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The District Goes Global: Export vs. FDI

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The District Goes Global: Export vs delocation[*]

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Abstract

This paper depicts an industrial district as a center of innovation in which local technological externalities sustain the endogenous invention of new goods by profit-seeking firms. After invention firms face a crucial choice between reaching distant markets by export or plant delocation. The paper shows how firms, in the attempt to circumvent the obstacles to goods and plant mobility, overlook the impact of their decisions on innovation activities inside the district thus generating a suboptimal mix of export and delocation.

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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, in many countries the MID has been recently put under strain by the so-called globalization (see, e.g., Conti and Menghinello, 1998, for a detailed analysis of the Italian case), 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 are going to be immaterial (Nelson, 1993; OECD, 1996). From the point of view of the district, globalization has at least three relevant dimensions (Frankel and Kahler, 1993). First, it may create new opportunities of cost reduction by delocating production to low wage countries. Second, it may imply increased competition from other (possibly very distant) regional clusters. Third, even when the MID faces no serious competitor in the global arena, globalization may raise the issue of how to penetrate world markets.

This paper investigates this third dimension and focuses on the choice between exportation and market-seeking delocation. It argues that, by the very nature of the MID, its firms are bound to resort to a combination of exports and delocation 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 imperfect competition in the presence of trade costs and increasing returns to scale at plant level (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.

Because the focus of the paper is not the origin of the district but rather on the decisions it faces in a global economy, we restrict our attention to a simple spatial economy in which an MID as already emerged as a center of innovation and we model it as an endogenously growing locale characterized by both technological and pecuniary externalities. In so doing, we build on the insights of one-sector models with local learning-by-doing (Bertola, 1993; Soubeyran and Thisse, 1999) as well as multi-sector models with localized product innovation (Walz, 1996; Martin and Ottaviano, 1999). In particular, we depict growth as the result of research and development (R&D) efforts carried out by profit-seeking labs that are located in the district and benefit from localized learning externalities (Romer, 1990; Grossman and Helpman, 1991). Since, in principle, our model may describe any stylized endogenously growing locale, its contribution to the study of industrial districts should be evaluated as a novel application of recent insights from endogenous growth and location theory.

R&D is modeled as perfectly competitive supply of new blueprints and it is characterized by external economies of scale that arise from collective learning by the workforce of the MID. More precisely, we assume that, at any instant in time, the productivity of each R&D lab is an increasing function of the stock of blueprints that not only have been invented but are also currently 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). By acquiring the corresponding copyrights, …rms are able to use the blueprints to produce new goods either in the district or in a foreign location. Thus, while in the former instance, foreign customers are supplied by exportation, in the latter they are reached through delocalized production. To give substance to the export-vs-delocation decision, …rms are assumed to face barriers to both trade and delocation so that foreign sales incur additional costs with respect to home sales.

All this leads to an analytical framework that supplements existing models of location and growth under three major respects by allowing for di¤erent regional sizes, barriers to plant delocation, and explicit welfare analysis. The framework is shown to generate the following results. First, as it is intuitive, in the market equilibrium high trade (delocation) barriers discourage exports (delocation) and encourage delocation (exports). Second, …rms' choices are generally suboptimal, but, third, they are not always biased in the same direction. In particular, we show that, from the point of view of the district, while for high trade barriers and low obstacles to delocation there are too many foreign plants and too few exports, the reverse is true for low trade barriers and high obstacles to delocation. This happens because, in the attempt to circumvent the obstacles to goods and plant mobility, …rms overlook the impact of their decisions on local innovation activities and consumer surplus. On the contrary, for the welfare of distant consumers, the level of trade barriers drives the results in the opposite way.

The remainder of the paper is organized in four parts. The …rst presents the model. The second …nds the market equilibrium. The third discusses its welfare properties. The fourth concludes.

2 The model

We consider an economy made of two regions. In one of them, an already existing district is the innovation center of a horizontally differentiated sector. Firms in this sector may supply both local and far markets. However, due to distance, the former are much easier to reach than the latter so that the costs of accessing the former can be considered negligible relatively of accessing the latter. Thus, each firm has a local market that can be reached costlessly and a distant market which can be reached only by spending additional resources. The economy can be partitioned accordingly in two locations: the district together its local market (henceforth labeled simply 'the MID') and its distant market (henceforth labeled '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. An innovation sector creates the blueprints that are necessary for the production of new varieties. Such blueprints are protected by infinitely lived patents.

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 number of available varieties of good D 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. In order to focus on market-seeking rather than cost-saving delocation, 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. Thus, because of free trade, it will have the same price everywhere therefore leading to wage rate equalization in the two locations. 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 are produced in a monopolistically competitive sector. More precisely, the supply of each variety requires the use of the corresponding blueprint 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 an one-to-one equilibrium relationship between firms and varieties. Differently from the homogeneous good, trade in the differentiated varieties is costly due to administrative barriers or sheer distance. 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

[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.

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.

R&D is carried out by perfectly competitive labs that benefit from local technological spillovers. In particular, the productivity of researchers is assumed to increase in the local record of past innovation (Marshall-Arrow-Romer externality) as filtered by the volume of the local production of good D (Jacobs externality). In other words, we assume the presence of local learning curves such that in any location the R&D unit labor requirement is decreasing in the number of varieties that not only have been locally invented but are also locally produced. Since we are not interested in the origin of the MID, but in its behavior as an already established innovation center, it is natural to assume that all blueprints N_0 that exist initially have been invented in the district. In the presence of the above-mentioned learning trajectories, this implies that researchers will always be more productive in the district than elsewhere so that, since the wage is the same everywhere, in equilibrium R&D will always take place in the district only. The specific functional form for the unit input coefficient is chosen to be η/n. This will ensure steady state growth of a balanced kind.

While invention takes place only in the MID, the production process can be localized either in the district or abroad. In the former case, foreign customers are reached by exports incurring the transport cost τ. In the latter, they are reached through local production. Also this option has its own costs that may 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 delocation 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 delocation costs as iceberg frictions: when a firm decides to set up its production facility abroad, it is able to appropriate only a fraction $\phi \in [0; 1]$ of the operating profits such facility generates. The remaining fraction $(1 - \phi)$ 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 investment in R&D is financed and it is global in the sense that it is accessible by all consumers, no matter where they reside.

3 The market equilibrium

The model can be solved as follows. 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: $\hat{E} = \hat{E}^* = r - \rho$.[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:

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

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 ϕ of them generates a cash flow for the corresponding firm.

Third, the model has no transitionary dynamics so that 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

[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.

the share of varieties produced in the district so that $(1-\gamma)$ measures the share of foreign plants. 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 and foreign plants, 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 delocation costs) wherever they are implemented. That happens if $\pi = \phi\pi^*$ or, by (4) and (5), if $x = \phi x^*$, which states that in equilibrium foreign plants need to operate on a larger scale. This equilibrium condition allows us to solve (6) and (7) for γ and x^*:

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

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

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

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

In the second scenario, all plants are concentrated in the district, i.e. $\gamma = 1$. For this outcome to be sustainable as a steady state, we need to have $\pi > \phi\pi^*$, which is the case if $\theta E/(1-\theta)E^* > (\phi-\delta)/\delta(1-\phi\delta)$. This inequality is likely to be satisfied whenever the cost of delocation is large with respect to trade costs (ϕ is small when compared with δ) and it always holds if $\phi - \delta < 0$. It also holds if the district has a relatively large local market (θE is large when compared with $(1-\theta)E^*$).

Finally, in the third scenario, all plants are located abroad, i.e. $\gamma = 0$. In this case no innovation can take place due to prohibitive costs so that the district specializes in the production of the homogeneous good. For this to be the case, $\theta E/(1-\theta)E^* < \delta(\phi-\delta)/(1-\phi\delta)$ 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 delocation is small with respect to trade costs (ϕ is large when compared with δ) and if the district has a relatively negligible local market (θE is small when compared with $(1-\theta)E^*$).

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 delocation barriers reduces the relative number of foreign plants ($\partial\gamma/\partial\phi < 0$). Less intuitive a priori is the impact of trade costs changes. Lower trade barriers increase the share of foreign plants ($\partial\gamma/\partial\delta < 0$) as far as $\theta E/(1-\theta)E^* < (\phi-\delta)^2/(1-\delta\phi)^2$ which belongs to the acceptable interval (10). Therefore, freer trade incentivates delocation against exportation, if delocation costs are small relatively to trade costs (ϕ is large with respect to δ) as well as if the MID has a relatively negligible local market (θE is small with respect to $(1-\theta)E^*$). 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 delocation 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 $(\phi-\delta)^2/(1-\delta\phi)^2 = 1$ for $\phi = 1$). 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 delocation costs biases the result against the foreign plants option (since $(\phi-\delta)^2/(1-\delta\phi)^2 < 1$ for $\phi < 1$ 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, given the total number of plants N, x^* and, therefore, x are increasing in γ, it points out that, ceteris paribus, as more plants are located abroad, operating profits fall worldwide. The condition also reveals the impact of delocation barriers: the smaller ϕ the lower home plant profits ($dx/d\phi > 0$) and the larger foreign plants profits ($dx^*/d\phi < 0$). This is due to the fact that, for higher delocation barriers (smaller ϕ), the home location can afford to offer lower levels of profitability than the foreign one without losing in terms of relative attractiveness.

Turning now to the intertemporal equilibrium, let v be the value of a domestic plant, i.e. the present value of the flow of its operating profits discounted at rate r. 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 an 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 foreign plant:

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

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:

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

Because of perfect competition in the innovation sector, in equilibrium the marginal cost of a blueprint is just covered by the discounted flow of operating profits that it generates for the corresponding plant so that $v = \eta/n = \eta/(\gamma N)$. 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:

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

Consider now the market clearing condition for labor which requires the economy endowment of labor L to be fully employed in R&D, in the homogeneous good sector and in the differentiated good sector:

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

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

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

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:

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

and

$$g = \frac{\alpha L}{\sigma} \frac{\gamma}{\eta} - \frac{\sigma - \alpha}{\sigma} \rho \qquad (18)$$

where γ has to be no less than $\gamma_L \equiv \rho \eta (\sigma - \alpha) / \alpha L$ for growth to be non-negative.

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 there since 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:

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

where $a \equiv (1-\delta)[(1-\phi\delta)\lambda + (\phi-\delta)(1-\lambda)]L$ and $b \equiv \{(1-\phi\delta)(1-\delta)\rho\eta - [(1-\phi\delta)\lambda - \delta(\phi-\delta)(1-\lambda)]L\}$. 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:

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

For most parameters, comparative statics results have already 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 producing abroad rather than at home, 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 delocation 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 delocation augments wealth by increasing the value of the initial stock of blueprints (wealth effect). This pulls towards an insufficient number of foreign plants. 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 delocation increases the MID price index and therefore penalize local consumers.[3] Again, this causes the market to overprovide foreign plants.

These three effects can be singled out by appropriate welfare analysis. By calculating (1) in steady state, we can write the indirect utility of a representative resident in the district as a function of γ:

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

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:

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

The three terms on the right hand side of (22) refer, respectively, to the growth, wealth and competition effects and have the expected signs. It can be readily verified that the expression made of the first two terms together is positive as far as:

$$\gamma > \frac{\rho\eta}{2\alpha\lambda L}\left[\sqrt{\alpha^2+4\sigma\lambda(\sigma-1)}-\alpha\right] \quad (23)$$

while the third term is always positive and decreasing in γ. In other words, V consists of the sum of a non-monotone convex function and an increasing

[3] Of course, monopolistically competitive firms do not interact directly but only indirectly through the aggregate price index. Formally, when plants are relocated out of the district, the MID price index rises and each domestic plant's perceived demand function moves away from the origin of the axes thus relaxing competitive pressures. The exact price index for the instantaneous Cobb-Douglas utility flow encapsulated in (1) is given by $[\beta\sigma/(\sigma-1)]^{\alpha}\{[\gamma+\delta(1-\gamma)]N\}^{\alpha/(1-\sigma)}$.

(concave) function, which implies that it always reaches its maximum at a boundary of the relevant interval $[\gamma_L; 1]$. In particular, the welfare of the MID is maximized at $\gamma = \gamma_L$ ($\gamma = 1$) if and only if $V(\gamma_L) - V(1) > 0$ (< 0) with:

$$V(\gamma_L) - V(1) = \ln\left(1 + \frac{\rho\eta}{\lambda L}\right) - \ln\left(1 + \frac{\rho\eta}{\gamma_L \lambda L}\right) - \frac{\alpha}{\sigma - 1}\ln[(1-\delta)\gamma_L + \delta] + \frac{\alpha^2}{\rho\eta\sigma(\sigma-1)}(1-\gamma_L) \quad (24)$$

As to the rest of the world, the expressions corresponding to (21) and (22) are:

$$V^* = \frac{1}{\rho}\ln\left\{\alpha^\alpha(1-\alpha)^{1-\alpha}\left(\frac{\sigma-1}{\sigma}\right)^\alpha N_0^{\frac{\alpha}{\sigma-1}}[1-(1-\delta)\gamma]^{\frac{\alpha}{\sigma-1}} e^{\frac{\alpha g}{\rho(\sigma-1)}}\right\} \quad (25)$$

and

$$\frac{\partial V^*}{\partial \gamma} = \frac{\alpha^2 L}{\rho^2\eta\sigma(\sigma-1)} - \frac{\alpha}{\rho(\sigma-1)}\frac{1-\delta}{1-(1-\delta)\gamma} \quad (26)$$

where the wealth effect is absent because foreign residents have no property rights on the initial stock of blueprints. Notice that in (26) the competition effect has a negative sign since local competition in the rest of the world is enhanced by delocation (smaller γ). From (26) it is readily seen that welfare in the rest of the world is a concave function of γ and reaches a maximum at $\gamma = \gamma_{ROW}$ with:

$$\gamma_{ROW} \equiv \frac{\alpha L - \rho\eta\sigma(1-\delta)}{\alpha L(1-\delta)} \quad (27)$$

which falls in the relevant range $[\gamma_L; 1]$ as far as trade costs are not extreme, namely $\delta \in [\rho\eta\sigma/(\alpha L + \rho\eta\sigma); 1 - \alpha L/(2\sigma - \alpha)]$.

To complete the welfare analysis, we have now to compare the market outcome (19) with (27) and γ_L or 1 depending on whether $V(\gamma_L) - V(1)$ is positive or negative. While, due to the many free parameters, analytical comparisons are difficult to handle, straightforward computations reveal that from the point of view of both the MID and the rest of the world the market outcome entails too much delocation if product differentation is pronounced (σ small), if consumers care a lot about the differentiated good (large α) and about the future (small ρ), if the productivity of labor in innovation is high (small η), and if the global market is large (large L). Under these circumstances the growth e¤ect is strong while the wealth e¤ect is weak. Moreover, from the point of view of the district (rest of the world) the market outcome supports an ine¢ciently large (small) relative number of foreign plants if the relative size of the MID local market ¸ is large. Finally, if trade barriers are high (large ¿), and if obstacles to delocation are small (large Á), the district observe an ine¢ciently large amount of delocation in equilibrium: as the economy gets more and more integrated, inside the MID pressures arise that favor the introduction of some control on plant delocation. As to the rest of the world, the share of foreign plants is also too pronounced for small delocation barriers but too scant for high trade costs. This is due to the fact that for high trade barriers local production would allow consumers to save a lot on transport costs (strong competition e¤ect).

To summarize: (i) less delocation than at the market outcome are likely to lead to a worldwide pareto-improvement when the growth e¤ect dominates; (ii) more delocation than at the market outcome are likely to lead to a worldwide pareto-improvement when the wealth e¤ect dominates; (iii) a con‡ict of interests is likely to arise when the competition e¤ect dominates since less (more) plant delocation than at the market outcome would bene…t (damage) the MID and damage (bene…t) the rest of the world.

5 Conclusion

Many external e¤ects are inherent to the very nature of a MID and, thus, individually rational decisions by its …rms are unlikely to map into collectively e¢cient 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 plant delocation as a means to penetrate distant markets. We have pointed out that pro…t seeking behavior by …rms does not take into account relevant external e¤ects that in‡uence 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 e¤ect). On the other hand, for the same reason, it increases local wealth (wealth e¤ect). Finally, it relaxes the competition among local producers to the consumer surplus detriment (competition e¤ect).

We have argued that, for high trade and low delocation barriers, the miscalculation by …rms of growth and competition e¤ects dominates the one of the wealth e¤ect so that, from the point of view of the district, the market outcome overprovides foreign plants and underprovides exports. The reverse is true when obstacles to trade are low and barriers to delocation are high. In any case, decentralized decision making by …rms results in suboptimal choices for the district as a whole.

While these results show how recent developments in endogenous growth and location theory can be fruitfully applied to the study of industrial districts, they call nonetheless for additional research. First, 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. Second, since our locations are just points, another natural extension would be to add a richer geographic dimension to distinguish between regional and truly international operations. Finally, the introduction of an intermediate sector could be useful to address the implications of the raising trend towards outsourcing.

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] Conti, G. and S. Menghinello (1998) Modelli di impresa e di industria nei contesti di competizione globale: l'internazionalizzazione produttiva dei sistemi locali del made in Italy, L'Industria 19, 315-348.

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

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

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

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

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

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

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

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

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

[18] 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).

[19] 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.

[20] Samuelson, P. (1954) The transfer problem and transport costs, II: Analysis of e¤ects of trade impediments, Economic Journal 64, 264-289.

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

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

[23] 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-…rm Cooperation in Italy (Geneva: International Institute for Labour Studies).

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

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

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