EUROPEAN UNIVERSITY INSTITUTE

DEPARTMENT OF ECONOMICS

EUI Working Paper ECO No. 99/29

The District Goes Global: Export vs FDI

Giorgio Basevi

and

Gianmarco I.P. Ottaviano

BADIA FIESOLANA, SAN DOMENICO (FI)

Printed in Italy in July 1999
European University Institute
Badia Fiesolana
I-50016 San Domenico (FI)
Italy

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 analizes 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 Njikamp 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 aknowledges 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 communities 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 *headquarter*, which provides the services embedded in the blueprint, and a *plant*, which uses headquarter services to produce the final good. Headquarter 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 headquarter and its plant in the district and *multinational* a firm that has its headquarter 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 λL 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:

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

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:

$$D(t) = \left[\int_0^{N(t)} c(s,t)^{1-1/\sigma} ds \right]^{1/(1-1/\sigma)} \tag{2}$$

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:

$$E = \int_0^n p(i)c(i)di + \int_n^N q(j)c(j)dj + p_Y Y \tag{3}$$

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 η 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 β 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 η/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 τ. 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, E and E^*, is equal to the difference between the interest rate and the rate of time preference: $\widehat{E} = \widehat{E}^* = r - \rho$.[2]

Second, the instantaneous allocation of expenditures attributes constant shares α and $(1-\alpha)$ to the consumptions of good D and Y respectively and yields demand functions for each variety with constant elasticity σ. 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:

$$\pi = px - \beta x = \frac{\beta x}{\sigma - 1} \tag{4}$$

[2]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:

$$\pi^* = px^* - \beta x^* = \frac{\beta x^*}{\sigma - 1} \tag{5}$$

but only a fraction ν 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 γ is time-invariant and their total number grows at a constant rate $g = \dot{N}/N$.

We begin the steady state analysis by discussing the equilibrium condition for the location of firms production plants γ. 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:

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

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

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

For γ 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 γ and x^*:

$$\gamma = \frac{1}{1-\delta}\frac{(1-\delta v)\lambda E - \delta(\nu-\delta)(1-\lambda)E^*}{(1-\delta v)\lambda E + (\nu-\delta)(1-\lambda)E^*} \tag{8}$$

$$x^* = \frac{\alpha(\sigma-1)}{\beta\sigma}\frac{L}{N}\frac{\lambda E + (1-\lambda)E^*}{v\gamma + (1-\gamma)} \tag{9}$$

where γ is bounded between 0 and 1 if and only if:

$$\delta\frac{\nu-\delta}{1-\nu\delta} < \frac{\lambda E}{(1-\lambda)E^*} < \frac{1}{\delta}\frac{\nu-\delta}{1-\nu\delta} \tag{10}$$

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 $\lambda E/(1-\lambda)E^* > (\nu-\delta)/\delta(1-v\delta)$. This inequality is likely to be satisfied whenever the cost of foreign investment is large with respect to trade costs (ν is small when compared with δ) and it always holds if $\nu - \delta < 0$. It also holds if the district represents a relatively important market for its firms products (λE 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, $\lambda E/(1-\lambda)E^* < \delta(\nu-\delta)/(1-v\delta)$ 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 (ν is large when compared with δ) and if the district is a relatively negligible market for its firms products (λE 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 $\lambda E/(1-\lambda)E^* < (\nu-\delta)^2/(1-\delta v)^2$ which belongs to the acceptable interval (10). Therefore, freer trade incentivates foreign investment against exportation, if FDI costs are small relatively to trade costs (ν is large with respect to δ) as well as if the MID is a relatively negligible market for its own firms products (λE 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 $(\nu-\delta)^2/(1-\delta v)^2 = 1$ 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 $(\nu-\delta)^2/(1-\delta v)^2 < 1$ 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 γ, 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:

$$r = \frac{\dot{v}}{v} + \frac{\pi}{v} \tag{11}$$

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*:

$$r = \frac{\dot{v}^*}{v^*} + \frac{\pi^*}{v^*} \tag{12}$$

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

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

$$r = \frac{\dot{v}}{v} + \frac{\pi\gamma + \pi^*(1-\gamma)}{v} = \frac{\dot{v}}{v} + \frac{[\nu\gamma + (1-\gamma)]\pi^*}{v} \tag{13}$$

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 γ 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 ρ. Using all these results as well as (5) and (9) in (13), we find:

$$g = \frac{\gamma}{\eta} \frac{\alpha L[\lambda E + (1-\lambda)E^*]}{\sigma} - \rho \tag{14}$$

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:

$$L = \frac{\eta}{\gamma} g + (1-\alpha)L[\lambda E + (1-\lambda)E^*] + \beta[\gamma x + (1-\gamma)x^*] \tag{15}$$

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

$$L = \frac{\eta}{\gamma} g + \frac{\sigma - \alpha}{\sigma} L[\lambda E + (1-\lambda)E^*] \tag{16}$$

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

$$[\lambda E + (1-\lambda)E^*] = 1 + \frac{\rho\eta}{\gamma L} \tag{17}$$

and

$$g = \frac{\alpha L}{\sigma} \frac{\gamma}{\eta} - \frac{\sigma - \alpha}{\sigma} \rho \tag{18}$$

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 γ which admits only one positive solution. Its expression is readily obtained as:

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

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:

$$\delta\frac{\nu-\delta}{1-\nu\delta} < \frac{\lambda + \rho\eta/\gamma L}{1-\lambda} < \frac{1}{\delta}\frac{\nu-\delta}{1-\nu\delta} \tag{20}$$

For most paremeters, comparative statics results have been stated when discussing equation (8) so that here we need to comment only on ρ and η. 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

[3] The exact price index for the instantaneous Cobb-Douglas utility flow encapsulated in (1) is given by $[\beta\sigma/(\sigma-1)]^{\alpha}\{[\gamma+\delta(1-\gamma)]N\}^{\alpha/(1-\sigma)}$.

of a representative resident in the district as a function of γ:

$$V = \frac{1}{\rho}\ln\left\{\alpha^{\alpha}(1-\alpha)^{1-\alpha}\left(1+\frac{\rho\eta}{\gamma\lambda L}\right)\left(\frac{\sigma-1}{\beta\sigma}\right)^{\alpha} N_0^{\frac{\alpha}{\sigma-1}}\left[(1-\delta)\gamma+\delta\right]^{\frac{\alpha}{\sigma-1}} e^{\frac{\alpha g}{\rho(\sigma-1)}}\right\} \quad (21)$$

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

$$\frac{\partial V}{\partial \gamma} = \frac{\alpha^2 L}{\rho^2\eta\sigma(\sigma-1)} - \frac{1}{\gamma}\frac{\eta}{\gamma\lambda L+\rho\eta} + \frac{\alpha}{\rho(\sigma-1)}\frac{1-\delta}{(1-\delta)\gamma+\delta} \quad (22)$$

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 γ 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 γ, 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 (σ large), if consumers care little about the differentiated good (α small) and about the future (ρ large), if the productivity of labor in innovation is low (η large), if the global market is small (L small) and if the local market is negligible (λ 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 (τ large and ν 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 facilities 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 (Saxenian, 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

[1] Bellandi, M. (1989) The industrial district in Marshall. In E. Goodman and J. Bamford, eds., *Small Firms and Industrial Districts in Italy* (London: Rootledge).

[2] Bertola, G., 1993, Models of economic integration and localised growth. In F. Torres and F. Giavazzi, eds., *Adjustment and Growth in the European Union* (Cambridge: CEPR and Cambridge University Press).

[3] Best, M. (1990) *The New Competition: Institutions of Industrial Restructuring* (Cambridge (Mass.): Cambridge University Press).

[4] Coate, S. and M. Ravaillon (1993) Reciprocity without commitment, characterization and performance of informal insurance arrangements, *Journal of Economic Development* 40, 1-24.

[5] Dixit, A.J. and J.E. Stiglitz (1977) Monopolistic competition and optimum product diversity, *American Economic Review* 67, 297-308.

[6] Frankel, J. and M. Kahler, eds. (1993) *Regionalism and Rivalry* (Chicago: Chicago University Press)

[7] Fujita, M., P. Krugman and A. Venables (1999) *The Spatial Economy* (Cambridge (Mass.): MIT Press).

[8] Fujita, M. and J.-F. Thisse (1996) Economics of Agglomeration, *Journal of the Japanese and International Economies* 10, 339-378.

[9] Granovetter, M. (1985) Economic action and social structure: The problem of embeddedness, *American Journal of Sociology* 91, 481-510.

[10] Helpman, E. and P. Krugman (1985) *Market Structure and Foreign Trade* (Cambridge (Mass.): MIT Press).

[11] Grossman, G., and H. Helpman (1991) *Innovation and Growth in the Global Economy* (Cambridge (Mass.): MIT Press).

[12] Lucas, R.E. (1993) Making a miracle, *Econometrica* 61, 251-272.

[13] Markusen, J. (1995) The boundaries of multinational enterprises and the theory of international trade, *Journal of Economic Perspectives* 9, 169-189.

[14] Martin, P. and G.I.P. Ottaviano (1999) Growing locations: Industry location in a model of endogenous growth, *European Economic Review* 43, 281-302.

[15] Nelson, R.R. (1993) *National Innovation Systems: A Comparative Analysis* (New York: Oxford University Press).

[16] OECD (1996) *Networks of Enterprises and Local Development* (Paris: OECD).

[17] Porter, M. (1990) *The Competitive Advantage of Nations* (New York: Fre Press).

[18] Pyke, F., B. Becattini and W. Sengenberger (1990) *Industrial Districts and Inter-firm Cooperation in Italy* (Geneva: International Institute for Labour Studies).

[19] Romer, P. (1990) Endogenous technological change, *Journal of Political Economy* 98, S71-S102.

[20] Sabel, C. (1988) Flexible specialization and the reemergence of regional economies. In P. Hirst and J. Zeitlin, eds., *Reversing Industrial Decline? Industrial Structure and Policy in Britain and Her Competitors* (Oxford: Berg).

[21] Sabel, C. and J. Zeitlin (1985) Historical Alternatives to Mass Production: Politics Markets and Technology in Nineteenth Century Industrialization, *Past and Present* 108, 133-176.

[22] Samuelson, P. (1954) The transfer problem and transport costs, II: Analysis of effects of trade impediments, *Economic Journal* 64, 264-289.

[23] Saxenian, A. (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge (Mass.): Harvard University Press).

[24] Scott, A.J. (1988) *New Industrial Spaces* (London: Pion).

[25] Sforzi, F. (1990) The quantitative importance of Marshallian districts in the Italian economy. In F. Pyke, B. Becattini and W. Sengenberger, eds., *Industrial Districts and Inter-firm Cooperation in Italy* (Geneva: International Institute for Labour Studies).

[26] Soubeyran, A. and J.-F. Thisse (1999) Learning-by-doing and the development of industrial districts, *Journal of Urban Economics* 45, 156-176.

[27] Teece, D.J. (1977) Technology transfer by multinational firms: The resource cost of transferring technological know-how, *Economic Journal* 87, 242-261.

[28] Walz, U. (1996) Transport costs, intermediate goods, and localized growth, *Regional Science and Urban Economics* 26, 671-695.

σ	α	η	λ	L	ρ	τ	ν	$\gamma(market)$	$g(\%)$	$\partial V/\partial\gamma$
6	0.8	1	0.1	10	0.05	1.3	0.7	0.08	5.9	−9.5
5	–	–	–	–	–	–	–	0.07	6.8	12.7
–	0.9	–	–	–	–	–	–	0.07	7.3	14.0
–	–	0.8	–	–	–	–	–	0.07	6.8	2.1
–	–	–	0.11	–	–	–	–	0.09	7.2	12.9
–	–	–	–	15	–	–	–	0.06	7.5	14.3
–	–	–	–	–	0.04	–	–	0.07	5.4	2.6
–	–	–	–	–	–	1.2	–	0.07	4.8	−32.3
–	–	–	–	–	–	1.4	–	0.09	8.4	23.5
–	–	–	–	–	–	–	0.8	0.05	2.7	−91.9
–	–	–	–	–	–	–	0.6	0.12	12.2	45.3

Table 1 - Welfare analysis