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Clusters and Comparative Advantage: Implications for Industrial Policy

by

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Abstract[1]

Industrial agglomerations or "clusters" arise in the presence of industry-specific and local externalities, also called Marshallian externalities. The standard argument is that such externalities may justify a policy of infant-industry protection to allow and encourage clusters to emerge. This paper explores that argument and shows that different policy implications emerge under a more realistic modeling of clusters. In particular, rather than distorting prices to promote clusters in "advanced" sectors that may exhibit strong clustering possibilities, countries should focus instead on promoting clustering in current sectors that have demonstrated the strongest comparative advantage. Import substitution is not a proper way to achieve such a goal.

JEL classification: F13, O24, O33, O41.

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[1] I thank Giovanni Maggi and Alejandro Micco for comments. All errors are my own. The views here do not necessarily reflect those of the IDB.

1. Introduction

There is a long tradition among both academics and development practitioners that associates economic development with the realization of agglomeration economies. In policy circles, this is evident in the focus on "clusters" as an important concept in understanding growth and in thinking about development policy (Porter, 1990). Clusters arise in the presence of "Marshallian externalities," according to which firms benefit from the production and innovation activities of neighboring firms in the same and related industries.[2] There is abundant evidence that such externalities exist and lead to industry-level agglomeration (Rosenthal and Strange, 2003). But what is the appropriate policy in the presence of Marshallian externalities (ME)? From a classical optimal-policy perspective, the correct approach would be to provide a production subsidy to firms generating ME, with the subsidy calibrated to match the strength of the externality. The problem, of course, is that this places very stringent information requirements on policy. The general impression is that "advanced" or "technology-intensive" sectors are the ones where ME are strongest, and recent empirical evidence appears to be consistent with this impression.[3] Does this validate the common suggestion that countries should promote development of technologically advanced sectors, perhaps through Import Substitution?

In this paper I will argue that Import Substitution or any policy that distorts prices so as to push resources towards "advanced" industries is not an appropriate way to deal with ME in the context of small developing countries. There are two reasons for this. First, because ME are not an intrinsic characteristic of an industry: the same industry could generate ME in one place and not the other, in one stage of its evolution and not another. A good example of this is found in the experience of many countries that followed Import Substitution strategies and succeeded in developing new industrial sectors, but failed to generate clustering and benefit from ME in these industries. Something similar happens when poor countries succeed in courting high-tech multinationals only to find that they fail to generate significant spillovers once installed. The second reason why Import Substitution is not necessarily appropriate in the presence of ME is

[2] Marshallian externalities may arise both because of knowledge spillovers or pecuniary externalities (see Krugman, 1991). Rodríguez-Clare (1996) and Ciccone and Matsuyama (1996) present models where the presence of pecuniary externalities associated with economies of scale leads to multiple equilibria and underdevelopment traps.

[3] In a recent review of the evidence, Rosenthal and Strange (2003) conclude that an important component of ME are knowledge spillovers, which are obviously stronger for knowledge-intensive industries.

that if an industry generates stronger ME, then it is likely that some advanced country is already benefiting from the higher productivity that comes from clustering in this sector. International prices would then be lower and nullify the stronger benefits of clustering.

The consequence of this last point is that the strength of ME does not matter in choosing which clusters to promote. Rather, what matters is plain old comparative advantage. If one takes ME and clusters seriously, the correct policy is to promote clustering in existing sectors. To show these results in the simplest manner, I start in the next section with a review of the standard model of a small open economy where one of the sectors exhibits ME. This model has been used to motivate the use of Import Substitution (IS) as a development strategy. I derive the standard result that IS makes sense only if the economy has a comparative advantage in the sector that has ME. If "advanced" sectors are the ones exhibiting ME, then this already suggests that IS is not a reasonable policy for poor countries, which are not likely to have a comparative advantage in these sectors. More importantly, if—as argued above—ME are not intrinsic to particular sectors, but rather arise from the particular way in which production is organized, then the standard model is not appropriate.

In Section 3 I develop an alternative model, where all sectors are amenable to experiencing ME (although the intensity of these externalities may vary across sectors) but this depends on the mode of production. Thus, instead of assuming that externalities are associated with certain *industries*, I postulate that externalities are related to the *technology* with which goods are produced. This captures the idea that what matters is not "what you produce, but how" (Porter, 1998; De Ferranti et. al., 2001). I will discuss several implications of this model, and in particular show that the best policy would be to promote clustering in the sector where the country has a comparative advantage, and not in the sector that enjoys the strongest possible ME.

One drawback of both the standard model and this alternative model is that they incorporate only static externalities, whereas the empirical literature reveals that dynamic externalities (e.g., external learning by doing) are equally if not more important. Moreover, since dynamic externalities are strongly associated with knowledge spillovers (Rosenthal and Strange, 2003), then it is very likely that they are accompanied by international spillovers, something left out of most models. The static nature of the models thus makes them difficult to relate to the recent literature on endogenous growth. In Section 4 I show a simple way in which the model

presented in Section 3 can be generalized to incorporate dynamic externalities and international spillovers, and show how the income gap between North and South is related to clustering.

2. The Standard Model

This section presents a simple two-sector model to explicitly show how comparative advantage affects the ranking among equilibria in the presence of Marshallian economies.

There are two countries, North and South, two goods and one factor of production, labor, in fixed supply, L. Good 1 is produced with constant returns to scale and no aggregate externalities, with productivity possibly differing across North and South: a unit of labor produces λ_{1i}, where $i = S,N$ is a country index. Good 2 is produced with constant returns to scale at the firm level, but there are aggregate externalities, so that labor productivity in country i is:

$$\lambda_{2i}[Min(\bar{L}, L_{2i})]^{\alpha}$$

with $\alpha > 0$ and $\theta \equiv \bar{L}^{\alpha} > 1$. The term $[Min(\bar{L}, L_{2i})]^{\alpha}$ captures ME (i.e., static, local, industry-specific external economies) that are increasing with industry-wide employment, L_{2i}, but that are exhausted once the labor force in a sector reaches the level $\bar{L}$. The term θ can be seen as the maximum benefits of clustering in sector 2.[4] Just as for good 1, there may be exogenous productivity differences (independent of ME) across North and South in the production of good 2 (captured by differences in the productivity parameter λ_{2i}).

It is assumed that preferences satisfy the Inada conditions, hence any equilibrium must have positive production of both goods. Given the simple production structure of the model, this is all that is needed to assume about preferences to derive the main results.

I focus on a situation where the South is "small," so that international prices can be derived from the equilibrium of the North as if it were an isolated economy. Choosing labor in North as the numeraire, international prices are simply given by the North's unit labor requirements. Assuming that in equilibrium $L_{2N} > \bar{L}$ then $p_1^* = 1/\lambda_{1N}$ and $p_2^* = 1/\theta\lambda_{2N}$. Note

[4]In the traditional model, $\bar{L}$ is infinite, so labor productivity is simply $\lambda_{2i}L_{2i}^{\alpha}$. The alternative assumption that these aggregate externalities are bounded is not only more realistic, but also leads to a simpler analysis.

that the benefits of clustering are reflected in a lower international price of good 2. This will become important later on.

Turning to the equilibrium analysis for South, imagine first that there are no Ricardian productivity differences, $\lambda_{ji} = 1$ for all j, i. Let us confirm that there are multiple equilibria, with one equilibrium characterized by complete specialization in good 1 and the other by complete specialization in good 2. To confirm that specialization in good 1 is an equilibrium, note that with $\lambda_{1N} = 1$ then $p_1^* = 1$. Letting w denote the wage in South, this implies that $w = 1$ if South is specialized in good 1. The unit cost of producing good 2 in South given that all labor is devoted to production of good 1 (and hence no benefits of clustering are realized) is then simply $w/\lambda_{2S} = 1$, which is higher than the international price of this good $p_2^* = 1/\theta < 1$. The alternative equilibrium entails specialization in good 2. In this case, the wage in South would be such that the unit cost of producing good 2 would be equal to the price, or $w/\theta = p_2^* = 1/\theta$,[5] hence $w = 1$. Since $p_1^* = 1$, complete specialization in good 2 is also an equilibrium.

Although there are multiple equilibria, the wage is not higher in the equilibrium with specialization in good 2. This is because even though the economy benefits from clustering in this equilibrium, this is exactly compensated by the lower price of this good, which in turn arises from the higher productivity in North derived from clustering.

There are two scenarios in which the equilibrium with complete specialization in good 2 would be superior to the one with specialization in good 1 for South. In the first one South is the only producer of good 2. For this, of course, the South could no longer be assumed "small." Instead, one would need to solve for the two-country equilibrium. As shown in Helpman and Krugman (1985, chapter 3), the presence of ME in sector 2 allows the country that produces this good to have a higher wage than the country that specializes in good 1. For this to happen in equilibrium, however, it is necessary that the country that specializes in good 2 be small *relative* to the world demand for this good, so that this country produces *only* this good.

[5] It is assumed here that the total labor force in South is higher than $\overline{L}$, so that, just as in North, full clustering is realized. Otherwise, specialization in good 2 would not be an equilibrium.

The second scenario under which the equilibrium with specialization in good 2 is superior to the one with specialization in good 1 entails exogenous productivity differences, so that the South has a "latent" or "natural" comparative advantage in the good subject to clustering. To see this, drop the assumption that $\lambda_{ji} = 1$ for all j, i and assume instead that

$$\lambda_{2S}/\lambda_{1S} > \lambda_{2N}/\lambda_{1N} \qquad \text{(Assumption 1)}$$

Specialization in good 1 implies $w/\lambda_{1S} = p_1^*$ and for this to be an equilibrium we need $w/\lambda_{2S} > p_2^*$. Combining these two equations, the condition for specialization in good 1 to be an equilibrium is:

$$\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} < \theta$$

That is, the South's comparative advantage in sector 2 must be weaker than the benefits of clustering. On the other hand, specialization in good 2 implies that $w/\lambda_{2S}\theta = p_2^*$. This is an equilibrium if $w/\lambda_{1S} > p_1^*$. But given this assumption, this inequality is always satisfied when $w/\lambda_{2S}\theta = p_2^*$. Thus, under the assumption, specialization in good 2 is always an equilibrium.

To see which equilibrium has a higher wage, note that the equilibrium with specialization in good j has $w = \lambda_{jS}/\lambda_{jN}$. Given Assumption 1, the wage with specialization in good 2 is higher. Just as in basic trade theory, the wage is higher if the economy specializes in the sector where it has a comparative advantage. The difference here is that, due to Marshallian economies, the economy could find itself specialized in a sector where it doesn't have a natural comparative advantage. In this case, the goal of trade policy would be to push the economy towards the other equilibrium, a goal that could be achieved through a temporary tariff on good 2. Of course, this is nothing more than the classic case for infant-industry protection, where policy is supposed to turn a natural comparative advantage into an effective one.

This analysis emphasizes that for infant-industry protection to make sense, it is not only necessary that the protected sector exhibit Marshallian externalities but also that the country have a natural comparative advantage in that sector. This may present a problem for the practical relevance of this idea, since the good with Marshallian externalities is usually regarded as an "advanced" good, making it unrealistic to expect LDCs to have a comparative advantage in this sector relative to developed countries. More importantly, a problem with this model is that it

assumes that the expansion of sector 2 *necessarily* brings about the benefits of clustering. As mentioned in the Introduction, however, this is not a reasonable assumption. In the next section I explore this issue in detail.

3. An Alternative Model

This section presents a model that deviates from the standard model in that both sectors exhibit Marshallian economies (perhaps to different degrees), although the realization of these economies is not a necessary outcome of the expansion of the sector. The critical assumption is that there are different technologies that can be used to produce a good, and that these technologies differ in the extent to which they generate externalities: clustering only happens if firms use the "modern" technology. This captures the idea that even sectors that are seen as "advanced" in developed countries, can behave as backward or traditional sectors when they operate in LDCs, and hence fail to generate any externalities. Thus, this model shifts attention from "goods" or "sectors" to modes of production as the crucial determinants of clustering.

There are two goods, *both* of which could exhibit Marshallian economies. Each good can be produced using two technologies, which I call "backward" and "modern," respectively. The backward technology entails labor productivity λ_{ji}, where $j = 1,2$ is a sector index and $i = S,N$ is a country index. The modern technology entails labor productivity equal to:

$$\lambda_{ji}[Min(\bar{L}_j, L_{jiM})]^{\alpha}$$

The only difference with the case above is that here ME depend on the amount of labor employed *using the modern technology*, L_{jiM}. I allow $\overline{L}_j$ to vary across sectors, and hence $\theta_j \equiv \bar{L}_j{}^{\alpha}$ will vary with j (although it is assumed that $\bar{L}_j{}^{\alpha} > 1$ for $j = 1,2$). Also, note that the exogenous productivity parameter λ_{ji} is independent of the technology used.

Goods are ordered in such a way that $\lambda_{2N}/\lambda_{2S} \geq \lambda_{1N}/\lambda_{1S}$, so that North has a natural comparative advantage in good 2. To simplify the exposition, I rule out the possibility that the static benefits of clustering are decreasing in j to such an extent that $(\lambda_{jN}/\lambda_{jS})\theta_j$ is lower for $j = 2$ than for $j = 1$. That is, I rule out the possibility that the sector in which the North has a Ricardian comparative advantage has much lower clustering potential. The role of this assumption will become clear below.

As in the previous section, I focus on the case where South is "small," so that international prices are completely determined by the equilibrium in North. To derive this equilibrium, note that the economy could be producing *each good* with clustering, with all labor employed in the sector using the modern technology ($L_{jNM} = L_{jN}$) and productivity ($\lambda_{jN}\theta_j$) higher than the one associated with the backward technology (λ_{jN}), or without clustering, with all labor employed in the sector using the backward technology ($L_{jNB} = L_{jN}$) and productivity higher than with the modern technology, which in this case would be zero (since $L_{jNM} = 0$). In other words, there are multiple equilibria.[6] To simplify the analysis, it is assumed in the rest of this section and the next one that there are clusters in all sectors in North. Thus, equilibrium prices are simply $p_j^* = 1/\theta_j\lambda_{jN}$.

Turning to the South, imagine first that there are no Ricardian productivity differences, $\lambda_{ji} = 1$ for all j, i, and also that $\theta_j = \theta$ for $j = 1,2$. There are multiple equilibria: an equilibrium where the South specializes in a sector with a cluster (it could be either good 1 or good 2), in which case there is no income gap between North and South (i.e., $1/w$ ¡1), and an equilibrium where the South has no clusters and there is no trade, in which case the income gap is given by $\theta > 1$. In this second equilibrium, North is richer than South thanks to its clustering-induced higher productivity.

With Ricardian productivity differences and differences in the intensity of static externalities across sectors (i.e., $\theta_1 \neq \theta_2$), there is an equilibrium in which South specializes completely in sector 1 and there is no cluster in this sector. The income gap would be $\theta_1\lambda_{1N}/\lambda_{1S}$. There is also an equilibrium with complete specialization in sector 1 with a cluster, in which case the income gap would be $\lambda_{1N}/\lambda_{1S}$. Finally, it could also be that South specializes completely in sector 2. This would only happen if good 2 were produced with the modern technology and clustering. This is an equilibrium if and only if nobody wants to deviate and produce good 1 with the backward technology. To derive conditions for this, note that if South specializes in sector 2 with a cluster, then it must be that:

[6] To be more precise, there are four equilibria: one with no clustering, one with clustering in both sectors, one with clustering in good 1 and no clustering in good 2, and another one with clustering in good 2 and no clustering in good 1.

$$\frac{w}{\theta_2 \lambda_{2S}} = p_2^* = \frac{1}{\theta_2 \lambda_{2N}}$$

Thus, $w = (\lambda_{2S}/\lambda_{2N})$. The unit cost of good 1 produced in South without a cluster would be $w/\lambda_{1S} = (\lambda_{2S}/\lambda_{2N})/\lambda_{1S}$. For complete specialization in good 2 with a cluster to be an equilibrium, it is necessary that this be higher than p_1^*, or:

$$\left(\frac{\lambda_{2S}}{\lambda_{2N}}\right)\left(\frac{1}{\lambda_{1S}}\right) > \frac{1}{\theta_1 \lambda_{1N}}$$

Simplifying,

$$\frac{\lambda_{1S}/\lambda_{1N}}{\lambda_{2S}/\lambda_{2N}} < \theta_1 \qquad \text{(Condition 1)}$$

Summarizing, there are multiple equilibria in the (small) South. One equilibrium entails complete specialization in the sector with the highest relative productivity (i.e., sector 1) and clustering in this sector. Another equilibrium entails complete specialization in this same good, but without a cluster. Finally, there is another equilibrium with complete specialization in sector 2 as long as Condition 1 is satisfied. The first equilibrium, which entails clustering in the sector with strongest comparative advantage, generates the highest income level. The second equilibrium, with specialization in that sector but without clustering, generates the lowest income level. The third equilibrium has an intermediate level of income. However, note that θ_2 does not affect income in this equilibrium. This is because the higher productivity generated by the stronger static externalities in sector 2 when θ increases is exactly compensated by a lower international price.

There is one important implication of these results regarding the income ranking of the different equilibria. If the government could choose the equilibrium, it would always choose an equilibrium with clustering, which is not surprising, but it would also choose an equilibrium with specialization in the sector with the strongest comparative advantage; the strength of externalities is not relevant for the choice among equilibria. This has important and surprising policy implications, since it implies that the government should not necessarily choose to promote clustering in sectors with strongest externalities.

4. Discussion

There are several additional policy implications of this model that I wish to highlight and discuss. The first is that protection in no way makes it more likely that a cluster will form, since the good can be produced without a cluster. Consider an initial situation where South is completely specialized in sector 1 with no cluster. Imposing a policy of Import Substitution (IS) would increase the domestic prices of good 2 and at some point South would start producing some of this good. But it could produce it *without* a cluster, just as it produces good 1 without a cluster. There is no reason why IS would lead to clustering! In other words, once we accept that production in the advanced sector can take place using backward technologies or modes of production, then it becomes clear that IS does not necessarily lead to externalities and clustering. IS could simply push resources towards what are regarded in rich countries as advanced sectors, but that once in LDCs could be organized in ways that do not generate any externalities.

This reasoning has broader implications. Not only IS, but any policy (even export promotion) that distorts prices so as to push resources into advanced sectors would have the same problem. Instead of policies to reallocate resources across sectors, it would be better to implement policies to promote clustering in sectors that already show comparative advantage. This implies that, as generally accepted by proponents of cluster-based policies, governments should not try to create clusters from scratch.

An additional implication is that promoting a cluster is not necessarily welfare enhancing, since it could be a cluster without a comparative advantage. To see this, imagine that the South has no clusters. This immediately implies that it is specialized in sector 1. Imagine further that the government tries to promote a cluster in sector 2 and that $\lambda_{1S}/\lambda_{1N} > \theta_1\lambda_{2S}/\lambda_{2N}$. To do so, it would have to distort prices, because—since Condition 1 is not satisfied by Assumption 1—clustering in sector 2 is not an equilibrium with undistorted prices. But if it does this, then welfare would decrease. Alternatively, if Condition 1 is satisfied, then there is an equilibrium with full specialization in sector 2 with a cluster, and it is conceivable that the government could induce the economy to switch to this superior equilibrium. Still, this equilibrium is inferior to the one with complete specialization and clustering in sector one. To summarize, when there are Ricardian differences (more generally, comparative advantage coming from sources different than clustering), promoting the creation of a cluster from scratch may be inferior to the status

quo, and is always dominated by promotion of a cluster in sectors where the economy is already showing comparative advantage.

Finally, the model shows that it is not the case that governments should favor clustering in industries with stronger externalities. As explained in the previous section, this is because such stronger externalities lead to higher productivity and hence lower international prices. Thus, for example, if we imagine that higher indexed goods are "more advanced" and that more advanced goods have stronger externalities, then $\theta_2 > \theta_1$. A common presumption here would be that policy should target more advanced sectors, to benefit from stronger clustering. The model presented here shows that this presumption is not correct. Instead, the appropriate policy is to promote clustering in the sector that has the strongest comparative advantage. Thus, industrial policy is not about "creating comparative advantage," but about achieving the high productivity that comes from a cluster in the sector where it has a comparative advantage.

5. Dynamic Externalities and International Spillovers

In contrast to the models explored above, which focus exclusively on static externalities, the empirical literature reveals that dynamic externalities play a very important role in industrial agglomeration. Moreover, given that knowledge spillovers are the main mechanism through which these dynamic externalities operate, it is likely that they are accompanied by international spillovers. Although the region where the knowledge originates is likely to benefit more and sooner, other regions are likely to benefit as well from spillovers. This section presents a very simple way to introduce dynamic externalities and international knowledge spillovers into the model developed above. The policy implications discussed are not affected; the purpose of this section is to add realism to the cluster-based model and allow for a sharper comparison between this model and the recent endogenous growth literature.

The model is similar to the one presented in the previous section, although now it is assumed that production with the modern technology generates both dynamic as well as static externalities. To introduce dynamic externalities and international spillovers, I allow for an additional productivity variable, A_{jit}, that increases with time thanks to external industry-specific learning by doing and international spillovers. Labor productivity across sectors and technologies

is just as above, except that now it is also multiplied by this variable A_{jit}. Just as with λ_{ji}, A_{jit} is independent of the technology used.

It is simpler to first explain the assumptions regarding dynamic externalities for a single economy (i.e., no international spillovers). In each sector, production with the backward technology generates no learning, whereas production with the modern technology generates external but sector-specific learning by doing, which leads to increasing productivity in manufacturing according to:

$$\dot{A}_{jit} = (g/\bar{L}_j)Min(\bar{L}_j, L_{jiM})A_{jit}$$

if $L_{jiM} > \bar{L}_j$ then $\dot{A}_{jit}/A_{jit} = g$ in steady state.

Productivity increases caused by dynamic externalities in one country eventually diffuse to the other country even if there is no cluster there. Thus, in this model clusters are important to generate knowledge but are not critical to benefit from knowledge spillovers. Imagine for concreteness that North has a cluster in sector j but the South does not. Then it is assumed that the rate of growth of the productivity variable A_{jSt} is governed by:

$$\dot{A}_{jSt} = \varepsilon(1 - a_{jSt})A_{jSt}$$

where $\varepsilon > g$ and $a_{jSt} \equiv A_{jSt}/A_{jNt}$. This formulation captures the idea that there are "benefits of backwardness," in the sense that a lower relative productivity in South (i.e., lower a_{jSt}) leads, *ceteris paribus*, to a faster rate of productivity growth. This implies that for a given parameter ε, there is a steady state gap $A_{jSt}/A_{jNt} = \hat{a}$ given implicitly by $g = \varepsilon(1 - \hat{a})$. If $a_{jSt} < \hat{a}$, then the benefits of backwardness will lead to an increase in a_{jSt} until it reaches $\hat{a}$. In contrast, if $a_{jSt} > \hat{a}$, then the benefits of backwardness are too weak, and the international spillovers will be weaker than learning by doing in North, leading to divergence and hence falling a_{jSt}, a process that will continue until a_{jSt} reaches the steady state gap $\hat{a}$.

More generally, letting $a_{jSt} = \max\{A_{jSt}/A_{jNt}, 1\}$ and $a_{jNt} = \max\{A_{jNt}/A_{jSt}, 1\}$, growth in A_{jit} is determined by both learning by doing (if there is a cluster) and international spillovers:

$$\dot{A}_{jit} = (g/\bar{L}_j)Min(\bar{L}_j, L_{jiM})A_{jit} + \varepsilon(1 - a_{jit})A_{jit}$$

The first term on the RHS captures learning by doing, whereas the second term captures international spillovers.

Given these assumptions governing dynamic externalities and international spillovers, if the South does not have a cluster in sector j, its labor productivity there at time t in steady state would be $\lambda_{jS}A_{jSt} = \lambda_{jS}\hat{a}A_{jNt}$. In contrast, the North's productivity in sector j, where we are assuming it has a cluster, would be $\lambda_{jN}\theta_j A_{jNt}$. Thus, the ratio of productivities in North versus South in sector j under these circumstances would be $(\lambda_{jN}/\lambda_{jS})\theta_j(1/\hat{a})$. The first term captures pure Ricardian productivity differences, whereas the second and third terms capture the impact of the static and dynamic benefits of clustering, respectively.

Just as in the previous section, prices are derived from the equilibrium in North as if it were an isolated economy. I then analyze the equilibrium in South considered as a small economy. The focus is on steady state equilibria. Assuming for simplicity that the North has clusters in all sectors (and that $L_{jNM} > \bar{L}_j$ for $j = 1,2$) the steady state equilibrium in North has productivity given by $\lambda_{jN}A_{jNt}\theta_j$ in sector j at time t. Thus, steady state international prices are $p^*_{jt} = 1/\lambda_{jN}A_{jNt}\theta_j$ with $\dot{A}_{jNt}/A_{jNt} = g$.

Imagine first that there are no Ricardian productivity differences, $\lambda_{ji} = 1$ for all j,i, and also that $\theta_j = \theta > 1$ for $j = 1,2$. There is an equilibrium where the South specializes in a sector with a cluster (in which case there would be no income gap) and an equilibrium where the South has no clusters, there is no trade, and $A_{jSt} = \hat{a}A_{jNt}$ for all j,t. Thus, in the backward equilibrium the income gap is given by $\theta/\hat{a} > 1$. The term θ captures the benefits of static externalities, while $1/\hat{a}$ captures the benefits of dynamic externalities (although capped by the international spillovers). If the South moves to an equilibrium with a cluster in sector j, then productivity would jump instantaneously thanks to the static externalities, and there would also be a dynamic effect, reflected in a temporary increase in the growth rate of A_{jSt} above g, to:

$$\dot{A}_{jSt} = gA_{jSt} + \varepsilon(1 - a_{jSt})A_{jSt}$$

where I have assumed that $L_{jSM} > \bar{L}_j$. Clearly, in this case, A_{jSt} would eventually converge to A_{jNt} and the income gap would disappear.

With Ricardian productivity differences and differences in the intensity of static externalities across sectors (i.e., $\theta_1 \neq \theta_2$), the set of equilibria is analogous to the set of equilibria derived in the model of the previous section: there is an equilibrium where South is specialized in good 1 with a cluster and income gap $\lambda_{1N}/\lambda_{1S}$; another equilibrium where the South is specialized in good 1 with no cluster, in which case the income gap is $(\theta_1/\hat{a})(\lambda_{1N}/\lambda_{1S})$; and finally, there is another equilibrium where South is specialized in good 2 as long as a condition similar to Condition 1 is satisfied, except that now we must also take into account the effect of dynamic externalities and international spillovers:

$$\frac{\lambda_{1S}/\lambda_{1N}}{\lambda_{2S}/\lambda_{2N}} < \theta_1/\hat{a}$$

Let us focus on the equilibrium where the South is specialized in good 1 with no cluster. As in many recent models of growth (Parente and Prescott, 1994; Klenow and Rodríguez-Clare, 2004), both North and South grow at the same rate, so there is no convergence. In contrast to many of these models, however, it is not necessary for South to increase its investment in technology adoption to catch up with the North. Convergence would occur if South managed to develop a cluster, so that it too could generate both static and dynamic externalities.

To summarize, the insights gained with the static model remain valid when we move to a more realistic setting with dynamic externalities and international spillovers. Countries with no clusters suffer from the lack of both static and dynamic externalities, although the income gap is bounded thanks to international spillovers. There are multiple equilibria, and the equilibrium with the highest income in South is the one where there is clustering in the sector where its comparative advantage is strongest. Policy should focus on promoting clustering in this sector and avoid price distortions.

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