

Multinationals: Too Many or Too Few?

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Abstract

The paper builds an analytically tractable model that illustrates the “proximity-concentration trade-off” involved in horizontal multinationals. For low trade costs, firms are single-plant firms, for intermediate costs, some are single-plant firms whereas others are multinationals, for large trade costs, firms are multinationals. It then examines three welfare implications of multinationals. First, it shows that too many firms choose to concentrate their production in only one location. Second, for some transport costs, a reduction in transport costs worsens welfare. Finally, a reduction in communication costs improves welfare.

JEL classification: F02, F12, F15, F23.

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1 Introduction

The EC and other customs and currency unions are willing to reduce trade costs between member states. This is thought to raise welfare in the union. The reduction in trade costs is likely to affect the behavior of multinational firms that have plants in several member states. Instead of serving separate markets with a plant located in each state, they may well try to concentrate their production into a single state and serve the market of the union from that single plant. Hoover is a well-known example of such a practice. In 1993, Hoover closed a vacuum factory in France that has been operational for 30 years, and moved the production to its Scottish plant to unify its models into a vacuum for all of Europe. To what extent does such a practice improve welfare?

The development of the new information and communication technologies makes it easier for a firm to communicate with affiliates settled in other countries. These technologies promote the development of multinational firms. Again, to what extent does such a development improve welfare? More generally, are there too many or too few multinationals? The paper addresses these questions.

Multinationals have been the subject of numerous analyses for the last twenty years, prompted by the development of the new trade theory (Helpman and Krugman, 1985). Two types of multinationals have been identified. The first is the “vertical” multinational in which firms separate production by stages, generally headquarter and production (see e.g. Markusen and Maskus, 2003, and Fujita and Thisse, 2003). The second is the “horizontal” multinational in which a given firm produces the same good in different countries. The trade-off between proximity to the market and the costs of duplicating plants determines the existence of multinationals (see e.g. Brainard, 1993, Markusen and Venables, 2000). Markusen (2002) named the combination of these two approaches “knowledge-capital model”.

By focussing on the explanation of the existence of multinational firms, the literature so far has neglected the issue of welfare analysis. Some welfare consideration are present in Markusen and Venables (1997) where it is shown that investment liberalization is likely to raise the wage gap in both

the skilled-labor abundant and the unskilled labor abundant country. More recently, Elberfeld, Götz and Stähler (2002) discuss some welfare implication of the “vertical” multinationals in a partial equilibrium framework. However, the analysis of the effects of “horizontal” multinationals on welfare in a general equilibrium model is still to be written. This paper makes a step into that direction.

A major difficulty in the analysis of multinationals is to find an adequate measure of welfare. Indeed, existing models distinguish different types of agents (skilled and unskilled workers for example). Some of them may gain with the development of multinationals whereas the others lose. It is then critical to aggregate preferences of different agents. To avoid this problem, we develop a model with horizontal multinationals in which all individuals are alike. It is then natural to measure welfare as the sum of real earnings of all individuals. By construction, the model abstracts from the question of the distribution among individuals of the gains and losses generated by multinationals, which is certainly a relevant question. However, because of that strategy, the model is able to isolate another channel through which multinationals affect welfare.

We derive three results. First too many firms choose to concentrate their production in only one location. When they concentrate their production, firms do not internalize the impact of their decision to be single-plant firms on the price level, which they take as a given macroeconomic variable. Still when a significant number of multinationals decide to concentrate their production, they increase the price level in each region because the consumers from one of the regions have to import a good that was previously produced in their own region.

Second, for some domain of the trade costs, a reduction in trade costs do not improve welfare. Indeed, this reduction induces more multinational firms to become single-plant firms. Since there are too few multinationals, it is not surprising that a reduction in trade costs may decrease welfare. Finally, a reduction in communication costs reduces the costs of multinational firms and induces more single-plant firms to become multinational. Both effects are favorable to welfare.

The model is analytically tractable and explains in a simple way the

“proximity-concentration trade-off” involved in horizontal multinationals. It is shown that for low trade costs, firms are single-plant firms; for large trade costs, they are multinationals and for intermediate costs, some are multinationals whereas others are single-plant firms. The use of the horizontal type of multinationals is justified on two grounds. First, this type of multinationals is empirically dominant among industrialized countries (see e.g. Brainard, 1997 and Markusen and Maskus, 2002). Second, it is mostly prevalent among similar industrialized countries where individuals are to some extent alike between countries, which allows to avoid the question of aggregation of preferences in the measure of welfare.

Section 2 sets up the model. Section 3 examines the location decision of firms. Section 4 analyzes the welfare implications of multinationals. It begins with the question “too many or too few multinationals?”, then it examines the impact of a reduction in trade costs when some multinationals are active and finally it analyzes the effects of a reduction in the communication costs on welfare.

2 The Model

The model builds on Dixit-Stiglitz (1977). Preferences are represented by a Cobb-Douglas function with a share $\mu \in (0, 1)$ of income spent on the manufactured good and a share $1 - \mu$ spent on the agricultural good. The manufactured good is a composite made of a continuum of differentiated varieties $i \in [0, N]$. Preferences for these varieties are represented by a CES function with an elasticity of substitution equal to $\sigma > 1$: $U = C_A^{1-\mu} * \left(\int_0^N (C_r(i))^{1-1/\sigma} di \right)^{\mu \frac{\sigma}{\sigma-1}}$ where C_A is the consumption of the agricultural good and where $C_r(i)$ is the consumption of a manufacturing variety $i \in [0, N]$ by the representative consumer located in region r . Accordingly, the demand for variety i by households located in region r is as follows:

$$C_r(i) = \frac{\mu Y_r}{P_r} \left[\frac{p_r'(i)}{P_r} \right]^{-\sigma} \quad \text{where } P_r \equiv \left[\int_0^N p_r'(i)^{-(\sigma-1)} di \right]^{-1/(\sigma-1)} \quad (1)$$

P_r is the price index of the varieties sold in region r , $p_r'(i)$ is the price paid by a household located in region r for one unit of variety i , and Y_r is the income available in region r .

The agricultural good is traded at no cost, whereas the proportion $0 < \phi < 1$ of a single unit of each variety shipped from one region arrives in the other region (the iceberg trade cost). Therefore, if variety i is consumed in the region where it is produced, the price paid by the households residing in this region, $p'_r(i)$, is equal to the mill price $p_r(i)$. If variety i is consumed in the other region s , then the price paid by a household equals the delivered price, which exceeds the mill price; $p'_s(i) = p_r(i)/\phi > p_r(i)$. For notational convenience we define $\Phi \equiv \phi^{\sigma-1}$.

As in Martin and Rogers (1995), we use a footloose capital model. To be run, each firm, being multinational or not, requires one unit of capital that is used to develop the variety that is produced. There exists N units of capital available worldwide, so that the number of varieties is equal to N . Among the N varieties, n_r are produced in region r and n_s in region s . Varieties produced in region r can be produced by firms located only in that region (there are N_r of these firms) or by multinational firms that have a plant in both regions (there are N_t of these firms). Hence $n_r = N_r + N_t$, $n_s = N_s + N_t$ and $N_r + N_s + N_t = N$. Then, the price index can be written as

$$P_r = \left\{ \int_0^{N_r} p_r(i)^{-(\sigma-1)} di + \int_{N_r}^{N_r+N_t} p_R(i)^{-(\sigma-1)} di + \Phi \int_{N_r+N_t}^N p_s(i)^{-(\sigma-1)} di \right\}^{-1/(\sigma-1)} \quad (2)$$

where $p_R(i)$ is the price set by a multinational on market r (symmetrically, the price set by the multinational on market s is denoted $p_S(i)$).

Each region is populated by the same number of individuals, L , who can work either in the agricultural or in the manufacturing sector. The agricultural good is produced under constant returns to scale. The production of one unit of agricultural good requires the use of one unit of labor. This good is used as the numeraire, so that wages are equal to one in this sector. For some individuals to work in the manufacturing sector and others in the agricultural sector, wages must be equal in both sectors: $w_r = w_s = 1$. The income available in one region is therefore equal to L , plus the region's share of total profits. In order to avoid initial conditions that favours one region, it is assumed that fifty percent of capital owners live in each region.¹

¹See Picard Thisse and Toulemonde (2004) for a general discussion on the role played

Capital is mobile but their owners are immobile: they repatriate the revenues from capital to the region where they live. Since firms compete for the available units of capital, profits serve as revenues for capital, which are equally shared between both regions. In each region, the total earnings are $Y_r = Y_s = L + \Pi/2$, that is, they are respectively made of revenues of workers, and their share in the total capital revenues of both regions Π .

We first examine the behavior of a single-plant firm that is located in region r . The demand addressed to this firm comes from two sources. On the one hand, agents from region r want to consume $\mu Y_r [p'_r(i)/P_r]^{-\sigma} / P_r$ units of that variety (see (1)) and, on the other hand, agents from the other region want to consume $\mu Y_s [p'_s(i)/P_s]^{-\sigma} / P_s$ units of that variety. In the latter case, consumers must buy $\mu Y_s [p'_s(i)/P_s]^{-\sigma} / \phi P_s$ units of the variety. Since $p'_r(i) = p_r(i) = \phi p'_s(i)$, the demand for that variety can be written as

$$q_r(i) = \psi_r \left[\frac{p_r(i)}{P_r} \right]^{-\sigma} \quad \text{where } \psi_r \equiv \mu \left[\frac{Y_r}{P_r} + \Phi \left(\frac{P_s}{P_r} \right)^\sigma \frac{Y_s}{P_s} \right] \quad (3)$$

ψ_r is the total real income adjusted for trade costs.

The production of one unit of variety i requires one worker. The profits of a single-plant firm settled in r are $\pi_r(i) = [p_r(i) - w_r]q_r(i) - f$ where $w_r = 1$ is the wage prevailing in region r whereas the demand $q_r(i)$ is given by (3). The firm incurs fixed costs f . For simplicity we assume that these fixed costs are paid in terms of the traditional goods.

Since there is a continuum of manufacturing firms, each of them is negligible and accurately considers the price index P_r as given. The single-plant firm producing variety i chooses its mill price to maximize profits $\pi_r(i)$. The price resulting from the maximization is a markup over marginal costs: $p_r \equiv p_r(i) = \sigma / (\sigma - 1)$. The production of a single-plant firm producing in region r is therefore:

$$q_r(i) \equiv q_r = \psi_r \left[\frac{\sigma}{\sigma - 1} \frac{1}{P_r} \right]^{-\sigma} \quad (4)$$

We now examine the behavior of a multinational firm that produces a variety with one plant in each region. The multinational serves the consumers from region r with its plant settled in r and it serves the consumers from the other region by the distribution of profits on firms' location.

other region with its plant settled in region s . The plant in r produces $q_R(i)$ units sold at price $p_R(i)$, whereas the plant in s produces $q_S(i)$ units sold at price $p_S(i)$. Because multinationals have plants in each region, consumers do not have to import the varieties produced by these firms. The demand for variety i produced by a multinational is

$$q_t(i) = q_R(i) + q_S(i) = \frac{\mu Y_r}{P_r} \left[\frac{p_R(i)}{P_r} \right]^{-\sigma} + \frac{\mu Y_s}{P_s} \left[\frac{p_S(i)}{P_s} \right]^{-\sigma}$$

The profits of the multinational are $\pi_t(i) = [p_R(i) - 1]q_R(i) + [p_S(i) - 1]q_S(i) - g$ where the fixed costs are denoted g and are paid in terms of the traditional goods.² Several factors affect the fixed costs of a multinational. First, it is natural to assume that the costs of operating two plants are larger than the costs of operating just one: $g \geq f$. Second, there may be some components of the fixed costs that are associated to the variety rather than to the number of plants. These costs are shared between both plants. Accordingly, one would expect $g \leq 2f$. However, there are also some costs of communication between plants: managers of both plants should coordinate, which adds some costs that do not exist in a single-plant firm. Accordingly, one would expect $g \geq 2f$. Summing up, there are good reasons to assume $g \geq f$, but it is a priori not possible to give the sign of $g - 2f$. The analysis below shows that the coexistence of multinationals and single-plant firms is possible whatever this sign.

In this paper, we associate globalization not only to a fall in trade costs, but also to a fall in communication costs, that is, to a fall in the fixed costs g . Indeed, the development of the new information and communication technologies reduces the costs of communication between plants located in two different regions. The effects of this type of globalization may be very different from the effects of a decline in trade costs.

Profit maximization by a multinational gives the optimal prices, which are the same as the prices set by single-plant firms: $p_R(i) = p_S(i) = p_r =$

²We assume that the number of workers in both regions ($2L$) is high enough to cover the fixed costs if all firms are multinationals: $2L - gN > 0$. In the Appendix we determine two conditions that ensure that $\pi_r(i)$ and $\pi_t(i)$ are positive (f and g must be sufficiently low).

p_s . Each plant of the multinational produces:

$$q_R(i) = \frac{\mu Y_r}{P_r} \left[\frac{\sigma}{\sigma-1} \frac{1}{P_r} \right]^{-\sigma}, \quad q_S(i) = \frac{\mu Y_s}{P_s} \left[\frac{\sigma}{\sigma-1} \frac{1}{P_s} \right]^{-\sigma} \quad (5)$$

Note that prices and output are independent of the variety i , so that we can drop the term (i) in the above expressions.

3 Location Equilibrium

If firms cannot increase their profits by changing the location of their plants, then that plant location is an equilibrium. Five cases are possible. First some firms have plants in region r only, others have plants in region s only, and others are multinationals. Second, all firms are single-plants, some in region r , others in s . Third, all firms are multinationals. Fourth, some firms are multinationals and the others are single-plant in only one region. Finally, all firms are single-plants in only one region. To examine location equilibria, we need to compute the profits of single-plant firms and multinationals in each case. The Appendix develops the derivation of the quantities q_r , q_s , q_R and q_S , which are needed to compute profits. Let

$$\begin{aligned} \Phi_1 &\equiv 1 - \frac{2N(g-f)(\sigma-\mu)}{\mu(2L-gN)}, & \Phi_2 &\equiv \frac{(2L-fN)\mu - N(\sigma-\mu)(g-f)}{(2L-fN)\mu + N(\sigma-\mu)(g-f)} \\ N_t^* &\equiv N - \frac{2N(g-f)(\sigma-\mu) - \mu(2L-gN)(1-\Phi)}{\sigma(g-f)(1-\Phi)} \end{aligned}$$

The following proposition collects the results

Proposition 1 *(i) For intermediate values of trade costs ($\Phi_1 < \Phi < \Phi_2$), single-plant firms and multinational firms coexist. The number of single-plant firms is the same in both regions. The number of multinationals is given by N_t^* . (ii) For low trade costs ($\Phi > \Phi_2$), all firms are single-plant and they spread evenly between both regions ($N_r = N_s = N/2$). (iii) For large trade costs ($\Phi < \Phi_1$), all firms are multinationals. (iv) It is not possible to have single-plant firms located in only one region.*

Proof. (i) Single-plant firms and multinationals coexist if and only if all types of firms make the same profits: $\pi_r = \pi_s = \pi_t$. To have N_r , N_s and N_t

strictly positive, it must be that $\pi_r - \pi_s = (q_r - q_s)(\sigma - 1)^{-1} = 0$ and $\pi_r - \pi_t = [q_r - (q_R + q_S)](\sigma - 1)^{-1} + (g - f) = 0$. Plugging the values of output derived in the Appendix, and $N = N_r + N_s + N_t$, in these two expressions gives the optimal number of plants in each region: $N_r = N_s = (N - N_t)/2$ and $N_t = N_t^*$. It is readily checked that the number of multinationals is positive if and only if $\Phi < \Phi_2$ and it is smaller than N if and only if $\Phi > \Phi_1$. Moreover, it is possible to prove that $\Phi_2 > \Phi_1$:

$$\Phi_2 - \Phi_1 = \frac{2\sigma(\sigma - \mu)(g - f)^2 N^2}{\mu(2L - gN)[\mu(2L - gN) + \sigma N(g - f)]} > 0$$

Note that this result does not depend on the sign of $g - 2f$.

(ii) All firms are single-plants if and only if $\pi_r = \pi_s > \pi_t$. Thus, for both regions to host single-plant firms only, it must be that $\pi_r - \pi_s = (q_r - q_s)(\sigma - 1)^{-1} = 0$ and $\pi_r - \pi_t = [q_r - (q_R + q_S)](\sigma - 1)^{-1} + (g - f) > 0$. Plugging the values of output derived in the Appendix, and $N = N_r + N_s$, in the first expression gives the optimal number of plants in each region: $N_r = N_s = N/2$. In that case, the inequality in the second expression is fulfilled if and only if $\Phi > \Phi_2$. For low trade costs, firms prefer to serve both markets from a single location.

(iii) All firms are multinational if and only if $\pi_r < \pi_t$ and $\pi_s < \pi_t$, that is, if and only if $\pi_t - \pi_r = [(q_R + q_S) - q_r](\sigma - 1)^{-1} - (g - f) > 0$ and $\pi_t - \pi_s = [(q_R + q_S) - q_s](\sigma - 1)^{-1} - (g - f) > 0$. Under $N_r = N_s = 0$ and $N_t = N$, both conditions collapse to $\Phi < \Phi_1$. For large trade costs, firms spread their production in two plants. By settling one plant in each region, they locate at the proximity of their consumers and avoid the trade costs.

(iv) To have single-plant firms located in only one region (say region r), it must be that $\pi_r - \pi_s = (q_r - q_s)(\sigma - 1)^{-1} > 0$. At $N_s = 0$, this condition requires

$$-\frac{1}{2} \frac{\mu(\sigma - 1)(2L - fN_r - gN_t)N_r(1 - \Phi)^2}{(\sigma - \mu)(N_t + N_r)(N_t + \Phi N_r)} > 0$$

which is clearly impossible because $2L - fN_r - gN_t > 2L - gN_r - gN_t = 2L - gN > 0$. ■

For large trade costs ($\Phi < \Phi_1$), firms spread their production between both regions. So doing they increase the fixed costs but they reduce the negative impact of trade costs on their profits. For low trade costs ($\Phi > \Phi_2$),

the negative impact of trade costs on profits is low and insufficient to justify the duplication of plants in both regions. For intermediate trade costs, some firms are multinationals and others are nationals. At this equilibrium, the negative impact of trade costs on profits just offsets the costs of duplicating plants in both regions. This is illustrated in Figure 1 that draws the proportion of multinational firms as a function of trade costs.

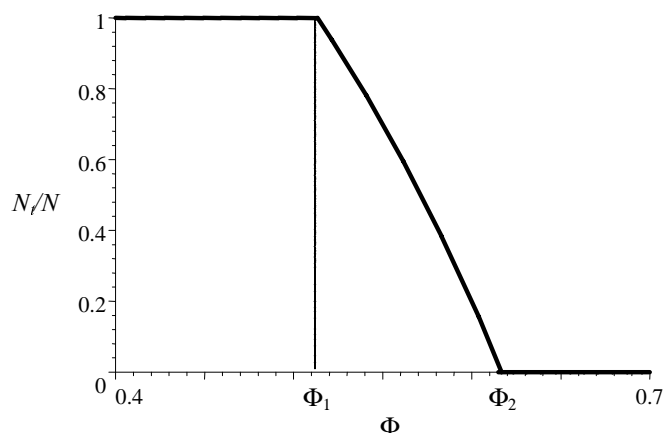


Figure 1: Proportion of multinational firms (N_t/N) as a function of trade costs (large Φ means low trade costs). Parameters used are $\sigma=7$, $\mu=.7$, $L=1$, $f=.1$ and $g=.15$.

Communication costs also affect firms' decisions to become multinational. As expected, a decline in these costs (a reduction in g) increases the proportion of multinational firms: $\partial N_t^*/\partial g > 0$. Globalization affects both types of costs: communication and trade costs. A reduction in the former promotes multinational firms whereas a fall in the latter disadvantages these firms. It is not clear whether globalization fosters the development of multinational firms. This is illustrated in the following figure that represents the iso-share curves of multinational firms. Globalization is a move from the south-east to the north-west: it may promote or discourage the development of multinational firms. Customs unions and currency unions mainly affect trade costs: it is a move from the south to the north of the figure, which induces multinationals to concentrate their production into a single country. The development of the new information and communication technologies are represented by a move from the east to the west of the figure: it promotes the development of multinational firms.

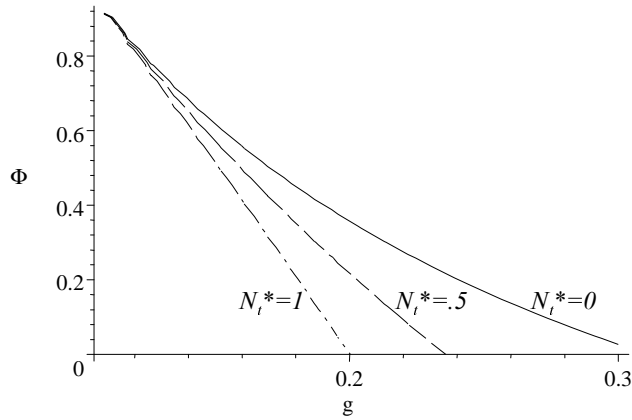


Figure 2: Iso-share curves of multinational firms. Parameters used are $\sigma=7$, $\mu=.7$, $L=1$, $N=1$, $f=.1$.

4 Welfare

In this section, we examine three questions. First, to what extent is the firms' decision to separate its production between two plants optimal for the society? In other words, are there too many or too few multinational firms? Second, does a reduction in trade costs always improve the welfare of the society? Finally, does a reduction in communication costs always improve the welfare of the society?

4.1 Real earnings as a measure of welfare

A measure of welfare is necessary to deal with these questions. The model developed in this paper makes a number of simplifications. In particular it assumes that all workers are alike and receive the same wages. This simplification proves useful for the analysis of welfare. Indeed, it is natural to identify welfare as the real earnings because workers do not have conflicting interests, and because preferences are linearly homogenous.

Real earnings are measured as $Y_r/P_r^G + Y_s/P_s^G$ where P_r^G is the general price index of both the traditional goods and manufactures consumed in region r . It is defined as $P_r^G \equiv (P_r)^\mu \mu^{-\mu} (1 - \mu)^{\mu-1}$. In both regions, L workers earn wages equal to 1 and earn fifty percent of worldwide profits. Hence, nominal earnings are alike in both regions. As shown in the

Appendix, the precise values of nominal earnings and prices are

$$Y_r = Y_s = \frac{2L - (N_r + N_s)f - N_t g}{2(\sigma - \mu)} \sigma$$

$$P_r = \frac{\sigma}{\sigma - 1} (N_r + N_t + N_s \Phi)^{\frac{-1}{\sigma-1}}, \quad P_s = \frac{\sigma}{\sigma - 1} (N_s + N_t + N_r \Phi)^{\frac{-1}{\sigma-1}}$$

Using these values and $N_t = N - N_r - N_s$, the measure of welfare becomes

$$\text{Welfare} = \frac{Y_r}{P_r^G} + \frac{Y_s}{P_s^G} = \mu_1 [2L + (N_r + N_s)(g - f) - Ng] * \left[(N - N_s + N_s \Phi)^{\frac{\mu}{\sigma-1}} + (N - N_r + N_r \Phi)^{\frac{\mu}{\sigma-1}} \right]$$

where μ_1 is a positive constant:

$$\mu_1 \equiv \frac{1}{2} \frac{\sigma(1 - \mu)}{\sigma - \mu} \left(\frac{\mu}{1 - \mu} \frac{\sigma - 1}{\sigma} \right)^\mu$$

4.2 Multinationals: too many or too few?

The first step to answer this question is to find the location (N_r, N_s) that maximizes the measure of welfare. Differentiating this measure with respect to N_r and using then the symmetric property of the objective function ($N_s = N_r$) gives the optimal location of plants:

$$\hat{N}_r = \hat{N}_s = \frac{2N(g - f)(\sigma - 1) - \mu(2L - gN)(1 - \Phi)}{2(\sigma - 1 + \mu)(g - f)(1 - \Phi)}, \quad \hat{N}_t = N - 2\hat{N}_r$$

In a second step, we compare the welfare maximizing number of multinational firms with the independent decision of firms concerning the location of their plants. It is readily checked that

$$\hat{N}_t - N_t^* = \mu(1 - \mu) \frac{2L - N(2f - g) - (2L - gN)\Phi}{(\sigma - 1 + \mu)(g - f)(1 - \Phi)\sigma}$$

If $\Phi < \Phi_3 \equiv [2L - N(2f - g)] / (2L - gN)$, then $\hat{N}_t > N_t^*$: there are too few multinationals. If $\Phi \geq \Phi_3$, there are too many multinationals. However, it is readily checked that $\Phi_3 > \Phi_2 > \Phi_1$. There are “too many” multinationals when the number of multinationals is already equal to zero. Therefore, it is always the case that too many firms choose to concentrate their production in only one location; there are too few multinationals. Figure 2 illustrates this property by plotting the location chosen by firms and the location that maximizes welfare.

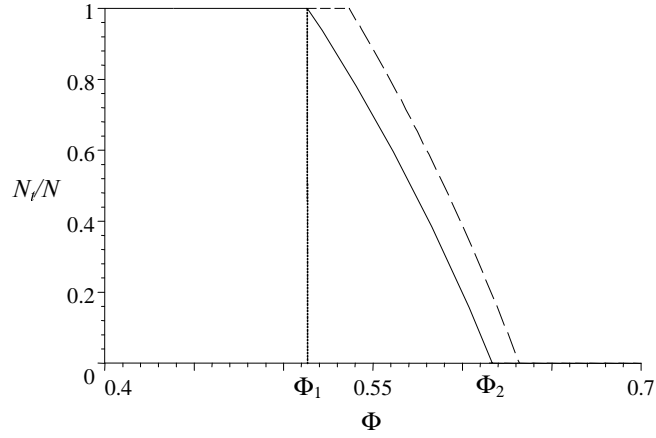


Figure 3: Plain curve: proportion of multinational firms (N_i/N) as a function of trade costs (large Φ means low trade costs). Dash curve: welfare maximizing proportion of multinational firms (\hat{N}_i/N). Parameters used are $\sigma=7$, $\mu=.7$, $L=1$, $f=.1$ and $g=.15$.

The discrepancy between private incentives and welfare comes from the externality played by firms' location on general price levels. The benevolent planner cares about real earnings: he/she knows that a change in plants' location will affect the nominal earnings (through profits) but also the price level. Indeed, if firms spread their plants across regions, they reduce the price level in each region because the different varieties are produced locally and do not have to be imported. An increase in the number of multinational firms raises welfare through the fall in prices. By contrast, each firm ignores the impact of its decision to be multinational on the price level, which is taken as a given macroeconomic variable. In choosing their location, firms only take into account nominal profits.

4.3 Welfare and the reduction in trade costs

For prohibitive trade costs, all firms are multinational and this is welfare maximizing. For low trade costs, all firms are single-plant firms and this is also welfare maximizing. For intermediate trade costs, too many firms are single-plant firms. To what extent is a decline in trade costs good for welfare? On the one hand, it reduces the costs of the imports but on the other hand, it induces too many firms to become single-plant.

In a model without multinationals, welfare unambiguously increases when trade costs decline: goods produced in the foreign region become cheaper for

the home region, which raises welfare. In our setting, multinationals do not exist for low trade costs. In that case, $N_t = 0$ and $N_r = N_s = N/2$. Plugging these values in the welfare expression gives $2\mu_1 (2L - Nf) [N(1 + \Phi)/2]^{\frac{\mu}{\sigma-1}}$ which unambiguously increases with Φ . This is the standard result.

For large trade costs, every firm is a multinational and settles one plant in each region. Consumption of individuals from one region is entirely produced in that region by multinationals. Hence, welfare is not affected by the level of trade costs. Technically, setting $N_t = N$ and $N_r = N_s = 0$ in the welfare expression gives $2\mu_1 (2L - Ng) N^{\frac{\mu}{\sigma-1}}$ which is independent of Φ .

For Φ slightly above Φ_1 , all firms should be multinational firms to maximize welfare but some are not. If they were all multinational, welfare would be some constant independent of Φ . It would reach the same level as in Φ_1 . However, since some firms are single-plant firms, welfare is not maximized and is therefore lower than in Φ_1 . Hence, around Φ_1 , welfare decreases when the trade costs drop. Technically, setting $N_t = N_t^*$, $N_r = (N - N_t^*)/2$, $N_s = N_r$ in the welfare expression gives

$$\text{Welfare} = 2\mu_1 \frac{\sigma - \mu}{\sigma(1 - \Phi)} \left[\frac{\mu}{2(g - f)\sigma} \right]^{\frac{\mu}{\sigma-1}} [(2L - gN)(1 - \Phi) + 2N(g - f)]^{1 + \frac{\mu}{\sigma-1}} \quad (6)$$

To check whether welfare increases or decreases with trade costs, we compute the derivative of this expression with respect to Φ . It is readily checked that the sign of the derivative is the same as the sign of $2N(\sigma - 1)(g - f) - \mu(1 - \Phi)(2L - gN)$. Let

$$\Phi_4 \equiv 1 - \frac{2N(g - f)(\sigma - 1)}{\mu(2L - gN)} > \Phi_1$$

If $\Phi < \Phi_4$, an increase in Φ reduces welfare. For $\Phi \in (\Phi_1, \Phi_4)$, a reduction in trade costs induces some multinationals to concentrate their production in a single plant. So doing, they impose a negative externality on consumers of the region that they leave. These consumers now suffer from the trade costs because they have to import some of their consumption. By contrast, if none of the multinational firms decide to concentrate its production the welfare of these consumers would not have been affected by the change in trade costs.

However, note that the positive effect of trade costs on welfare holds for a limited range of trade costs only, as illustrated in the following figure.

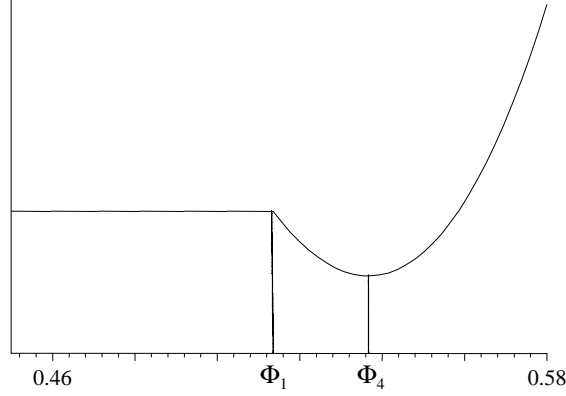


Figure 4: Welfare as a function of Φ . It decreases between $\Phi_1=0.51$, and $\Phi_4=0.54$. Parameters used are $\sigma=7$, $\mu=.7$, $L=1$, $N=1$, $f=.1$ and $g=.15$.

The level of welfare is always larger when trade costs are nil and firms are single-plant ($\Phi = 1$) than when trade costs are maximum and firms are multinationals ($\Phi = 0$). Indeed, in both cases, since all varieties are available at the same price in both regions, the price indexes are identical. However fewer resources are spent on fixed costs when all firms are single-plant.

4.4 Welfare and the reduction in communication costs

A second dimension of globalization is the decreasing costs of communication between plants settled in different regions. This favors the division of production in distinct plants. In the model, a reduction in communication costs is represented by a smaller difference between g and f .

Let

$$g_1 \equiv 2 \frac{(\sigma - \mu) f N + L \mu (1 - \Phi)}{N [2\sigma - \mu (1 + \Phi)]}, \quad g_2 \equiv \frac{f N \sigma (1 + \Phi) + 2L \mu (1 - \Phi) - 2\mu f N}{N (\sigma - \mu) (1 + \Phi)}$$

It is readily checked that all firms are multinational firms for low communication costs ($g \leq g_1$), they are single-plant firms for large communication costs ($g \geq g_2$), and some are multinational whereas the others are single-plant for intermediate trade cost ($g_1 < g < g_2$).³

³To see this, set $N_t^* = 0$ and $N_t^* = 1$.

When every firm is a multinational, a reduction in communication costs increases the profits of all firms. Earnings and welfare benefit from this increase. To prove this mathematically, use the expression of welfare when $N_t = N$ and $N_r = N_s = 0$. In the previous section this expression was shown to be $2\mu_1 (2L - Ng) N^{\frac{\mu}{\sigma-1}}$ which clearly decreases with the communication costs g .

When all firms are single-plant firms, they are not affected by a reduction in communication costs. Hence, welfare is unchanged. Technically, setting $N_t = 0$ and $N_r = N_s = N/2$ in the welfare expression gives $2\mu_1 (2L - Nf) [N(1 + \Phi)/2]^{\frac{\mu}{\sigma-1}}$ which is independent of g .

A reduction in communication costs have two effects when some firms are multinationals and the others are single-plant firms. It increases the profits of multinationals, which raises profits, earning and welfare. It also induces some single-plant firms to become multinationals, which raises welfare since the number of multinationals is sub-optimal. Unambiguously a decrease in communication costs raises welfare. Technically, setting $N_t = N_t^*$, $N_r = (N - N_t^*)/2$, $N_s = N_r$ in the welfare expression gives (6). This expression increases with g if and only if

$$g > g_3 \equiv f + \mu \frac{1 - \Phi}{1 + \Phi} \frac{2L - fN}{(\sigma - 1)N}$$

It is readily checked that $g_3 > g_2$. Hence, for the relevant values of g , welfare always decreases with g . The following figure illustrates the point.

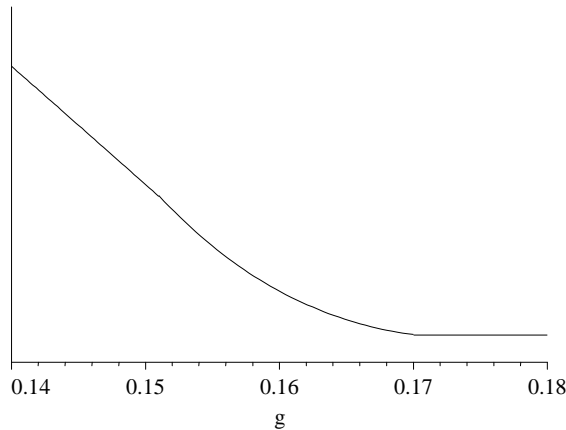


Figure 5: Welfare as a function of g . Parameters used are $\sigma=7$, $\mu=.7$, $L=1$, $N=1$, $f=.1$ and $\Phi=.5$.

Thus, contrary to the effects of globalization through trade costs, globalization through communication costs unambiguously raises welfare.

5 Conclusion

Globalization involves the reduction of two types of costs. On the one hand trade costs are reduced, which induces some multinationals to agglomerate their production in a single plant. On the other hand, communication costs between plants of a same firm decrease, which induces more firms to become multinationals. The effect of globalization on multinationals is therefore ambiguous and crucially depends on the type of costs involved.

The development of customs and currency unions is likely to mainly affect trade costs and induce multinationals to concentrate their production into a single country. The development of the new information and communication technologies tends to promote the development of multinational firms.

The paper builds a model that illustrates these forces. The main simplification in the model is that all workers are treated alike. The disadvantage of that strategy is that the model abstracts from distribution effects. A change in plants location affect all workers equally. The advantage of this simplification is that it allows to deal with a welfare analysis of multinationals and globalization. Even though distribution effects are absent from the model, it is possible to show that multinationals and globalization do not affect welfare monotonically.

Three results are emphasized. First, too many firms choose to concentrate their production in only one location. Second, for some domain of the trade costs, a reduction in trade costs worsens welfare. Finally, a reduction in communication costs improves welfare.

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7 Appendix

7.1 Determination of q_r , q_s , q_R and q_S .

To find q_r , q_s , q_R and q_S , we need to compute the values of P_r and ψ_r . Since $p_r = p_s = p_R = p_S = \sigma/(\sigma - 1)$, the regional price indices of manufactured goods (2) can be written as

$$P_r = \frac{\sigma}{\sigma - 1} (N_r + N_t + N_s \Phi)^{\frac{-1}{\sigma-1}}$$

Using P_r and the result that $Y_r = Y_s$, the expression of ψ_r can be simplified to

$$\psi_r \equiv \mu \frac{Y_r}{P_r} \left[1 + \Phi \left(\frac{N_r + N_t + N_s \Phi}{N_s + N_t + N_r \Phi} \right) \right]$$

Using (4), P_r and ψ_r on the one hand, and (5), and P_r on the other hand, we find a first set of relations between output and earnings:

$$\begin{aligned} q_r &= \mu Y_r \frac{\sigma - 1}{\sigma} \left[\frac{1}{N_r + N_t + N_s \Phi} + \frac{\Phi}{N_s + N_t + N_r \Phi} \right] \\ q_s &= \mu Y_r \frac{\sigma - 1}{\sigma} \left[\frac{\Phi}{N_r + N_t + N_s \Phi} + \frac{1}{N_s + N_t + N_r \Phi} \right] \\ q_R &= \mu Y_r \frac{\sigma - 1}{\sigma} \left[\frac{1}{N_r + N_t + N_s \Phi} \right] \\ q_S &= \mu Y_r \frac{\sigma - 1}{\sigma} \left[\frac{1}{N_s + N_t + N_r \Phi} \right] \end{aligned}$$

To evaluate q_r , q_s , q_R and q_S as functions of plants' location, we need to compute the earnings. These can be written as $Y_r = Y_s = L + \Pi/2 = L + (N_r \pi_r + N_s \pi_s + N_t \pi_t)/2$, or

$$Y_r = L - \frac{(N_r + N_s) f + N_t g}{2} + \frac{1}{\sigma - 1} \frac{q_r N_r + (q_R + q_S) N_t + q_s N_s}{2}$$

The solution to the system made of the last five equations is

$$\begin{aligned} q_r &= \mu(\sigma - 1) X \frac{N_s \Phi^2 + (2N_r + N_t) \Phi + (N_t + N_s)}{(N_r + N_t + N_s \Phi)(N_s + N_t + N_r \Phi)} \\ q_s &= \mu(\sigma - 1) X \frac{N_r \Phi^2 + (2N_s + N_t) \Phi + (N_t + N_r)}{(N_r + N_t + N_s \Phi)(N_s + N_t + N_r \Phi)} \\ q_R &= \mu(\sigma - 1) X \frac{N_r \Phi + N_t + N_s}{(N_r + N_t + N_s \Phi)(N_s + N_t + N_r \Phi)} \\ q_S &= \mu(\sigma - 1) X \frac{N_s \Phi + N_t + N_r}{(N_r + N_t + N_s \Phi)(N_s + N_t + N_r \Phi)} \\ Y_r &= Y_r = \sigma X \end{aligned}$$

where

$$X \equiv \frac{2L - (N_r + N_s)f - N_t g}{2(\sigma - \mu)}$$

7.2 Conditions for positive profits

Since the price set by each firm is equal to $\sigma/(\sigma - 1)$, profits are written as

$$\begin{aligned}\pi_r &= \left(\frac{\sigma}{\sigma - 1} - 1 \right) q_r - f \\ \pi_s &= \left(\frac{\sigma}{\sigma - 1} - 1 \right) q_s - f \\ \pi_t &= \left(\frac{\sigma}{\sigma - 1} - 1 \right) (q_R + q_S) - g\end{aligned}$$

In every location equilibrium the following properties hold: $N_t = N - N_r - N_s$, and $N_s = N_r$. The last property implies that $q_r = q_s$ and $\pi_r = \pi_s$. We first derive the condition for $\pi_r > 0$ and then we do the same for $\pi_t > 0$.

7.2.1 Profits of single-plant firms are positive ($\pi_r > 0$)

Using the equilibrium output q_r and price p_r , and setting $N_t = N - N_r - N_s$ and $N_s = N_r$, profits can be written

$$\pi_r = \frac{\mu(1 + \Phi)}{2} \frac{2L - gN + 2N_r(g - f)}{(N - N_r + N_r\Phi)(\sigma - \mu)} - f$$

We now prove that π_r increases with Φ and with N_r .

$$\begin{aligned}\frac{\partial \pi_r}{\partial \Phi} &= \mu \frac{N - 2N_r}{2} \frac{2L - gN + 2N_r(g - f)}{(\sigma - \mu)(N - N_r + N_r\Phi)^2} \\ \frac{\partial \pi_r}{\partial N_r} &= \mu(1 + \Phi) \frac{1}{2} \frac{2N(g - f) + (1 - \Phi)(2L - gN)}{(\sigma - \mu)(N - N_r + N_r\Phi)^2}\end{aligned}$$

Since $N_r = N_s$ and $N_r + N_s < N$, it must be that $N - 2N_r > 0$. Therefore, $\partial \pi_r / \partial \Phi > 0$ and $\partial \pi_r / \partial N_r > 0$. The smallest profits are for $\Phi = 0$, $N_r = 0$ which gives:

$$\pi_r = \frac{1}{2} \frac{\mu(2L - gN)}{N(\sigma - \mu)} - f$$

They are positive if and only if

$$f < \bar{f} \equiv \frac{1}{2} \frac{\mu(2L - gN)}{N(\sigma - \mu)}$$

7.2.2 Profits of multinational firms are positive ($\pi_t > 0$)

Using the equilibrium output q_R, q_S , and setting $N_t = N - N_r - N_s$ and $N_s = N_r$, profits can be written

$$\pi_t = \mu \frac{2(L - N_r f) - (N - 2N_r)g}{(\sigma - \mu)(N - N_r + N_r \Phi)} - g$$

They clearly decrease with Φ whereas

$$\frac{\partial \pi_t}{\partial N_r} = \mu \frac{2N(g - f) + (1 - \Phi)(2L - gN)}{(\sigma - \mu)(N - N_r + N_r \Phi)^2} > 0$$

The smallest profits are for $\Phi = 1$ and $N_r = N/2$ which gives

$$\pi_t = \mu \frac{(2L - Nf)}{(\sigma - \mu)N} - g$$

They are positive if and only if

$$g < \bar{g} \equiv \mu \frac{(2L - Nf)}{(\sigma - \mu)N}$$