is always globally efficient when the mass of unskilled is not too large.

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