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INDUSTRIAL SELECTION AND GROWTH*

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Abstract

The paper provides an argument for how selective industrial policies (targeting) can produce faster productivity growth. A model is developed to show that when learning externalities are present, targeting can increase the amount of learning that is produced and shared within the targeted sector. This effect will raise the sectoral and the economy-wide average productivity growth rates. The paper also discusses how targeting can speed output growth by raising the incentives to learn and by reducing investment risk.

I. Introduction

There is yet no consensus on how to explain exceptional growth performances over long periods of time, such as those of the East Asian NICs. On theoretical grounds, the traditional neoclassical model (Solow, 1956) is not very helpful since it can not explain growth of income per capita in the long run. The transitional dynamic process of this model is not very helpful either. King and Rebelo (1993) have shown that under relevant sets of parameters for the production function, physical capital accumulation "...cannot account for much growth without generating very large marginal products in the early stage of development", which we actually do not observe. This result suggests that we should explore other models that can provide explanations for persistent growth of income per capita.

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The endogenous growth models (Romer, 1986; Lucas, 1988 and 1993; Young, 1991) highlight the role of learning in bringing about income per capita growth. More emphatically, Romer (1993) suggests that learning is the main driving force in the growth process. Following Romer (1993), any country can acquire knowledge by producing it domestically or by borrowing it from abroad. Capital goods incorporate knowledge in their design and construction. For developing countries, this knowledge as well as some knowledge in the form of information can be bought in international markets. However, some knowledge necessary for improvements in output per worker has to be produced within the country. This may be so because this knowledge is not in a form suitable for sale or because the firms owning the knowledge find that it is more profitable not to sell it. Also, the assimilation of knowledge from abroad may depend on the level of human capital in the domestic economy, which in turn depends on the accumulated knowledge generated at home[1]. This brings us to the point that generating knowledge through research or learning by doing, and diffusing this knowledge throughout the production sector are important, probably crucial, aspects of the growth process.

Many studies have shown that there seems to be a positive correlation between trade openess and growth. Indeed, during the last decade many Latin American countries have opened their economies and have observed significant increases in their growth rates. This has been partially explained by the allocative improvements brought about by specialization in goods in which a country has its comparative advantages, but this is only a level effect and can not explain long term differences in growth rates. We could think of other consequences of openness that could produce growth effects, such as: continuous introduction of new equipment and intermediate inputs and stiffer competition that puts persistent pressure on firms to improve their performance. This paper will contribute to this topic by proposing another explanation for the observed growth effects. The argument is that when a country is closed it has to produce almost every kind of good, as it opens, its degree of specialization increases since it cannot have a comparative advantage on everything. As a country specializes, more firms now exist in each sector and whatever is learned in each firm, can now be shared among a larger number of firms, increasing the sectoral and country-wide rate of productivity growth.

Industrial selectivity (targeting) could also be pursued as an active industrial policy. In Japan, Korea, and Taiwan the government selected specific sectors for promotion and these countries showed impressive growth performances even when they could not be considered very opened economies[2]. The model presented here could provide a link between the selective industrial policies and the high growth rates observed[3].

The role of selective policies has been usually linked to "picking winners", that is to specialization in sectors that are perceived to have a higher potential for productivity growth and/or whose demand is perceived as more income elastic[4]. Lucas (1988) and Ros (1987) provide models that portray the "picking winners" argument. For practical purposes, the problem with this argument is that in real life it is difficult to predict which sectors are winners, and we observe that sometimes governments choose sectors that do not perform as expected. This circumstance has led to a common perception that targeting is bad policy making and should not be tried.

This paper will show that there is a justification for targeting even when there are no "winner" sectors. If learning externalities were equally strong within a group of sectors, subsidizing one of them would speed productivity growth more than evenly distributing the same subsidy among all sectors within the group.

Section II presents a trade model that shows how in the presence of learning externalities targeting can increase the amount of learning that is produced and shared within the targeted sector. If this effect is strong, targeting could have a significant positive impact on the sectoral and the economy-wide average productivity growth rates. This outcome could be interpreted as "creating winners", as Stewart and Ghani (1991) put it, rather than "picking winners". Section III discusses how targeting can also speed output growth by raising the incentives to learn and by reducing investment risk. Section IV concludes.

II. Targeting with Learning Externalities

Bardhan (1970) used a closed economy two-sector model with learning by doing in only one industry to show that when learning externalities are present, welfare optimization requires subsidization of the learning industry. This argument suggests that countries should subsidize all the learning industries. Krugman (1987) also assumed learning by doing and learning externalities in a many goods Ricardian model. He showed that by subsidizing output until enough learning occurs –through import protection or export promotion–, a country can gain a comparative advantage in additional sectors. If the new domestic industry attains a monopolistic position in international markets, the home country's share of World's expenditures increases and, with a given labor supply, that will raise its relative wage. Krugman's model is an example of how industrial policies can improve a country's welfare at the expense of the rest of the World. His model is more relevant for countries with large domestic markets and sizeable labor forces, which does not fit well the characteristics of Korea and Taiwan. The present model will show that when different sectors have similar levels of learning externalities, targeting one sector can increase domestic and global welfare by bringing about faster productivity growth at home and abroad.

This section will add an industrial structure to a small country Ricardian trade model with two goods and will make two arguments. First, it will formalize the idea that, on technological grounds alone, an economy that opens to trade may not specialize completely and may not be the only country producing those same goods. Second, it will show that when learning externalities are present, further specialization can raise productivity growth. The model will assume organizational diseconomies that will limit the size of the firm and learning that occurs through learning by doing which can diffuse to other firms.

The Ricardian model has the virtue of being simple by predicting that there is only one country producing each good but we do not observe this production structure in reality. Incomplete specialization in similar goods is explained in the Hercksher-Ohlin-Samuelson model by relative endowments of capital and labor in a world where all countries use the same technology. However, technology is not a public good available to any firm from the shelves and technical comparative advantage should play a role in explaining incomplete specialization in similar goods.

From a technological standpoint, a possible explanation for the absence of complete specialization is that differences in productivity do not stop at the country's borders. The present model will assume that industry specific skills and knowledge are unevenly distributed among a country's population. In a small country, international output prices and domestic factor prices will then determine which firms in each industry are internationally competitive.

The following model assumes two tradable goods with constant returns to scale in production at any point in time. Labor is the only input in production and is inmobile across countries. There will be n firms in the economy and each firm could in principle produce either of the two goods. At time t, output in firm s is given by:

$$x_{sj}(t) = \mathrm{h}_{sj}(t) * l_{sj}(t) \qquad s = 1, \ldots, n; \quad j = 1, 2 \tag{1}$$

where is output in firm s of good j, h is the level of labor productivity, and l is the amount of labor employed. For each firm we can find its relative productivity between goods 1 and 2. For firm s, that will be:

$$a(s,t) = \frac{\mathrm{h}_{s1}(t)}{\mathrm{h}_{s2}(t)} . \tag{2}$$

Firms will be ordered so at time zero a lower s corresponds to a higher relative productivity in good one, thus, $a(s,0)$ will be strictly decreasing on s. I will also assume $a(s,t)$ has an inverse function for all values of s. For a small country, output prices are given by international markets and they determine the comparative advantage of each firm. At any point in time, firm s will specialize in good one if:

$$a(s,t) > p_2/p_1 ,$$

and wages in that firm will adjust to the value of its marginal product:

$$w_s(t) = p_1 * \mathrm{h}_{s1}(t)$$

The marginal firm (z) will be indifferent between producing any of the two goods. Using the previous equation for each good in the marginal firm, we must have:

$$\frac{p_2}{p_1} = \frac{h_{z1}}{h_{z2}} \tag{3}$$

From (3) and (2) we can find z as:

$$z = a^{-1}(p_2/p_1, t) \tag{4}$$

To simplify the indexing process, let us assume that firm z especializes in good one. Since at time zero firms were ranked by their relative productivity in producing good one, all firms from 1 to z have a comparative advantage in good one. Thus, initially there were z firms producing good one and n-z producing good two. In this model, when foreign prices change, the marginal firm in the sector whose relative price falls switches production to the good whose relative price increases, and becomes the marginal firm in the sector whose price has increased. Depending on the size of the change in relative prices, none, one, or more firms may switch production.

The pattern of trade will be determined by tastes and the production structure. We can think that some variable, such as the exchange rate, adjusts to ensure that the foreign exchange constraint is binding and trade is in balance.

I will now introduce the dynamics of productivity change through learning by doing as a by-product of output[5]. The usual specification of output related learning by doing derives from the stylized fact of the learning curve. This curve generally shows that labor productivity increases at a decreasing rate with cumulative output. In other words, productivity growth rates are high at the initial stages of production, but decrease over time towards zero. A problem with this specification is that a fixed product mix inevitably brings a persistence decrease in productivity growth. Stokey (1988), Young (1991), and Lucas (1993) have worked with the notion that it is the continuous introduction of new goods, where learning can start anew, that produces permanent productivity growth at the industry level. The new goods are assumed of higher quality and command higher prices in world markets, and are introduced only when enough learning in older goods has made their production competitive at world prices.

A continuous change in product mix portrays very closely the industrialization experience in Japan, Korea, and Taiwan, but adds another layer of complexity that may only obscure the basic point I want to raise. To keep the model as simple as possible, I will assume that persistent productivity growth with learning by doing comes as a result of the continuous introduction of new processes, rather than goods. Furthermore, I will assume that these new processes are innovations of the old ones and that these innovations take place in a continuous and regular fashion as a consequence of learning by doing. This innovation process can be represented by non-decreasing effects to learning by doing. Thus, in this model the level of productivity due to learning that occurs from the firm's own output (h^o) will be directly proportional to cumulative output:

$$h^o_{sj}(t) = \int_0^t \theta x_{sj}(r)\, dr$$

where θ represents a learning constant. Taking derivatives with respect to time in the previous equation, we obtain the rate at which productivity changes in firm s of sector j, due to learning by doing from its own output:

$$\dot{h}^o_{sj}(t) = \theta x_{sj}(t), \qquad (5)$$

where the dot over productivity indicates productivity change per unit of time.

Learning by doing introduces dynamic scale economies and a tendency towards monopoly in the production structure. The biggest firm produces more, learns and reduces costs faster, and is able to pay higher wages and lure workers from less productive firms. In the long run the production structure in each country should become a monopoly. However, we do not observe this situation in real economies. Microeconomic arguments suggest that there might be constraints that operate on firm size, such as, organizational diseconomies, limits on indebtedness, and antitrust legislation, that may preclude the most efficient firms from becoming a monopoly[6].

Organizational diseconomies usually relate to employment levels and may be specially important in developing economies where entrepreneurial skills are not well developed. After some level of employment, these diseconomies can increase rapidly enough to offset the present value of the benefits brought by employment through productivity growth. Although this constraint on employment could vary from firm to firm, as a first approximation to the problem, I will assume that it is the same for all firms regardless of their productivity level. The simplest way to introduce this constraint is to assume a constant positive marginal productivity up to a level of employment (L_m), and zero marginal productivity after that point. As stated before, wages in each firm will adjust to make the firm competitive in the good it has a comparative advantage on. Thus, every firm will hire workers up to the employment level L_m. If L represents the stock of employable population (fixed in this model), then the labor constraint implies the number of firms:

$$L / L_m = n, \qquad (6)$$

Replacing L_m in (1), substituting this expression for output in (5), and dividing both sides of the equation by the productivity level, we obtain a simple expression for the rate of growth of productivity due to own output:

$$\hat{h}^o_{sj}(t) = \theta L_m \qquad s=1,\ldots,\ n\ ;\ j=\ 1,\ 2$$

Learning that occurs in any firm can trickle to other firms through a variety of diffusion mechanisms: labor mobility between firms, buyer-supplier relations, informal peer contact, and by the action of specific institutions created for that

purpose[7]. This difussion effect should be stronger when firms are in a geographical proximity. Each firm, then, diffuses learning to all other firms in the proximity and captures external effects from all those firms as well[8]. To simplify the aggregation problem, the rate at which learning diffuses will be proportional to the rate of productivity growth in the industry and second round learning effects are assumed negligible. The former assumption implies that workers in more productive firms –that have a higher accumulated knowledge– can make more out of the same information than workers in less productive firms. This is consistent with the assumption made in endogenous growth models that the rate of learning depends positively on the level of human capital. I will also assume that learning in one good is not useful for the other good so that there are no diffusion effects across sectors. This is only done for the sake of simplicity, it can be readily shown that to obtain beneficial effects from targeting we only require that diffusion across industries be lower than within industry. Thus, a fraction ($\delta < 1$) of every firm's learning growth from own output diffuses without cost to any other firm within the same industry. The diffusion effect from own learning in firm s to any other firm in the same industry is given by:

$$\delta\hat{h}^o_{sj}(t) = \theta L_m \qquad s=1,\ldots,\ n\ ;\ j=\ 1,\ 2$$

Since all firms in an industry contribute in the same proportion to productivity growth of any other firm within the industry, the total effect on productivity growth of firm s in sector j due to diffusion of learning from all other firms in the same sector is:

$$\hat{h}^d_{sj}(t) = (n_j - 1)\delta\theta L_m$$

where n_j is the number of firms in sector j. The total rate of productivity growth due to own and diffused learning is then:

$$\hat{h}_{sj}(t) = \delta_j \theta L_m, \qquad \text{where} \quad \delta_j = 1 + (n_j - 1)\delta \qquad (7)$$

Since δ_j is the same for all firms in industry j, every firm in industry j will have the same rate of productivity growth, and equation (7) will also represent the average rate of productivity growth for industry j. For firm s in sector one, this expression will take the form:

$$\hat{h}_{s1}(t) = [1 + (z-1)]\delta\ \theta L_m$$

Thus, with a given set of parameters, the rate of growth of productivity depends positively on the number of firms in that sector. This is not surprising since it only implies that productivity growth is still positively associated to the level of output, and learning by doing, in that sector.

If firms take their production decisions based on current prices, as assumed in equation (4), then the diffusion of learning from other firms is an externality for

each firm that gives rise to a possible divergence between the market and the social optimum allocation of labor[9].

To make a clear distinction with the picking winners argument, let us assume that there is no winning sector. That is, both sectors have the same potential for productivity growth and demand patterns do not shift in favor of any of the two goods. Thus, the international relative price remains constant and, as we are already assuming, the production parameters are the same for both sectors. Equation (4) and the labor constraint will determine the number of firms producing each good. If sector one has z firms, the simple weighed average productivity growth rate for the whole economy will be:

$$\hat{h}_a = \frac{z}{n}[1+(z-1)\delta]\theta L_m + \frac{(n-z)}{n}[1+(n-z-1)\delta]\theta L_m.$$

If the home country decides to target sector one, firms will eventually be lured into sector one and that move will affect average productivity growth. Taking the partial derivative with respect to z, and after some simplification, we obtain the change in productivity growth due to one firm shifting from sector two to sector one:

$$\frac{\partial \hat{h}_a}{\partial z} = 4[\frac{z}{n} - \frac{1}{2}]\delta\theta L_m \qquad (8)$$

The effect will be positive if sector one was initially larger than sector two. By deepening its specialization, the switching firm shares its learning with more firms and raises average productivity growth. This effect captures the dynamic scale economies of learning that can not be fully captured at the firm level because of the constraints to firm size introduced by organizational diseconomies.

A constant supply of labor and fixed international prices implies that productivity growth exactly reflects growth of income per capita. Presumably, this will also imply higher growth of personal welfare. A more general model should account for adjustments in international prices due to the changing composition of domestic trade. This adjustment will create a gap between labor productivity and income per capita growth.

The structure of the model is useful to highlight that the gains in productivity growth come at the expense of static losses[10]. From the assumptions on this model we know that as firms switch to the targeted industry, they are increasingly less efficient in producing the targeted good and more efficient in producing the non-targeted one so that the static efficiency loss increases with every new addition to the targeted sector. The number of firms that should be encouraged to switch industries to maximize cumulative welfare will depend on the size of the dynamic gains, the size of the static losses, the time horizon of the planning agent, tastes, and the social discount rate.

The two-sector model would imply that larger countries will have a larger number of firms per sector and will experience faster rates of productivity growth. But a more complete model that allows for many goods and that portrays agglomeration benefits and costs in a more realistic way should eliminate this implication. On the cost side, as suggested by Lucas (1993), we could follow the literature on optimal city size (for example, see Rauch, 1989) and allow for increasing unit costs from rent and commuting that would add to the static losses of switching firms between sectors. On the benefit side, it may be that, as the cluster size increases, diffusion between more distant firms becomes more difficult and the parameter d in this model would be negatively affected by cluster size. This will cause the present value of the benefits obtained from the flow of learning externalities to increase with the number of firms (n_j), but at a decreasing rate. Assuming that there are net positive initial returns to specialization, increasing marginal present value of costs and decreasing marginal present value of benefits will imply an optimal cluster size after some specialization has occurred. With an optimal cluster size for each of many goods, country size need not play a role in determining the country's average productivity growth rate. If the country is large enough to support at least one cluster of optimal size, then productivity can grow at the maximum feasible rate in that industry[11]. Unlike Krugman's (1987) argument for targeting, this argument is stronger for small countries. In this model, large countries have more firms and are more likely to achieve optimum cluster size in each of their industrial sectors.

At a more general level, the optimal cluster size would depend on the specific conditions of each country and of each industry. Better organizational skills will produce larger firms, increase the static loses from changing specialization and may make targeting less desirable. Low diffusion of knowledge among firms, because of more rigid labor markets or the lack of appropriate institutions, will also decrease the dynamic benefits from specialization and make targeting less desirable. On the other hand, it would be more desirable to target knowledge intensive industries were the potential for learning is greater, and larger sectors, were the potential for diffusion is greater[12]. Government action should be restricted to promoting new investments in the targeted industry (increase z) and to provide an institutional framework that encourages learning within firms (increase θ) and diffusion of knowledge among firms (increase δ).

III. Other Effects of Targeting

The model presented here shows that industrial targeting can focus learning in some sectors and increase the total amount of learning shared. A faster acquisition of knowledge will then increase the economy-wide productivity and per capita income growth. Since targeting increases specialization, this strategy can only be pursued if the economy is opened to trade. Within trading economies, the picking winners argument shows that some countries can gain at a loss for others (the ones that had already specialized in the winner sectors). The argument for targeting presented here shows that selective policies could improve productivity growth in all countries by addressing the market failure produced by the learning externality[13].

Targeting can also increase the future value of present learning and this incentive can raise learning effort (θ in the model). Reducing the number of areas in which an economy specializes increases the probability that information regarding the production and marketing of those goods may become useful. This may be so for several reasons. First, the official support by the state increases the probability that the sector, and the firm, will succeed and that what is learned may actually be useful to the same firm sometime in the future. Second, since there are more firms in the sector, the probability that what is learned may become useful to other firms in the sector also increases. If there is partial excludability for that knowledge, the firm can sell this information to other firms in the sector. This is also true for individual workers. Since there are more firms in the targeted sector, the probability that what the worker learns is general rather than firm specific increases, and with it, the worker's value to other firms. As workers can move and cash some fraction of their higher value, the increase in the expected value of learning will motivate workers to raise learning effort and produce more knowledge. Thus, in the presence of targeting both firms and workers may have a higher incentive to increase learning effort and through it, productivity and income per capita growth.

Targeting may also have a positive effect on the countrywide level of investment because the existence of more firms in a sector may reduce the technical and commercial risks perceived by private entrepreneurs. A larger number of firms in the same sector increases the probability of obtaining important technical and marketing knowledge from other firms either through exogenous diffusion or by hiring personnel working in other firms. A reduction in risk in one sector should reduce the average level of risk in the economy and have a net positive effect on overall investment.

The model shows that targeting can improve welfare whenever there are significant learning externalities among certain groups of producers. These groups of producers may not be restricted to specific industries. For example, the targeted sector may be defined by the sales market, particularly, exports could be targeted. The learning externalities model can then depict how export subsidies and export targets can raise productivity growth. If we assume that higher returns bring about more effort, then the parameter θ in the model can depend positively on the price elasticity of the final market and on the size of the government's transfers when some export targets are achieved. On the other hand, θ may depend negatively on the rate of change of competitors' prices.

A focus on export markets, where the price elasticity is higher and competitors' prices tend to fall more rapidly, will raise θ, and with it productivity and overall growth. As in South Korea, the government may also create contests with sizable benefits for firms that achieve some export targets. If firms need to learn in order to raise exports, then contests will also raise learning effort and productivity growth. On the other hand, if domestic firms are protected, a slow reduction of protection brings about a fall in the price of competitors and a rise in learning effort and productivity growth. But if protection is scratched rapidly, less productive firms may find impossible or unprofitable to learn quickly enough to remain

competitive in the domestic market[14]. As some firms go bankrupt, the size of the industry shrinks, reducing the learning potential and the viability of the sector. Thus, this model may help explain why export orientation and slow liberalization went hand in hand in East Asia. Both strategies could have contributed to strengthen the competitiveness of the domestic industry by inducing firms to learn at their fastest possible rate.

Targeting could also have negative effects. In particular, if there are winner and loser sectors, we could target a loser sector and might have been better off not targeting at all. A loser sector will have lower potential for industry average productivity growth and negative price effects in international markets. This is a risk of targeting that has to be taken into account when policy action is evaluated. However, the risk may not be too large. As explained before, the positive dynamic effects of the model presented here compensate to some extent the negative effects of a bad choice[15]. In addition, the loser effects may not be too strong. These effects occur because of prediction errors, but if information is fully available to private entrepreneurs, they should incorporate these effects in their plans, and divergences in potentials between sectors should be small. Actually, this is a typical rebuke for the picking winners argument: there is no evident market failure that makes government intervention desirable. However, the learning externalities effect depicted here are external to each firm, produce a market failure, and in principle, justify intervention.

Another important risk to take into account is implementing badly a potentially good policy. Here design could help greatly. In the past some countries have targeted sectors without addressing the market failure that could justify intervention. Design in those cases may have been flawed. For example, when developing countries closed their domestic markets, they may have reduced the incentives to learn, producing low productivity growth and loss in competitiveness. By highlighting which variables increase productivity growth more, this model can help the design of appropiate targeting policies.

IV. Conclusions

This paper argues that industrial targeting can raise the amount of learning that is produced and shared among firms, and thus can help raise the country or region´s productivity growth rate. If learning externalities are present, targeting can also raise a country's growth rate by speeding the rates of learning and investment. This can happen through two channels. First, the model developed shows that targeting can increase the amount of learning that is shared, resulting in a more efficient utilization of the knowledge created, and raising the rate of growth of productivity.

Second, targeting may signal what sectors are most probable to develop. This information would raise the expected value of knowledge generated in those areas and boost learning effort and productivity growth. Targeting could also reduce the

technological and commercial risks associated to investments in those sectors and could increase the overall rate of investment in physical capital.

Government action to promote productivity growth through targeting should be restricted to promoting new investments in the targeted industry and to provide an institutional framework that encourages learning within firms and diffusion of knowledge among firms. Future research should identify policy proposals that are justified from an economic perspective on how to implement these types of government action.

Notes

[1] In other words, experience in producing and assimilating ideas (learning) makes us better learners.

[2] Amsden (1989), Wade (1990), Woronoff (1992).

[3] There are a few empirical studies dealing with this issue and it is an area that needs some research. Studies made by World Bank (1993, Appendix 6.1) and Dollar and Sokoloff (1990), tend to show lack of evidence for the beneficial effects of targeting. However, Echecopar (1995) argues that a finer reading of Dollar and Sokoloff's results for Korea, that is looking at industries actually targeted through development plans rather than at broad capital intensity categories, actually show evidence of positive targeting effects. This argument also affects the World Bank (1993) study for Korea, which does not identify either the specific industries targeted. On the other hand, Okuda (1994) shows evidence that industries targeted in Taiwan during the 1980s were also the ones that presented higher rates of productivity growth. In summary, there is no clear evidence to reject the proposition of this model, and if the effects are empirically relevant, reaping benefits from targeting may depend mostly on how policy is implemented.

[4] Policy makers in East Asia have explicitly used this argument to target specific industries. From an official document in Japan:
"Advancement of industrial structure implies a move closer to an economically optimal industrial structure. In general, an appropriate industry should be decided on the basis of two criteria –an income elasticity criterion on the demand side and a productivity criterion on the supply side. ... Thus, industrial sectors meeting the above criteria should be fostered to bring about an advanced industrial structure;... " *White Paper on International Trade and Industry*, 1964, pp. 238-40; as quoted in Itoh et al. (1991 p. 32).

[5] In this model the productivity level represents a measure of the stock of human capital, while learning is the flow of human capital.

[6] Limits on indebtedness may be due to borrower's risk, lender's risk, and collateral requirements.

[7] Diffusion effects seem to be an important source of productivity improvements. See Stewart and Ghani (1991) for a discussion on the importance of these effects in developing countries. More empirical studies that try to quantify these effects also reach similar conclusions. For example, Dahlman, Kim, and Westphal (1985) report from a survey of entrepreneurs in Korea that "...domestic sources (of technology) were considered to be important slightly more often than were foreign sources" and that "...the transfer of labor among firms was more important than contacts with suppliers alone or with buyers alone" as a source of technology. Thus, as a source of technological improvements, diffusion of technology within an economy seems to be at least as important as acquiring the technology from abroad.

[8] This externality from learning is one of the synergy effects discussed in the literature on industrial clusters (see Best, 1990). An industrial cluster usually refers to firms located within a small geographical area. Here I will assume that firms are close enough for these effects to take place.

[9] Since the potential for learning from own output is the same for each good, this dynamic effect do not influence production decisions.

[10] If sector one is targeted, as firm z switches from sector two to sector one, it experiences a change in the value of production equal to $p_1 x_{z1} - p_2 x_{z2}$. Since initial especialization in sector one required that $p_1 h_{z1} > p_2 h_{z2}$ and since $x_{zi} = h_{zi} L_m$, it is straightforward that the change in production is necessary a loss.

[11] The only difference would be due to the residual firms that are not enough to produce a new optimal cluster.

[12] Under certain circumstances, targeting an industry that has low potential for industry average productivity and demand growth (a "looser") could still produce benefits. For that to happen the dynamic gains from increased productivity brought by the switching firms to the targeted sector will have to outweigh the dynamic gains of those same firms in their initial sector and the static losses of switching. This may be if the targeted sector has other characteristics that enhance the learning and diffusion process as compared to the initial one, such as an already large number of firms or better mechanisms for difussion of knowledge.

[13] A simple example: if the foreign economy is similar to the domestic economy and the domestic economy specializes completely in one sector, the foreign economy will have to specialize in the other sector and equation (12) also represents the rate of productivity growth in the foreign economy.

[14] In managament literature this effect is called "time compression diseconomies", meaning that there are limits to the speed at which new knowledge or proficiency in skills can be acquired.

[15] On the other hand, selecting sectors in which the country has a comparative advantage, following traditional trade theory, can reduce the risk of error. These sectors are less likely to be losers from the point of view of the home country, though they could still be losers: Bhagwati (1958).

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