The District Goes Global: Export vs FDI

Giorgio Basevi
and
Gianmarco I.P. Ottaviano

ECO No. 99/29
The District Goes Global: Export vs FDI

GIORGIO BASEVI
and
GIANMARCO I.P. OTTAVIANO
The District Goes Global:  
Export vs FDI*

Giorgio Basevi† and Gianmarco I.P. Ottaviano‡

16 June 1999

Abstract

This paper depicts an industrial district as a center of innovation and production in a sector characterized by horizontal product differentiation. Local technological externalities sustain the endogenous invention of new varieties by profit-seeking firms. After invention, because a substantial fraction of their output is demanded by distant markets, firms face a crucial choice between reaching them by exports or by FDIs. The paper studies the effects that 'globalization'—in the form of lower trade costs and freer capital flows—has on this choice. In particular, it analyzes the efficiency of firms decisions from the point of view of the district as a whole. It shows that in the decentralized outcome firms engage in too much FDI and too little exportation when there are still substantial barriers to trade and foreign investment, while the reverse is true when such barriers are lowered.

*We would like to thank Giorgio Barba Navaretti, Anna Falzoni, Karen-Helene Midelfart-Knarvik, and Jacques-François Thisse for fruitful discussions as well as Peter Nijkamp and workshop participants at Tinbergen Institute Amsterdam for helpful comments on an earlier draft. Both authors are indebted to D’Agliano Foundation and the University of Bologna for financial support. Ottaviano also gratefully acknowledge funding by a Jean Monnet Fellowship at EUI Florence.

†University of Bologna

‡University of Bologna. CORE, EUI and CEPR. Corresponding author: Gianmarco Ottaviano, Università di Bologna, Dipartimento di Scienze Economiche, Piazza Scaravilli 2, 40126 Bologna, Italy. E-mail: ottavian@economia.unibo.it
1 Introduction

Among the different modes of organizing the production process, great interest has been repeatedly attracted by the so-called Marshallian Industrial District, henceforth MID (see, e.g., Sabel and Zeitlin, 1985; Sabel, 1988; Best, 1990). The reason is simple: MIDs are often considered among the most successful agents in the economic landscape (Scott, 1988; Pyke et al., 1990). The most studied contemporary examples include the so-called Third Italy and Germany's Baden-Württemberg in the EU as well as Route 128 and Silicon Valley in the US. However, similar industrial clusters can be identified also elsewhere in Denmark, Sweden, Spain as well as in Los Angeles and copycats are pet projects of policy-makers worldwide (Porter, 1990; Saxenian, 1994).

Yet, despite its success, the MID has been recently put under strain by the so-called globalization, that is, by the ongoing reduction of barriers to trade and factor mobility which is supposed to be leading towards the creation of a unique world market place where the actual locations of demand and supply is going to be immaterial (Nelson, 1993; OECD, 1996). From the point of view of the district, globalization has at least two relevant dimensions (Frankel and Kahler, 1993). On the one hand, it may imply increased competition from other (possibly very distant) regional clusters. On the other hand, even if the MID faces no serious competitor in the global arena, globalization raises the issue of how to penetrate world markets. This paper investigates this second dimension and focuses on the choice between exportation and foreign direct investment (FDI). It argues that, by the very nature of the MID, its firms are bound to resort to a combination of exports and FDIs that is inefficient from the point of view of the district as a whole. However, before proceeding any further, it is necessary to clarify what we mean by MID.

In principle, a MID is "an organization of the production process based on single specialized industries, carried out by concentrations made up of many small firms of similar character in particular localities achieving the advantages of large-scale production by external rather than internal economies, with social environments that feature local communi-
ties of people adhering to relatively homogeneous systems of values, and with networks of merging urban and rural settlements inside territories united by production and social links” (Sforzi, 1990). While this definition points at all the socio-economic subtleties of a MID, it would be futile to aim at presenting an integrated model capturing all its distinctive features (Soubeyran and Thisse, 1999). Therefore we adopt here a streamlined approach and, for the purposes of the present analysis, we define a MID as a location that hosts a large number of small firms which produce similar goods for export and take advantage of the localized accumulation of skills embodied in the resident labor force (Bellandi, 1989).

From this narrower perspective, a MID is essentially an agglomeration where several external effects are at work (Fujita and Thisse, 1996). First of all, there are technological externalities stemming from a collective process of learning-by-doing fed by local interactions in the form of “informal discussions among workers in each firm, interfirm mobility of skilled workers, the exchange of ideas within families and clubs, and bandwagon effects” (Souberayn and Thisse, 1999). Secondarily, there are pecuniary externalities due to demand (‘backward’) and cost (‘forward’) linkages between firms that arise from increasing returns to scale at plant level in the presence of trade costs (Fujita, Krugman and Venables, 1999). It is precisely the presence of all such externalities that makes a priori unlikely that individually rational decisions by firms will map into collectively optimal outcomes for the district.

In order to model the MID as an endogenously growing locale characterized by both technological and pecuniary externalities, we build on the insights of one-sector models with local learning-by-doing (Bertola, 1993; Souberayn and Thisse, 1999) as well as multi-sector models with localized product innovation (Walz, 1996; Martin and Ottaviano, 1999). In particular, we model growth as the result of research and development (R&D) efforts carried out by profit-seeking firms located in the district that benefit from localized learning externalities (Romer, 1990; Grossman and Helpman, 1991).

To capture in a stylized way the dynamics of technology start-ups
(Saxenian, 1994), firms in the MID are assumed to undergo a life-cycle. They are born as laboratories engaged in R&D inside the district, which is the only center of innovation. However, as soon as they have invented and patented a new differentiated blueprint, they quit R&D and start production to reap the corresponding monopoly rents. In this second phase of their life, firms are vertically integrated entities consisting of two units. A headquarters, which provides the services embedded in the blueprint, and a plant, which uses headquarters services to produce the final good. Headquarters services generate a fixed cost of production so that each firm's technology exhibits overall increasing returns to scale (Markusen, 1995).

Due to nontransferable knowledge embodied in the local labor force (Teece, 1977), labs and headquarters can be located only in the district. On the contrary, plants can be established also abroad. We call national a firm that has both its headquarters and its plant in the district and multinational a firm that has its headquarters in the district and its plant abroad. While in the former case, foreign customers are supplied by exportation, in the latter they are reached through FDI. In both cases, due to barriers to trade and capital flows, foreign sales face additional costs with respect to home sales.

Innovation is modeled as a constant returns to scale activity characterized by external economies of scale due to collective learning by the workforce of the MID. More precisely, we assume that the productivity of each R&D lab is an increasing function of the stock of blueprints that are not only invented but also implemented inside the district. This assumptions is aimed at capturing the local positive feedback from plants to labs which characterize much of localized innovation processes (Lucas, 1993; Martin and Ottaviano, 1999).

All this leads to the following results. First, as it is intuitive, high trade (FDI) barriers discourage exports (FDIs) and encourage FDIs (exports). Second, firms' choices are generally suboptimal, but, third, they are not always biased in the same direction. In particular, we show that while for high levels of barriers to trade and FDI firms engage in too much FDI and too few exports, the reverse is true for low levels of bar-
riers. This inefficiency stems from the existence of three main external effects that firms do not take into account when choosing where to locate their plants. First, due to the local spillover from plants to labs, a firm’s plant location decision affects the productivity of R&D and, therefore, the rate of growth of the district (growth effect). Ceteris paribus, since such a spillover is positive, decentralized decision making would yield too many multinationals from the point of view of the MID as a whole. Second, again due to the technological externality, a firm does not take into account its impact on the value of blueprints that exist initially in the district (wealth effect). As just pointed out, by locating its plant in the district, the firm increases the speed of innovation. This reduces the value of the initial stock of blueprints and depletes the wealth of the district. Ceteris paribus, in equilibrium one would observe too few multinationals. Finally, due to the presence of trade costs, a firm does not realize that its plant location decision affects the intensity of competition in the MID beyond what is captured by its profits (competition effect). In particular, the decision of going multinational weakens competition in the district and generates welfare losses for local consumers. Ceteris paribus, this would lead to too many multinationals at the market outcome. Therefore, the way the market mix of national and multinational firms departs from what is efficient for the district is determined by the balance between the growth and competition effects on the one side and the wealth effect on the other.

This explains the result. In general, due to technological spillovers, more local plants are good for growth. However, before drawing welfare implications, this straightforward intuition has to be qualified in view of the competition and wealth effects. When barriers are high, home and foreign markets are essentially isolated so that it makes a huge difference for competition inside the MID whether a firm goes multinational or not. Because the local market is sheltered against cheap reimports from foreign plants, competition would be much more feeble in the former case than in the latter. In other words, with high barriers the competition effect is strong and consumers in the district would like to have more local production than what they get at the market equilibrium. On the
contrary, when barriers are low, from the point of view of competition and growth the location of plants is almost immaterial. The strongest effect is now on the wealth of the district. That is why, for low barriers, the district collectively favors FDIs over exports.

The remainder of the paper is organized in four parts. The first presents the model. The second finds the market equilibrium. The third discusses its welfare properties from the point of view of the MID as a whole. The fourth concludes.

2 The model

There are two locations, the MID and the rest of the world. Variables pertaining to the district bear no label, while those belonging to the rest of the world are labeled by *. There is a unique factor of production, labor, whose total endowment $L$ is distributed between locations so that a fraction $\lambda L$ of workers reside in the district with $\lambda \in (0, 1)$. Workers are geographically immobile and are employed in the production of two final goods: a homogenous good $Y$ and a composite good $D$ consisting of $N$ horizontally differentiated varieties. The main difference between the district and the rest of the world is that in the former labor is also employed in an innovation sector which creates the blueprints that are necessary for the production of new varieties. Blueprints are protected by infinitely lived patents whose property belongs to the district. After registration, patented varieties can be produced either in the district to be exported to the rest of the world or directly in foreign markets and possibly reimported. Therefore, we assume that innovation happens exclusively in the MID, which is the engine of growth in the differentiated good sector.

Since the specification of the model is largely symmetric in most of its crucial features, we concentrate on the description of the MID. Preferences are instantaneously Cobb-Douglas and intertemporally CES with unit elasticity of intertemporal substitution:

$$U = \int_0^\infty \ln \left[ D(t)^\alpha Y(t)^{1-\alpha} \right] e^{-\rho t} dt$$

(1)
where $Y(t)$ is the consumption flow of the homogeneous good at time $t$, $\rho > 0$ is the rate of time preference, and $\alpha \in (0, 1)$ is the share of expenditures devoted to the consumption flow of the composite good $D(t)$, which, following Dixit and Stiglitz (1977), consists of a number of different varieties:

$$D(t) = \left[ \int_0^{N(t)} c(s, t)^{1-1/\sigma} ds \right]^{1/(1-1/\sigma)}$$

where $c(s, t)$ is the consumption of variety $s$ at instant $t$, $N(t)$ is the total mass of varieties available in the economy at $t$, and $\sigma > 1$ is the elasticity of substitution between varieties as well as the own-price elasticity of demand for each variety. As in Romer (1990) and in Grossman and Helpman (1991) growth will come from an endogenous increase in the variety of goods as measured by $N(t)$.

To simplify notation, from now on we will drop the explicit time dependence of variables when this does not generate confusion. Accordingly, the value of expenditure $E$ is:

$$E = \int_0^n p(i)c(i)di + \int_n^N q(j)c(j)dj + p_Y Y$$

where $p_Y$ is the price of good $Y$, $p(i)$ is the price of the $i$-th out of $n$ varieties produced in the district, $q(j)$ is the price of the $j$-th out of $n^*$ varieties produced abroad so that $N = n + n^*$.

As to the supply side, the homogenous good $Y$ is produced using labor with constant returns to scale in a perfectly competitive sector and it is freely traded between locations. Without loss of generality, the unit input requirement is set to 1 for convenience. It is assumed that the demand of this good in the whole economy is large enough that it cannot be satisfied by production in one place only.\(^1\) This hypothesis ensures that in equilibrium the homogenous good will be produced everywhere.

\(^1\)This will turn out to be the case in equilibrium if the expenditures share of good $Y$ is large enough, namely if $\alpha < \rho \eta/(1 + \rho \eta)$, where $\eta$ is the cost parameter of innovation that will be introduced in the next paragraph. In what follows this restriction is assumed to hold.
and, thus, because of free trade, the wage rates in the two locations will be the same. In addition, the assumption about the unit input requirement and the choice of $Y$ as the numeraire pin down the wage rate to 1 all over the economy.

The differentiated varieties of good $D$, which as already mentioned are protected by infinitely lived patents, are produced in a monopolistically competitive sector. More precisely, the supply of each variety requires the use of the corresponding patent (the fixed cost at the source of economies of scale) for any scale of production and $\beta$ units of labor for each unit of output. Consequently, production exhibits increasing returns to scale and this ensures that each firm will produce one and only one variety. Differently from the homogeneous good, trade in the differentiated varieties is costly. Following Samuelson (1954) trade costs are modelled as iceberg frictions: $\tau \geq 1$ units have to be shipped for a unit delivery of any variety to the foreign market. Therefore, only a fraction of the shipped quantity is actually consumed. A value of $\tau = 1$ represents free trade, while in the limit, as $\tau \to \infty$, the district reaches autarky.

The MID is also active in the invention of new varieties of good $D$. R&D is modelled as a constant returns to scale activity carried out by perfectly competitive labs that use labor with a unit input requirement $\eta/n$. Such an assumption implies that the cost of innovation depends negatively on the number of plants located in the district and captures the presence of a learning curve that will be able to sustain growth in the long run (Martin and Ottaviano, 1999). This technological spillover is generated by local interactions between the people employed in innovation and those employed in production (Saxenian, 1994). Finally, for innovation to happen at all, some blueprints $N_0$ are assumed to be owned by people in the MID right from the start. Only the profits accruing to this initial stock of blueprints are pure rents and contribute to the wealth of the district.

Research and development are performed by firms themselves, which then use the blueprints they have developed and patented to start production of new varieties. In particular, firms are assumed to undergo a
life-cycle. After being born as R&D labs, as soon as they have invented and patented a new blueprint, they leave R&D and start production to reap the corresponding operating profits. Because patents are infinitely lived, the second phase of their life lasts forever. In this phase, firms are vertically integrated entities consisting of two units. A *headquarter*, which provides the services embedded in the patented blueprint, and a *plant*, which uses headquarter services together with labor to produce the final good. Due to firm-specific know-how which is too costly to transmit, patents are not transferable to other firms.

While invention takes place only in the MID, the production process can be localized either in the district or abroad. In the former case, firms are *national* in scope and reach their foreign customers by *exports* incurring the transport cost $\tau$. In the latter, they are *multinational* in that, while their headquarters remain in the district, their production facilities are located abroad. With only national firms, the pattern of intratemporal trade consists of intersectoral trade only with the district exporting the differentiated good $D$ and importing the homogeneous good $Y$. With multinational firms, there are two additional kinds of intratemporal trade: intrafirm trade in patent services between headquarters and foreign plants; intraindustry trade of good $D$ due to exports and reimports from foreign plants to the district.

Also the option of FDI incurs additional costs with respect to home sales. Such costs arise from various sources (Teece, 1977). First, there are problems which hamper the effective implementation of blueprints abroad due to tacit knowledge which might be difficult to transfer from the MID to foreign workers. Second, there is the difficulty of mastering and monitoring the operations of far plants due to alien business practices as well as cultural and linguistic differences. Third, there are administrative barriers that discourage foreign investment such as restrictions to profit repatriation as well as idiosyncratic laws and bureaucratic procedures whose handling cuts into the profitability of foreign plants. As in the case of trade costs, we model all these *FDI costs* as iceberg frictions: when a firm decides to set up its production facility abroad, it is able to appropriate only a fraction $\nu \in [0, 1]$ of the operating profits such facility
generates. The remaining fraction \((1 - \nu)\) melts away.

Finally, to close the model we have to specify the institution that governs the intertemporal allocation of resources. We assume that there is a financial market where a safe bond is traded which bears an interest rate \(r\) in units of the numeraire. This market is where firms in the MID finance their investment in R&D and it is global in the sense that it is accessible by all consumers, no matter where they reside.

3 The market equilibrium

The solution of the model is fairly standard (see, e.g., Grossman and Helpman, 1991). First, the intertemporal optimization by consumers implies that the growth rate of individual expenditures, \(\bar{E}\) and \(\bar{E}^*\), is equal to the difference between the interest rate and the rate of time preference: \(\bar{E} = \bar{E}^* = r - \rho.\)

Second, the instantaneous allocation of expenditures attributes constant shares \(\alpha\) and \((1 - \alpha)\) to the consumptions of good \(D\) and \(Y\) respectively and yields demand functions for each variety with constant elasticity \(\sigma\). Thus, given wage equalization, profit-maximization by firms leads to producer prices (mill prices) that are the same for all varieties independently from the places of production and sale: \(p = \beta\sigma / (\sigma - 1)\). This entails that consumers pay different prices on varieties supplied by firms in different places. In particular, they pay a lower price \(p = \beta\sigma / (\sigma - 1)\) for locally produced varieties and, due to trade costs, a higher price \(q = \tau\beta\sigma / (\sigma - 1)\) for imported varieties.

As a consequence, the operating profits of a typical production facility located in the district are:

\[
\pi = px - \beta x = \beta x / (\sigma - 1) \tag{4}
\]

\(^2\text{From now on we follow the common convention according to which a dot or a hat over a variable label respectively its absolute or percentage rates of change.}\)
where $x$ is the scale of output. In the same way, a foreign plant yields operating profits:

$$\pi^* = px^* - \beta x^* = \frac{\beta x^*}{\sigma - 1}$$  \hspace{1cm} (5)

but only a fraction $\nu$ of them generates a cash flow for the corresponding firm.

Third, since the model is essentially an AK-model and, thus, it has no transitionary dynamics, its solution requires only the characterization of the steady state. In order to proceed, it is useful to introduce some additional notation. In particular, let $\gamma \in [0,1]$ be the share of varieties produced in the district so that $(1 - \gamma)$ measures the share of multinationals among all firms. Then, a steady state of the model is defined as an equilibrium where the geographic distribution of plants $\gamma$ is time-invariant and their total number grows at a constant rate $g = \frac{\dot{N}}{N}$.

We begin the steady state analysis by discussing the equilibrium condition for the location of firms production plants $\gamma$. This can be derived from the market clearing conditions for the manufacturing sector, according to which the supply of each variety has to be equal to its demand (inclusive of trade costs) from consumers in both regions:

$$x = \frac{\alpha(\sigma - 1) L}{\beta \sigma} \frac{\lambda E}{N} \left[ \frac{\lambda E}{\gamma + \delta(1 - \gamma)} + \frac{\delta(1 - \lambda)E^*}{\delta \gamma + (1 - \gamma)} \right]$$  \hspace{1cm} (6)

$$x^* = \frac{\alpha(\sigma - 1) L}{\beta \sigma} \frac{\lambda E}{N} \left[ \frac{\delta \lambda E}{\gamma + \delta(1 - \gamma)} + \frac{(1 - \lambda)E^*}{\delta \gamma + (1 - \gamma)} \right]$$  \hspace{1cm} (7)

where $\delta = \tau^{1-\sigma}$ is a measure of the freeness of trade ranging between 0 in autarky and 1 with free trade.

For $\gamma$ to be constant, firms must have no incentive to relocate their plants. This can happen under three alternative scenarios. In the first, there are both local firms and multinationals, i.e. $\gamma \in (0,1)$. For this to be the case, firms must be indifferent between producing in the MID or abroad and therefore blueprints must command the same operating profits (net of FDI costs) wherever they are implemented. That happens if $\pi = \nu \pi^*$ or, by (4) and (5), if $x = \nu x^*$. This equilibrium condition
allows us to solve (6) and (7) for \( \gamma \) and \( x^* \):

\[
\gamma = \frac{1}{1 - \delta} \frac{(1 - \nu \delta) \lambda E - \delta (\nu - \delta)(1 - \lambda)E^*}{(1 - \nu \delta) \lambda E + (\nu - \delta)(1 - \lambda)E^*}
\]

(8)

\[
x^* = \frac{\alpha (\sigma - 1) L \lambda E + (1 - \lambda)E^*}{\beta \sigma N \nu \gamma + (1 - \gamma)}
\]

(9)

where \( \gamma \) is bounded between 0 and 1 if and only if:

\[
\frac{\nu - \delta}{1 - \nu \delta} < \frac{\lambda E}{(1 - \lambda)E^*} < \frac{1}{\delta} \frac{\nu - \delta}{1 - \nu \delta}
\]

(10)

In the second scenario, all plants are concentrated in the district, i.e. \( \gamma = 1 \), so that there are no multinationals. For this outcome to be sustainable as a steady state, we need to have \( \pi > \nu \pi^* \), which is the case if \( \lambda E/(1 - \lambda)E^* > (\nu - \delta)/(1 - \nu \delta) \). This inequality is likely to be satisfied whenever the cost of foreign investment is large with respect to trade costs (\( \nu \) is small when compared with \( \delta \)) and it always holds if \( \nu - \delta < 0 \). It also holds if the district represents a relatively important market for its firms products (\( \lambda E \) is large when compared with \( (1 - \lambda)E^* \)).

Finally, in the third scenario, all plants are located abroad, i.e. \( \gamma = 0 \), so that all firms are multinationals and the district is specialized in innovation and in the production of the homogeneous good. For this to be the case, \( \lambda E/(1 - \lambda)E^* < (\nu - \delta)/(1 - \nu \delta) \) has to hold, which depicts this scenario as the mirror image of the previous one. Indeed, the foregoing inequality is likely to hold if the cost of foreign investment is small with respect to trade costs (\( \nu \) is large when compared with \( \delta \)) and if the district is a relatively negligible market for its firms products (\( \lambda E \) is small when compared with \( (1 - \lambda)E^* \)).

Condition (8) illustrates the 'forward linkage' at work in our model implying that, ceteris paribus, the geographic concentration of production plants in the MID is increasing in the relative size of the local market. It also shows that, as it is intuitive, ceteris paribus an increase in FDI barriers reduces the relative number of multinationals (\( \partial \gamma/\partial \nu < 0 \)). Less intuitive a priori is the impact of trade costs changes. Lower trade barriers increase the share of multinationals (\( \partial \gamma/\partial \delta < 0 \)) as
far as $\lambda E/(1 - \lambda)E^* < (\nu - \delta)^2/(1 - \delta \nu)^2$ which belongs to the acceptable interval (10). Therefore, freer trade incentivates foreign investment against exportation, if FDI costs are small relatively to trade costs ($\nu$ is large with respect to $\delta$) as well as if the MID is a relatively negligible market for its own firms products ($\lambda E$ is small with respect to $(1 - \lambda)E^*$). The reason why is the so-called home-market effect (Helpman and Krugman, 1985) by which plants are (more than proportionately) attracted by the larger market and the more so the lower the trade costs. Therefore, absent FDI costs, when the home market is the smaller one, lower trade costs make it more convenient for firms to locate in the larger foreign market and supply home consumers via reimports (since $(\nu - \delta)^2/(1 - \delta \nu)^2 = 1$ for $\nu = 1$). On the contrary, when the home market is the larger one, lower trade costs incentivate firms to place their plants in the MID and to supply foreigners by exports. On top of that, the presence of FDI costs biases the result against the multinational option (since $(\nu - \delta)^2/(1 - \delta \nu)^2 < 1$ for $\nu < 1$ when (8) holds).

Condition (9) shows how the profitability of firms is influenced by the geographical distribution of their plants. In particular, since it points out that $x^*$ and, therefore, $x$ are decreasing in $\gamma$, it shows that, ceteris paribus, as more firms go multinational, operating profits fall worldwide. The more so, the larger the costs of FDI.

Turning now to the intertemporal equilibrium, let $v$ be the value of a national firm. Then the condition of no-arbitrage-opportunity between investing in R&D and borrowing at the safe rate $r$ implies:

$$r = \frac{\dot{v}}{v} + \frac{\pi}{v}$$

(11)

where we have used the fact that, on a start-up investment of value $v$, the return is equal to the operating profits plus the change in the value of the firm. A similar condition must hold for the value $v^*$ of a multinational:

$$r = \frac{\dot{v}^*}{v^*} + \frac{\pi^*}{v^*}$$

(12)

where, since R&D takes place only in the MID, it must be $v^* = v$. 

12
It is useful to aggregate (11) and (12) across all firms to express the no arbitrage property as:

\[ r = \frac{\dot{v}}{v} + \pi \gamma + \pi^*(1 - \gamma) = \frac{\dot{v}}{v} + [\nu \gamma + (1 - \gamma)]\pi^* \]  

(13)

Because of perfect competition in the innovation sector, patents are priced at marginal cost, which gives the value of a firm \( v = \eta/n = \eta/(\gamma N) \). Because \( \gamma \) is constant in steady state, after differencing, this yields \( \dot{v}/v = -\dot{N}/N = -g \). Because also consumers’ expenditures are constant in steady state, the interest rate \( r \) is equal to the rate of time preference \( \rho \). Using all these results as well as (5) and (9) in (13), we find:

\[ g = \frac{\gamma \alpha L[\lambda E + (1 - \lambda)E^*]}{\eta} - \rho \]  

(14)

Consider now the market clearing condition for labor which implies that the economy endowment of labor \( L \) is fully employed in R&D, in the homogeneous good sector and in the differentiated good sector:

\[ L = \frac{\eta}{\gamma} g + (1 - \alpha) L[\lambda E + (1 - \lambda)E^*] + \beta[\gamma x + (1 - \gamma)x^*] \]  

(15)

Condition (15) can be transformed by substituting for \( x = \nu x^* \) and \( x^* \) from (9) to obtain:

\[ L = \frac{\eta}{\gamma} g + \frac{\sigma - \alpha}{\sigma} L[\lambda E + (1 - \lambda)E^*] \]  

(16)

Equations (14) and (16) can be solved together to express the steady state values of expenditures and the corresponding growth rate as functions of \( \gamma \) only:

\[ [\lambda E + (1 - \lambda)E^*] = 1 + \frac{\rho\eta}{\gamma L} \]  

(17)

and

\[ g = \frac{\alpha L \gamma}{\sigma \eta} - \frac{\sigma - \alpha}{\sigma} \rho \]  

(18)

In (17) the first term on the right hand side is wage income, while the second is the value of the initial per capita stock of blueprints, which
appears because, as previously noticed, only the operating profits accruing to the initial stock of blueprints are pure rents. Because this stock is exclusively owned by people in the district, we have $\lambda E = \lambda + \rho \eta / \gamma L$ and $(1 - \lambda) E^* = (1 - \lambda)$. Equation (18) illustrates the positive externality at work in the model between production and innovation. An increase in the concentration of plants in the district decreases the cost of innovation (because of local spillovers) pushing new labs to enter the innovation sector until profits in that sector are back to zero. This in turn increases the rate of innovation.

We are now ready to determine the steady state location of plants. It suffices to substitute the equilibrium values of expenditures into (8). This gives rise to a second order equation in $\gamma$ which admits only one positive solution. Its expression is readily obtained as:

$$\gamma = \frac{-b + \sqrt{b^2 + 4a(1 - \nu \delta)\rho \eta}}{2a}$$  \hspace{1cm} (19)

where $a \equiv (1 - \delta)[(1 - \nu \delta)\lambda + (\nu - \delta)(1 - \lambda)]L$ and $b \equiv \{(1 - \nu \delta)(1 - \delta)\rho \eta - [(1 - \nu \delta)\lambda - \delta(\nu - \delta)(1 - \lambda)]L \}$. As already discussed, this corresponds to an interior steady state with $\gamma \in (0,1)$ whenever the difference in expenditures levels between the district and the rest of the world is not too pronounced, that is, by plugging equilibrium expenditures into (10), whenever:

$$\delta \frac{\nu - \delta}{1 - \nu \delta} < \frac{\lambda + \rho \eta / \gamma L}{1 - \lambda} < \frac{1 - \nu - \delta}{\delta (1 - \nu \delta)}$$  \hspace{1cm} (20)

For most parameters, comparative statics results have been stated when discussing equation (8) so that here we need to comment only on $\rho$ and $\eta$. They are both directly related to the equilibrium value of the initial stock of blueprints. Since such stock belongs to the MID, a fall in either parameter reduces the difference in expenditures between the two locations and, thus, decreases the share of plants that the district hosts.

Finally, the steady state growth rate of the economy can be found by plugging (19) into (18).
4 Welfare analysis

There are a number of reasons why we should expect the market outcome to be inefficient for the MID as a whole. They arise from the many distortions at work in the model. These can be classified in two main groups. To the first group belong those distortions which are not specific to the plant location problem we are studying, but pertain to the wider class of models with monopolistic competition and horizontal product innovation. First, revenues from producing a certain variety do not capture the corresponding consumer surplus. Second, the profit of a new variety does not, in general, correspond to the net change in total profits for the economy. Third, innovators are not aware of the positive spillover they generate to future R&D. Because such distortions are not specific to the present setting and have been studied at length by Grossman and Helpman (1991), we restrain from discussing them here and we focus on the second group of distortions. These are inherent to the plant location choices. First, there are technological spillovers from production plants to R&D labs. When going multinational, firms do not acknowledge the loss they provoke to the MID in terms of foregone positive externalities and lower growth rate (growth effect). From the point of view of the district, this pulls towards too much FDI at the market equilibrium. Second, firms do not understand the impact of their plant location decisions on the wealth of people in the district. More precisely, by (17) more FDIs augment wealth by increasing the value of the initial stock of blueprints (wealth effect). This pulls towards insufficient FDIs. Third, there are pecuniary externalities, due to the presence of increasing returns and trade costs. When relocating, firms affect the intensity of competition, but they neglect this effect (competition effect). In particular, they do not realize that FDI increases the MID price index and therefore penalize local consumers. Again, this causes the market to overprovide FDIs.3

These three effects can be singled out by appropriate welfare analysis. By calculating (1) in steady state, we can write the indirect utility

3The exact price index for the instantaneous Cobb-Douglas utility flow encapsulated in (1) is given by \( \left[ \frac{\beta \sigma}{(\sigma - 1)} \right]^\alpha \left[ (\gamma + \delta(1 - \gamma)) N \right]^\sigma / (1 - \sigma) \).
of a representative resident in the district as a function of $\gamma$:

$$V = \frac{1}{\rho} \ln \left\{ \alpha (1 - \alpha)^{1-\alpha} \left(1 + \frac{\rho \eta}{\gamma \lambda L}\right) \left(\frac{\sigma - 1}{\beta \sigma}\right)^{\alpha} N_0^{\frac{\alpha}{\sigma-1}} \left[(1 - \delta)\gamma + \delta\right]^{\frac{\alpha}{\sigma-1}} e^{\frac{\alpha}{\sigma-1}} \right\}$$

(21)

where $g$ is the steady state growth rate shown in (18) which also depends on $\gamma$. By differencing (21) with respect to $\gamma$, we obtain:

$$\frac{\partial V}{\partial \gamma} = \frac{\alpha^2 L}{\rho^2 \eta \sigma (\sigma - 1)} - \frac{1}{\gamma \gamma \lambda L + \rho \eta} + \frac{\alpha}{\rho (\sigma - 1)} \frac{1 - \delta}{(1 - \delta)\gamma + \delta}$$

(22)

The three terms on the right hand side of (22) refer, respectively, to the growth, wealth and competition effects and have the expected signs.

To assess the desirability of the market combination of exports and FDIs in terms of MID welfare, we have to sign (22) at the equilibrium value of $\gamma$ given by (19). However, because the resulting expression is too complex to provide any valuable analytical insight, it is useful to look at the numerical examples summarized in Table 1. The first row, which we take as a benchmark case, presents a numerical example where, as shown by the last column, the district would benefit from a marginal reduction in $\gamma$, that is, by an increase in the relative number of multinationals, with respect to the market outcome. The other rows show how the results are sensitive to changes in parameter values. Quite intuitively, the MID gains from more FDIs if the welfare losses to consumers from slower growth and weaker competition are offset by the gain in terms of higher wealth. This is the case if competition is strong anyway ($\sigma$ large), if consumers care little about the differentiated good ($\alpha$ small) and about the future ($\rho$ large), if the productivity of labor in innovation is low ($\eta$ large), if the global market is small ($L$ small) and if the local market is negligible ($\lambda$ small). Under opposite circumstances, the district would instead gain from a reduction of FDIs in favor of more local production and exports.

More interestingly, the optimal mix of national and multinational firms depend on the level of barriers to trade and FDI. If such barriers are large ($\tau$ large and $\nu$ small), then decentralized decision making generates too few exports and too many FDIs ($\partial V/\partial \gamma > 0$), while the reverse is true when the economy becomes more integrated ($\partial V/\partial \gamma < 0$). Thus,
the model suggests the incapability of the MID to choose the best mix of exports and FDIs in order to penetrate foreign markets. As the economy gets more and more integrated firms turn from too much foreign investment to too much exportation.

This result can be explained in terms of the three aforementioned external effects. In general, due to technological spillovers, more local plants are good for growth. However, before drawing welfare implications, we have to take into account also the competition and wealth effects. When barriers are high, home and foreign markets are essentially isolated so that it makes a huge difference for competition inside the MID whether a firm goes multinational or not. Because the local market is protected against cheap reimports from foreign plants, competition would be much weaker in the former case than in the latter. In other words, with high barriers the competition effect is strong and consumers in the district would like to have more local production than what they get at the market equilibrium. On the contrary, when barriers are low, from the point of view of competition and growth the location of plants is almost immaterial. The strongest effect is now on the wealth of the district. That is why, for low barriers, the district collectively favors FDIs over exports.

5 Conclusion

Many external effects are inherent to the very nature of a MID and, thus, individually rational decisions by its firms are unlikely to map into collectively efficient outcomes for the district as a whole.

We have analyzed one particular choice that becomes crucial as the MID faces an economic environment where goods and factors are increasingly mobile. It is the choice between exports and FDIs as a means to penetrate distant markets. We have pointed out that profit seeking behavior by firms does not take into account relevant external effects that influence the welfare of the district. Due to local technological spillovers from plants to R&D labs, their choice to delocate their production facili-
ties abroad slows down the pace of innovation (growth effect). Moreover, it relaxes the competition among local producers to the consumer surplus detriment (competition effect). On the other hand, for the same reason, it increases local wealth (wealth effect).

We have shown that, for high trade and FDI barriers, the miscalculation by firms of growth and competition effects dominates the one of the wealth effect so that the market outcome overprovides FDIs and underprovides exports. The reverse is true when obstacles to trade and FDI are low. In any case, decentralized decision making by firms results in suboptimal choices for the district as a whole.

These results call for additional research. Since we have modeled an economy where there is only one MID that supplies the world markets, a natural extension would be to investigate the case of competing districts. This would reveal the crucial importance of the internal cohesion of the MID. While this cohesion is likely to depend on economic factors (e.g., the type of goods produced, the input-output structure of network relations, the nature and intensity of spillovers), noneconomic factors (e.g., the homogeneity of the system of values, the intensity of social interactions, the propensity to job turnover) would also be central (Saxonian, 1994). As suggested by Soubeyran and Thisse (1999), modeling these latter factors would require the integration of more socio-economic variables into the analysis possibly along the lines drawn by Granovetter (1985) and Coate and Ravaillon (1993).

References


<table>
<thead>
<tr>
<th>$\sigma$</th>
<th>$\alpha$</th>
<th>$\eta$</th>
<th>$\lambda$</th>
<th>$L$</th>
<th>$\rho$</th>
<th>$\tau$</th>
<th>$\nu$</th>
<th>$\gamma(\text{market})$</th>
<th>$g(%)$</th>
<th>$\partial V / \partial \gamma$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.8</td>
<td>1</td>
<td>0.1</td>
<td>10</td>
<td>0.05</td>
<td>1.3</td>
<td>0.7</td>
<td>0.08</td>
<td>5.9</td>
<td>9.5</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
<td>6.8</td>
<td>12.7</td>
</tr>
<tr>
<td>-</td>
<td>0.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
<td>7.3</td>
<td>14.0</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
<td>6.8</td>
<td>2.1</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.11</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.09</td>
<td>7.2</td>
<td>12.9</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.06</td>
<td>7.5</td>
<td>14.3</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.04</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
<td>5.4</td>
<td>2.6</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
<td>4.8</td>
<td>32.3</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.4</td>
<td>-</td>
<td>-</td>
<td>0.09</td>
<td>8.4</td>
<td>23.5</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>-</td>
<td>0.05</td>
<td>2.7</td>
<td>-91.9</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.6</td>
<td>-</td>
<td>-</td>
<td>0.12</td>
<td>12.2</td>
<td>45.3</td>
</tr>
</tbody>
</table>

**Table 1 - Welfare analysis**
EUI Working Papers are published and distributed by the European University Institute, Florence

Copies can be obtained free of charge – depending on the availability of stocks – from:

The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI)
Italy

Please use order form overleaf
Publications of the European University Institute

To
The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI) – Italy
Telefax No: +39/055/4685 636
e-mail: publish@datacomm.iue.it
http://www.iue.it

From
Name .............................................................
Address ...........................................................
........................................................................
........................................................................
........................................................................
........................................................................
........................................................................
........................................................................

☐ Please send me a complete list of EUI Working Papers
☐ Please send me a complete list of EUI book publications
☐ Please send me the EUI brochure Academic Year 1999/2000

Please send me the following EUI Working Paper(s):

No, Author ...........................................................
Title: ................................................................
No, Author ...........................................................
Title: ................................................................
No, Author ...........................................................
Title: ................................................................
No, Author ...........................................................
Title: ................................................................

Date ....................................................

Signature ................................................
Working Papers of the Department of Economics
Published since 1998

ECO No. 98/1
Bauke VISSER
Binary Decision Structures and the Required Detail of Information

ECO No. 98/2
Michael ARTIS/Massimiliano MARCELLINO
Fiscal Solvency and Fiscal Forecasting in Europe

ECO No. 98/3
Giampiero M. GALLO/Barbara PACINI
Early News is Good News: The Effects of Market Opening on Market Volatility

ECO No. 98/4
Michael J. ARTIS/Zenon G. KONTOLEMIS
Inflation Targeting and the European Central Bank

ECO No. 98/5
Alexandre KOLEV
The Distribution of Enterprise Benefits in Russia and their Impact on Individuals’ Well-Being

ECO No. 98/6
Kitty STEWART
Financing Education at the Local Level: A Study of the Russian Region of Novgorod

ECO No. 98/7
Anna PETTINI/Louis PHLIPS
A Redistributive Approach to Price and Quality Discrimination

ECO No. 98/8
Aldo RUSTICHINI/Andrea ICHINO/Daniele CHECCHI
More Equal but Less Mobile? Education Financing and Intergenerational Mobility in Italy and in the US

ECO No. 98/9
Andrea ICHINO/Pietro ICHINO
Discrimination or Individual Effort? Regional Productivity Differentials in a Large Italian Firm

ECO No. 98/10
Andrea ICHINO/Rudolf WINTER-EBMER
The Long-Run Educational Cost of World War II. An Example of Local Average Treatment Effect Estimation

ECO No. 98/11
Luca FLABBI/Andrea ICHINO
Productivity, Seniority and Wages. New Evidence from Personnel Data

ECO No. 98/12
Jian-Ming ZHOU
Is Nominal Public but De Facto Private Land Ownership Appropriate? A Comparative Study among Cambodia, Laos, Vietnam; Japan, Taiwan Province of China, South Korea; China, Myanmar; and North Korea

ECO No. 98/13
Anna PETTINI
Consumers’ Tastes and the Optimal Price Gap

ECO No. 98/14
Christian DUSTMANN/Najma RAJAH/Arthur VAN SOEST
School Quality, Exam Performance, and Career Choice

ECO No. 98/15
Ramon MARIMON/Juan Pablo NICOLINI/Pedro TELES
Electronic Money: Sustaining Low Inflation?

ECO No. 98/16
Michael ARTIS/Marion KOHLER/Jacques MÉLITZ
Trade and the Number of OCA’s in the World

ECO No. 98/17
Nuala O’DONNELL
Why Did Earnings Inequality Increase in Ireland: 1987-1994?

ECO No. 98/18
Luis A. GIL-ALÁÑA
Fractional Integration in the Purchasing Power Parity

*out of print
ECO No. 98/19
Luis A. GIL-ALANA
Multivariate Tests of Fractionally
Integrated Hypotheses

ECO No. 98/20
Luis A. GIL-ALANA/
P.M. ROBINSON
Testing of Seasonal Fractional Integration
in U.K. and Japanese Consumption and
Income

ECO No. 98/21
Luis A. GIL-ALANA
Nelson and Plosser Revisited: Evidence
from Fractional ARIMA Models

ECO No. 98/22
Alexander GÜMBEL
Herding in Delegated Portfolio
Management: When is Comparative
Performance Information Desirable?

ECO No. 98/23
Giuseppe BERTOLA
Microeconomic Perspectives on
Aggregate Labor Markets

ECO No. 98/24
Anindya BANERJEE/Stepana
LAZAROVA/Giovanni URGA
Bootstrapping Sequential Tests for
Multiple Structural Breaks

ECO No. 98/25
Anindya BANERJEE/Giovanni URGA
Sequential Methods for Detecting
Structural Breaks in Cointegrated
Systems

ECO No. 98/26
Anindya BANERJEE/Lynne
OCKERELL/Bill RUSSELL
An I(2) Analysis of Inflation and the
Markup

ECO No. 98/27
Alan BEGGS/
Anindya BANERJEE
Simultaneous Versus Sequential Move
Structures in Principal-Agent Models

ECO No. 98/28
Michael EHRMANN
Will EMU Generate Asymmetry?
Comparing Monetary Policy
Transmission Across European Countries

ECO No. 98/29
Pierpaolo BATTIGALLI/Marciano
SINISCALCHI
Hierarchies of Conditional Beliefs and
Interactive Epistemology in Dynamic
Games

ECO No. 98/30
Mathias HOFFMANN
Long Run Capital Flows and the
Feldstein-Horioka Puzzle: A New
Measure of International Capital Mobility
and Some Historical Evidence from Great
Britain and the United States

ECO No. 98/31
Oliver KIRCHKAMP
Simultaneous Evolution of Learning
Rules and Strategies

ECO No. 98/32
Ramon MARIMON/Fabrizio ZILIBOTTI
Unemployment vs. Mismatch of Talents:
Reconsidering Unemployment Benefits

ECO No. 98/33
Giorgia GIOVANNETTI/Ramon
MARIMON
An EMU with Different Transmission
Mechanisms?

ECO No. 98/34
Marcello D'AMATO/Barbara PISTORESI
Delegation of a Monetary Policy to a
Central Banker with Private Information

ECO No. 98/35
Leonardo BARTOLINI/Giuseppe
BERTOLA/Alessandro PRATI
Day-To-Day Monetary Policy and the
Volatility of the Federal Funds Interest
Rate

ECO No. 98/36
Matthias BRUECKNER
Voting on Policies in Committees: A
Welfare Analysis

ECO No. 98/37
Albert MARCET/Ramon MARIMON
Recursive Contracts

ECO No. 98/38
Étienne BILLETTE de VILLEMEUR
Heterogeneity and Stability: Variations on
Scarf’s Processes

*out of print
ECO No. 98/39
Giuseppe BERTOLA
Macroeconomics of Distribution and Growth

ECO No. 98/40
Spyros SKOURAS
Risk Neutral Forecasting

ECO No. 99/1
Jian-Ming ZHOU
How to Carry Out Land Consolidation - An International Comparison

ECO No. 99/2
Nuala O’DONNELL

ECO No. 99/3
Ray BARRELL/Rebecca RILEY
Equilibrium Unemployment and Labour Market Flows in the UK

ECO No. 99/4
Klaus ADAM
Learning while Searching for the Best Alternative

ECO No. 99/5
Guido ASCARI/Juan Angel GARCIA
Relative Wage Concern and the Keynesian Contract Multiplier

ECO No. 99/6
Guido ASCARI/Juan Angel GARCIA
Price/Wage Staggering and Persistence

ECO No. 99/7
Elena GENNARI

ECO No. 99/8
Marcello D’AMATO/Barbara PISTORESI
Interest Rate Spreads Between Italy and Germany: 1995-1997

ECO No. 99/9
Søren JOHANSEN
A Small Sample Correction for Tests of Hypotheses on the Cointegrating Vectors

ECO No. 99/10
Søren JOHANSEN
A Bartlett Correction Factor for Tests on the Cointegrating Relations

ECO No. 99/11
Monika MERZ/Axel SCHIMMELPFENNIG
Career Choices of German High School Graduates: Evidence from the German Socio-Economic Panel

ECO No. 99/12
Fragiskos ARCHONTAKIS
Jordan Matrices on the Equivalence of the $I(1)$ Conditions for VAR Systems

ECO No. 99/13
Étienne BILLETTE de VILLEMEUR
Sequential Decision Processes Make Behavioural Types Endogenous

ECO No. 99/14
Günter REHME
Public Policies and Education, Economic Growth and Income Distribution

ECO No. 99/15
Pierpaolo BATTIGALLI/
Marciano SINISCALCHI
Interactive Beliefs and Forward Induction

ECO No. 99/16
Marco FUGAZZA
Search Subsidies vs Hiring Subsidies: A General Equilibrium Analysis of Employment Vouchers

ECO No. 99/17
Pierpaolo BATTIGALLI
Rationalizability in Incomplete Information Games

ECO No. 99/18
Ramon MARIMON/Juan Pablo NICOLINI/Pedro TELES
Competition and Reputations

ECO No. 99/19
Ramon MARIMON/Fabrizio ZILIBOTTI
Employment and Distributional Effects of Restricting Working Time

ECO No. 99/20
Leonor COUTINHO
Euro Exchange Rates: What Can Be Expected in Terms of Volatility?

* out of print
ECO 99/21
Bernard FINGLETON
Economic Geography with Spatial Econometrics: A 'Third Way' to Analyse Economic Development and 'Equilibrium', with Application to the EU Regions

ECO 99/22
Mike ARTIS/
Massimiliano MARCELLINO
Fiscal Forecasting: The Track Record of the IMF, OECD and EC

ECO 99/23
Massimo MOTTA/Michele POLO
Leniency Programs and Cartel Prosecution

ECO 99/24
Mike ARTIS/Hans-Martin KROLZIG/
Juan TORO
The European Business Cycle

ECO 99/25
Mathias HOFFMANN
Current Accounts and the Persistence of Global and Country-Specific Shocks: Is Investment Really too Volatile?

ECO 99/26
Mathias HOFFMANN
National Stochastic Trends and International Macroeconomic Fluctuations: The Role of the Current Account

ECO 99/27
Gianmarco I.P. OTTAVIANO/
Jacques-François THISSE
Integration, Agglomeration and the Political Economics of Factor Mobility

ECO 99/28
Gianmarco I.P. OTTAVIANO
Ad usum delphini: A Primer in 'New Economic Geography'

*out of print*