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**Conference Paper**

## Externalities, clusters and economic growth: The Cluster Policy Paradox

51st Congress of the European Regional Science Association: "New Challenges for European Regions and Urban Areas in a Globalised World", 30 August - 3 September 2011, Barcelona, Spain

**Provided in Cooperation with:**

European Regional Science Association (ERSA)

*Suggested Citation:* Pessoa, Argentino (2011) : Externalities, clusters and economic growth: The Cluster Policy Paradox, 51st Congress of the European Regional Science Association: "New Challenges for European Regions and Urban Areas in a Globalised World", 30 August - 3 September 2011, Barcelona, Spain, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

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# Externalities, clusters and economic growth: The Cluster Policy Paradox

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## Abstract

The literature on clustering has highlighted several advantages of industrial agglomerations. Persons and firms benefit from the production and innovation activities of neighbouring companies in the same and related industries. Considering such benefits, which are viewed as positive externalities, Michael Porter argues that clustering is an important way for firms fulfilling their competitive advantages and for rising regional and national competitiveness. So, it is opportune to ask: what is the appropriate policy for maximizing the benefits of CE (cluster externalities)?

There are basically two possible replies to the above question: on the one hand, the traditional optimal-policy perspective recommends providing a subsidy to firms generating CE, with the subsidy adjusted for equalizing the strength of the externality; on the other, a more pragmatic perspective based on Porter's policy prescriptions. However, the evidence shows a paradox: policy makers use the competitiveness rhetoric inspired in the competitive advantages of Porter but, in practice, they go on using the industrial targeting that was also criticized by Porter.

In this paper we deal with this paradox proving that despite the extensive amount of externalities is the traditional comparative advantage approach that must guide policy. This finding is congruent with the Porter's policy prescriptions and has clear implications in regional policy allowing to support the answer to the following question: Must policy be focused on creation of new clusters in activities that have verified large positive effects elsewhere or, conversely, on developing the traditional activities in region, which allegedly have shown lower externalities? But the answer to this question depends on our comprehension of industrial aggregation processes, which implies the full understanding of concepts as clusters and externalities. So, the remainder of this paper is organized as follows. After reflecting on the concept of cluster in section 2, section 3 deals with the different types of externalities present in industrial agglomerations. Section 4 considers the existence of dynamic externalities and relates them with the advantages of backwardness. Section 5 uses a model that includes various types of externalities in order to draw lessons for guiding clustering policy. Finally, section 6 concludes.

Theme D. Agglomeration, clusters and policy

## 1. Introduction

It is a well-known fact that industrialization is often accompanied by spatial agglomeration, whatever the term used to describe this grouping phenomenon: *industrial district*, *spatial agglomeration*, *industrial concentration*, *cluster*, and so on. Not only regions in Southern European countries as Italy, Portugal and France, which have contributed to the popularity of the industrial district concept<sup>1</sup>, but also regions of so diverse countries as Japan, China (Huang et al., 2008; Ruan and Zhang, 2009) and other East Asian economies (Sonobe and Otsuka 2006) have all experienced a path of spatial clustering led by SMEs (small and medium enterprises) during the course of industrialization. Some consider this as a long lasting process at least so long as the popular putting-out system occurred in the U.K prior to its Industrial Revolution (Hounshell, 1984)<sup>2</sup>.

Research in economic geography and regional science has empirically shown that agglomeration has been positively associated with productivity at the local geographical level both in the US and in Europe (e.g., Ciccone and Hall, 1998; Ciccone, 2002). But in spite of the positive correlation between agglomeration and productivity, only in recent years the rhetoric about regional clusters has been widely adopted in policy circles. This rhetoric can be viewed as a mixture of Michael Porter's (1990) point of view about what creates competitive advantage for firms and nations, and regional theories on localisation advantages and industrial districts. Although we can trace the origin of this rhetoric in the Porter's diamond model<sup>3</sup>, originally developed to analyse competitive advantages in national terms, but in international markets, the Porter's arguments that 'competitive advantage is created and sustained through a highly localised process' (Porter, 1990, p. 19) have determined a refocusing of competitive advantage from nations to regions. So, in line with the deep discussion that has characterised the literature on agglomeration externalities, the competitiveness concept of Porter has also come to be used to examine regional competitiveness. However, now attention has mostly been directed towards a combination of the Marshallian agglomeration externalities (labour pool, collaboration with companies with similar production and collaboration along the value

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<sup>1</sup> Industrial districts in which different factories and workshops crowded together were extensively documented in Italy and France in the twentieth century and according to several authors (Piore and Sabel 1984; Porter 1998) are still feasible in some regions of Italy.

<sup>2</sup> In the putting-out system, a merchant took market orders and contracted out the production to farmers or skilled workers in close proximity, who usually completed the work in their homes or family workshops. Several authors consider outsourcing (or subcontracting) as a modern variant of the traditional putting-out system, and show that it remains a major feature of industrial production organization in contemporary Japan and Taiwan (Sonobe and Otsuka 2006)

<sup>3</sup> Porter's diamond model considers the following as the most important factors for explaining competitive advantage of nations: i) the context for firm strategy and rivalry; ii) demand conditions; iii) factor conditions; and iv) related and supporting industries.

chain) and dynamic externalities, rather than the explicit evaluation of the various dimensions of Porter's diamond.

As this change occurs, the point of view that competitive advantage developed from characteristics about entire industries in their 'home region' evolved into a universal policy prescription that offered the promise of sustained growth to any locality or region. Porter-inspired cluster development gave policy professionals a rationalization for local intervention. Policy makers in many countries and regions view this validation as advice to combine cluster promotion with any position along the intervention spectrum, from simply recognizing the presence of a cluster to the complete promotion of entirely new clusters. Porter's consultant work, alone or in association with his Monitor Company, has also contributed to the wide diffusion of cluster strategies in many European countries (Benneworth et al., 2003).

However the admiration devoted by policy circles is not completely shared by the research community. For instance Martin and Sunley (2003, p. 29) interpreted cluster support more as a result of the use of the techniques of brand management than as a genuine intellectual discourse. Just as commercial organizations use a brand image to seek to differentiate an otherwise 'ordinary' product, the cluster label has been cleverly used to sell an idea of prosperity that some policy-makers buy the world over. The image of high productivity, prosperity, decentralization and entrepreneurship associated to the cluster brand helps to promote the idea that a socially progressive local economy is within the reach of policy makers wherever located.

Besides the cluster brand induced effects, the literature on clustering has contributed to highlight a set of ideas existing for decades, which derived from standard business agglomeration theory. This has emphasized several advantages over alternative modes of industrial organization, which are usually viewed as positive externalities. Clusters arise in the presence of such externalities, according to which persons and firms benefit from the production and innovation activities of neighbouring companies in the same and related industries. It is also considering the positive externalities that Porter (1998) has argued that clustering is an important way for firms to fulfil their competitive advantage. There is abundant evidence that such externalities exist and lead to industry-level agglomeration (Rosenthal and Strange, 2004). But, what is the appropriate policy for enforcing the clustering development and so to encourage such externalities?

The traditional answer corresponds to what Rodríguez-Clare (2007) named a classical optimal-policy perspective, i.e., to provide a production subsidy to firms generating externalities, with the subsidy adjusted in a way that equalize the strength of the externality.

However, this would be a very demanding solution, as it is extraordinarily difficult, or even impossible, to compute the exact power of the externalities. Given these difficulties, it is usually accepted that the presence of externalities is per se a good and enough indication to advise public intervention and, accordingly, to support the industries that are likely to produce positive external economies.

Another possible answer to the above question is based on the Porter's policy prescriptions<sup>4</sup>. But, as Woodward and Guimaraes (2009) point out, there are no known cases where regions or countries have explicitly followed these principles instead of the industrial targeting associated to the classical optimal-policy perspective. On the contrary, there are significant examples where policy makers use the competitiveness rhetoric inspired in the competitive advantages but, in practice, they go on using the industrial targeting that was criticized by Porter (Pessoa, 2010). In this paper we deal with this paradox arguing that in spite of the extensive amount of externalities is the traditional comparative advantages that must guide policy and this is congruent with the Porter's policy prescriptions.

Choosing the right alternative has clear implications in regional policy. For instance, what is the most appropriate policy for a depressed region? To promote the appearance of a specific industrial cluster in a region without tradition in such activities or, on the contrary, facilitating the development of traditional activities embedded in this region? In other words, must policy be focused on creation of new clusters in activities that have proven to have large positive effects elsewhere or, conversely, on developing the traditional activities in region, which allegedly has shown lower externalities? The answer to these questions depends on our comprehension about the effects of industrial aggregation processes, which implies the full understanding of concepts as clusters and externalities. So, the remainder of this paper is organized as follows. After reflecting on the concept of cluster in section 2, section 3 deals with the different types of externalities present in industrial agglomerations. Section 4 considers the existence of dynamic externalities and relates them with the advantages of backwardness. Section 5 uses a model that includes various types of externalities in order to draw lessons for guiding clustering policy. Finally, section 6 concludes.

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<sup>4</sup> These prescriptions are synthesized in Woodward and Guimaraes (2009): i) support the development of all clusters, not choose among them; ii) reinforce established and promising clusters rather than attempt to create entirely new ones; iii) cluster initiatives are advanced by the private sector, with government as facilitator; iv) development should not be guided by top-down policy strategies.

## **2. Clusters: key characteristics**

Although the study and discussion of industrial atmosphere has a long history in academic community discussions, it was the Porter's competitiveness concept that put it in the front page. In fact, it was only after Michael Porter (1990) has examined the industrial agglomeration from the firm perspective that the theme surpassed the restricted circles of economists and geographers. Porter's definition of clusters as "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g. universities, standards agencies, trade associations) in a particular field that compete but also cooperate" (Porter, 2000 p. 15) has become perhaps the most widely used. But the Porter's approach to industrial agglomerations helped not only to impose a concept and to justify clusters as targets for public policy, but also it has created a global demand for consultants with policies to fit it. As Rosenfeld (2005: 4) has noted, this increasing demand of consultants can explain, almost partly, why industry clusters have moved from a "relatively obscure idea situated on the periphery of economic development to a core practice".

Whatever the reason, Michael Porter's work about 'clusters' have established the standard in the field, and policy-makers of all over the world have used Porter's cluster model as a tool for promoting national, regional, and local competitiveness, innovation and growth. In fact, very quickly clusters called the attention of many leaders in many regions, and consequently the cluster related concepts were extended promptly to go with local circumstances and expectations. However, at least a large part of the popularity of clusters lies in its vagueness and definitional elusiveness (Martin and Sunley, 2003). But this imprecision in concepts allows to apply the cluster concept to different realities and furthermore prevents an accurate policy evaluation. Also the tendency to oversimplify, which is associated to the vulgarisation of the definition of "cluster", permits to find clusters everywhere. In effect, both individual researchers and development agencies have identified in recent years clusters so diverse as ranging in size from two to thousands companies, enveloping territories as small as a neighbourhood and as large as nations, and comprising highly specialized members as defined by a four digit industry code and as broadly defined as "high tech". In today's policy world, clusters are acquiring "the discreet charm of obscure objects of desire" as Martin and Sunley (2003) remind, citing Steiner (1998, p. 1).

In fact there is a lot of confusion around the cluster concept. A key characteristic of clusters is the interdependence among firms. This interdependence gives clustered firms certain advantages over isolated firms. But is this interdependence a sufficient condition for

classifying any association of firms (for instance, a network) as a cluster? In our view the answer is negative. There are other forms of firms collaboration characterized by interdependence. But, as Rosenfeld (2005) explains, there are significant differences between clusters and the other forms of firms' associations.

Both networks and clusters are agglomerations of firms with certain common interests. According to Porter (1998, p. 78) "clusters are geographic concentrations of interconnected companies and institutions in a particular field". But, contrasting with networks, neither "membership" in an organisation nor cooperation are required to be "in" a cluster. Free riders, just by virtue of location, are able to benefit from non-exclusive external economies that spill over people and organizations localized under the cluster influence. This constitutes an important difference between clusters and other forms of association. According to Rosenfeld (2005), the former are informal and inclusive while the latter are formal and exclusive, with members gaining advantages over non-members. In clusters, free riders are not only unavoidable but also, and perhaps more importantly, contribute to make cluster more powerful.

Another important issue is the proximity between cluster elements. The benefits of proximity are well-known: Proximity makes greater access to tacit knowledge possible, opens opportunities for cooperation and collaboration and gives the clustered firms power to influence customers, markets, or policies. Proximity also gives higher access to experienced labour and allows firms to be more familiarized with competitors' products and processes and to check own innovation and targets. In spite of the influence of recent innovations, as Internet and overnight delivery, proximity go on being crucial for some production inputs as key equipment and components that are knowledge-intensive and/or result from interactive research and design (Rosenfeld, 2005). These are issues where "soft" externalities are prominent.

The importance of proximity in the transfer of tacit knowledge does not depend solely on geographical distance, as traditional explanations of the time and cost advantages of co-location tend to conclude. Although geographic co-location increases the probability of interaction does occur, proximity has also a *relational* dimension. This is important to keep in mind since the exchange of strategically important information and knowledge requires mutual trust between the parties. In this sense, proximity is very related with the social capital concept highlighted by Putnam (1993) when he analyses the Italian economy.

So, the proximity that is the key characteristic of a region possesses not only a spatial (geographical) dimension, but also a *relational* dimension. This involves aspects such as trust

and understanding (Boschma, 2005). Although much of the literature agrees that spatial proximity often generates, or at least encourages, the emergence of relational proximity, this is not an automatic result from geographic proximity, because trust between the actors is basically an effect of how long a particular relationship lasts, how frequent communication between the actors is, and whether they engage in repeated collaborations with the same actors (Nilsson, 2008). So, despite how close two actors are in terms of geographical location, a lack of trust between them can lead to the failure of wished interaction and knowledge exchange.

In the case of the tacit dimension of knowledge, labour mobility between organisations is probably one of the most common channels for knowledge transfer between organisations in a region. Labour mobility also has a clear territorial dimension since the mobility of individuals between regions, and even more so between countries, is very limited. However, the experience of human resources has remained a primary reason of clustering (Krugman, 1991). Firms depend on a continuous flow of workers skilled with the necessary ability, and with the knowledge of the business, which are needed to both routine and unforeseen situations. In every cluster not only a sufficient provision of technicians, sales staff, network organization, but also a labour force experienced on the specific milieu in which the cluster functions are crucial. This is very hard to get when policy tries to create an entirely new cluster.

On the other hand, the evidence suggests spontaneity in clusters emergence. As shown by Rosenfeld (2005: 9), clusters emerge out of a solid foundation that is either embedded in existing companies, local expertise, or some special resources. The world's best-known clusters have a long history and were spontaneous until they reached a sufficient level activity that called attention. This suggests some sample bias in analyses of cluster benefits: many potential clusters disappear before they constitute case studies. Perhaps this fact can explain some controversy about the positive effects of clusters, although it can be risky to conclude, as Perry (2010) does, that in practice, there is no strong evidence that businesses that are located in a cluster gain an advantage over those that do not.

Economic history shows that the origins of clusters are diverse and wide-ranging: we find clusters that result from one or two successful companies with employees with an entrepreneurial vision; or from the expansion of value added chains around very large firms; or even from efforts by laid off employees to use their competencies in innovative ways. But, although their origin may be varied, spontaneity, *relational* dimension of proximity, tacit



knowledge, interdependence and some informality are key characteristics of all of the best-known. All of these characteristics are hardly created or manipulated by policy.

### **3. Agglomeration and static externalities**

There are several theories that highlight, in different ways, the importance of the local environment for economic transformation and growth. Some of these can be catalogued as belonging to “regional cluster theory”, but a number of basic concepts are common to most of other different theoretical perspectives. Many of such perspectives have a past well before cluster’s fashion. The *Agglomeration* externalities constitute the basis of one of such perspectives. In effect near a century ago Alfred Marshall, in his book *Principles of Economics* described how companies got advantages as a result of being located in close geographic proximity to each other businesses. Potter and Watts (2011) have grouped these externalities in a “trinity of agglomeration economies” (local pool of skilled labour, local supplier linkages, and local knowledge spillovers), from which firms should receive increasing returns.

Table 1 summarizes the recognized types of agglomeration externalities. It shows the division into localisation externalities, urbanisation externalities, Jacob's externalities and related variety benefits, and gives examples where they act positively or negatively.

Commonly speaking, localization externalities are advantages got by companies from being located in regional environments where there are many other businesses. The financial industry in the City of London, the textile and footwear manufacturing in northern Italy, the ICT industries in Silicon Valley and the Hollywood film industry are only a few of best known examples highlighted in literature of industrial agglomerations, which are characterized by high externalities. The fundamental reason is that individual companies benefit from the high spatial concentration of businesses, but agglomeration can also cause negative effects. The external effects (positive or negative) may arise both because of knowledge spillovers or pecuniary externalities (see Krugman, 1991). They are created through co-location, but each individual company can only influence the conditions to a very small degree.

There are many different types of localization externalities, and their nature also depends on which other companies share the regional environment (businesses of the same industry, or companies working in other, but still related, sectors), but the best known in literature are the following: a) better access to the market for goods and to suppliers, labour

pooling, and easy flow of technology know-how (Marshall, 1920); b) speeding the flow of ideas (Glaeser and Gottlieb, 2009) and increasing the innovation, which results from technology linkages among related industries (Scherer 1982; Feldman and Audresch 1999); c) transforming into many small investments a large lump-sum investment (Schmitz 1995) and so lowering capital entry barriers (Ruan and Zhang, 2009).

Table 1. Positive and negative agglomeration externalities

Type of externality	Positive	Negative
<u>Localization:</u> These are agglomeration advantages that result from a spatial concentration of companies operating in the same industry or conducting similar types of activities. Companies in similar industries benefit from co-location due to the creation of a regional pool of specialised inputs.	Creation of a regional pool of specialised and experienced manpower; exchange of knowledge, and collaboration between companies along a product's value chain; better access to the market for goods and to suppliers, and easy flow of technology know-how (Marshall, 1920) Small firms can achieve economies of scale that would otherwise only be accessible to large organisations; transforming into many small investments a large lump-sum investment (Schmitz 1995) and, so, lowering capital entry barriers (Ruan and Zhang, 2009)	Lock-in effects. Such lock-ins may arise, for example, as a result of a too introverted aptitude (Grabher, 1993)
<u>Urbanization:</u> The agglomeration advantages that arise in large cities as a consequence of their rich economic environment, or simply because of their size.	A variety of different actors can share access to advanced infrastructure, highly skilled workers or specialised services, which are all to the benefit of businesses in many different industries.	The higher cost of living that boosts salaries (Glaeser and Maré, 2001). Higher property and land prices, and pollution and congestion from the use of infrastructure.
<u>Jacobs:</u> a variant of urbanisation externalities that places the focus on a region's economic variety (the presence of many different industries, for example). Different industries complement each other in the creation of innovations.	Many different industries in one region may benefit young companies in their ability to innovate (Duranton and Puga, 2001), as young companies can gain inspiration from other industries for solving their problems. Speeding the flow of ideas (Glaeser and Gottlieb, 2009) and increasing the innovation, which results from technology linkages among related industries (Scherer 1982; Feldman and Audresch 1999).	In cases of too fragmented small sectors, there is a risk that the support functions, such as specialised services, targeted infrastructure initiatives or business policy, will also become too fragmented to be effective.
<u>Related variety benefits:</u> a mix of Jacobs and localisation externalities. If industries are related, the likelihood of a successful cross-pollination of ideas increases. If a region is home to many actors in related industries, this can lead to more ideas being spread between the industries than if they were unrelated (Frenken et al, 2007).	Firms within the industries use similar types of knowledge, or similar types of production technology (or both). For example, companies in the chemicals and pharmaceuticals sectors may largely use workers with the same skills.	The prevalent knowledge can be used routinely and so there are scarce hypotheses of emerging new types of knowledge.

Although there is a consensus about the existence of such externalities and that they lead to industry-level agglomeration, empirically the agreement is less notorious. On the one hand, some researchers regard externalities as impressive and abundant (Rosenthal and Strange, 2004), on the other, several authors are less optimistic about the possibility of measuring the effects of different externalities. For example, Feldman (2000) notes that the results of research typically vary from negative to positive externalities. The discrepancy has many reasons: a) differences in methodological design and the type of selection (De Groot et al, 2008); b) companies benefit from some type but not from every type of externalities (Neffke et al, 2008); c) the impact of different types of externalities seems to change with the development phase of the industry (Potter and Watts, 2011), for example, localisation externalities look like more important for mature and well-established industries, while Jacobs' externalities are more important for young industries in dynamic development stages (Henning et al, 2010).

With the exception of some Jacobs' external economies, the agglomeration externalities summarized in table 1 are static in the sense that they affect the total factor productivity of firms through an increase in the efficiency of the technologies in use. This increase in efficiency usually comes from a reduction of costs caused by concentration, such as reduced transportation and transaction costs for intra-organisational exchange and access to external markets. But there is another type of external economies that can influence the development and the relative well being of different regions in the long run. These are the dynamic externalities, which we deal with in the next section.

#### **4. Dynamic externalities: Localised learning and the advantages of backwardness**

It is important to distinguish between static and dynamic externalities (Glaeser et al, 1992). Dynamic externalities arise mainly through the relationships between people and organisations that increase knowledge flows and, consequently, enhance knowledge formation, innovation and diffusion. So, dynamic externalities are strongly associated with knowledge spillovers (Rosenthal and Strange, 2003).

It is possible to explain dynamic externalities as resulting from processes of localised learning (Malmberg and Maskell, 2006). This means that learning appears as the key way of transmitting knowledge in territorially industrial agglomerations and, consequently, to know how and under what principles knowledge can be transmitted is decisive for qualifying external economies as dynamic. Particularly in this context, learning processes must consider

the two dimensions of knowledge: tacit and codified (Polanyi, 1967)<sup>5</sup>. The key point here is that these dimensions are not substitutable. On the contrary, they are complementary: in principle, the application of any codified knowledge requires a degree of tacit knowledge. In fact, the economic useful knowledge always contains a tacit as well as a codified dimension, although the proportions between them can vary from one to another situation.

In regional innovation research the tacit dimension of knowledge is usually emphasized as it allows explaining how firms can benefit from regional co-location (Gertler, 2003). Proximity and face-to-face contacts are very important in transmitting tacit knowledge. Where the proximity is high it is likely that the tacit knowledge spills over to neighbours. Furthermore, proximity increases the strength of linkages between people and organizations. This is also why many process of learning are described as "learning-by-doing" or "learning by interacting".

The empirical literature reveals that dynamic externalities play a very important role in industrial agglomerations. Moreover, given that knowledge spillovers are the main mechanism through which the dynamic externalities work, it is probable that they are accompanied by international spillovers in open economies (Rosenthal and Strange, 2003; Coe and Helpman, 1995; Coe *et al.*, 1997). This means that although the economy (national or regional) where the knowledge originates is on the point of benefiting more and sooner, other economies are likely to benefit from spillovers, too. But the power of international spillovers is also associated to the different level of development between economies.

Indeed, the process of economic development can be analysed by focussing on changes occurring in the economy's industrial structure at the same time as its GDP increases. This is the driving idea of the structural approach to economic development and is also of the perspective known as the 'advantages of backwardness', following the leading work of Abramovitz (1979, 1986). This perspective, also known as the 'catch-up hypothesis', in its simplest form states an inverse association between the initial productivity level of an economy and its productivity growth rates in the long run.

For some authors (Nelson and Phelps, 1966; Fagerberg, 1987; Fagerberg and Verspagen, 2002), it is the existence of a technology gap between economies that allows the possibility of profiting from advanced technologies without the cost of inventing them. So, according to this hypothesis, the technology gap carries a potential for generating growth more rapidly in the technologically backward economies than in leader ones, since they can

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<sup>5</sup> The difference is well known. While tacit knowledge is based on practice, which cannot be expressed in words, codified knowledge can be easily formulated, for instance, in designs, text, or mathematical formulas.

have access to technologies that have already been employed by the technological leaders, and by profiting from them they can make a larger productivity jump. Although the Abramovitz's (1986) analysis goes beyond this simplest version, we can take the technology gap perspective as a basis to show how knowledge spillovers can occur in international (and interregional) context, and to introduce them in the model of the next section.

The technology gap perspective bases the tendency of economies to converge on the existence of a technology differential (Nelson and Phelps, 1966) between advanced and less developed economies or more specifically in the capacity of laggard economies to use knowledge developed abroad through imitation (Fagerberg, 1987). But, although the Fagerberg's (1987, 1988) perspective provides a source of growth and convergence, the advantages of backwardness are not limited to the positive effects of international diffusion of knowledge. They must be more accurately characterized as the combined effect of several economic mechanisms associated to the structural transformation of a backward economy occurred as economic development proceeds (see Abramovitz and David, 1995).

The 'advantages of backwardness' theory was initially developed for a national situation, inserted in an international background characterized by a "leader" country and other "follower" countries, but we can adapt it to a regional context with few small adjustments. Indeed, if a laggard region is not completely closed it can enjoy from four advantages in growth potential, according to Abramovitz and David (1995). First, differently from a leader region, which already uses state-of-the-art technology, in a laggard one the tangible capital is likely to be technologically obsolete and so, when the latter expands or replace its capital stock the new equipment can embody up-to-date technology. So, the laggard can realize larger improvements in the average efficiency of its productive facilities than are available to the leader. A similar rationale applies to potential advances in disembodied technology, and to the non-technological innovations (new forms of industrial organization and managerial practices, routines of purchasing, production and merchandising, etc.), of a laggard region. Knowledge spillovers play here an important role.

Also, because laggard regions have low levels of capital per worker, such circumstance, in particular considering the possibility to modernize capital stock, tends to increase marginal returns to capital and, so, to promote higher rates of capital accumulation. Additionally, because laggard regions often maintain relatively large numbers of redundant workers in farming and petty trade, with very low levels of productivity, the productivity growth can occur by shifting labour from agricultural to industrial jobs and from self-employment and family shops to business firms, even taking into account the cost of the

additional capital that might be necessary to maintain productivity levels in the new occupations.

Finally, the relatively rapid growth resulting from the first three sources goes towards fast growth in aggregate regional output and, consequently, in the scale of markets. This promotes the technical progress, especially the one that is dependent on larger-scale production. This sort of technical progress can disguise the lack of technological efforts to create new knowledge through R&D activity, inside boundaries of laggard regions. This is also a fertile soil for knowledge spillovers to play an important role.

To sum up, if a poor region trades with a rich economy, the economic growth in the poor one can increase by effect of the production factors and technology used but also by the occurrence of static and dynamic externalities, the latter operating through two basic ways: localized learning (e.g., learning by doing, learning by interacting) and as a result of the advantages of backwardness, which increase the propensity for profiting from positive externalities including the knowledge spillovers.

## 5. The model

This section presents a model that demonstrates the action of different types of externalities and allows determining the equilibrium conditions in a poor open region. The model is based on the following assumptions:

- 1) There are two regions,  $R$  (rich) and  $P$  (poor), indexed by  $j$ , one factor of production,  $L$  (labour), in fixed supply, and two sectors each one producing only one good  $i$ , with  $i = 1, 2$ .
- 2) Both goods, can display SE (static externalities), not necessarily in the same degree. This captures the idea that SE are not an automatic result of the type of sector (advanced or backward) but depend on the characteristics of the regional milieu. This permits to focus attention on modes of production as the crucial sources of externalities, instead of on the characteristics of goods or sectors. Accordingly, each good can be produced using two possible MoP (modes of production), which we call  $Cl$  and  $Is$ , “clustering” and “isolation”, respectively. These MoP differ in the extent to which they generate externalities: Only the  $Cl$  mode produces externalities.
- 3) There may be exogenous productivity differences across  $R$  and  $P$  regions in the production of good  $i$  (controlled by the productivity parameter  $y_{ij}$ ). This exogenous productivity parameter  $y_{ij}$  is independent of the mode of production used and, consequently independent of SE. The  $Is$  mode of production has labour productivity  $y_{ij}$ . That is, if there are no aggregate

externalities, good  $i$  is produced with constant returns to scale: a unit of labour produces  $y_{ij}$ .

So,  $y_{ijIs} = y_{ij}$ .

4) Although good  $i$  is produced with constant returns to scale at the firm level, the use of the *Cl* mode of production makes appear static externalities, and consequently an increase in the labour productivity, which, in steady state, equals to:

$$y_{ijCl} = y_{ij}\lambda_i \quad (1)$$

With the term  $\lambda_i > 1$  representing the maximum benefit of clustering in sector  $i$ . It captures the static, local, external economies (for short, SE).

5) As in similar models, we suppose that preferences satisfy the Inada conditions; consequently any equilibrium must have positive production of both goods.

6) For convenience goods are ordered in such a way that  $y_{2R} / y_{2P} \geq y_{1R} / y_{1P}$ , so that  $R$  has a natural comparative advantage in good 2. To simplify the exposition, the possibility that the static benefits of clustering are decreasing in  $i$  is excluded. This means that  $(y_{iR} / y_{iP})\lambda_i$  is higher for good 1 than for good 2. That is, we exclude the possibility that the sector in which  $R$  has a Ricardian comparative advantage has much lower capacity of generating externalities.

7) Because we assume that  $P$  is “open” and “small,” the international prices can be derived from the equilibrium of  $R$  region, as if the latter was a single economy. If we choose labour in  $R$  as the numeraire, international prices will be simply given by the requirements of labour

units in  $R$ . So the prices will be:  $p_i^* = \frac{1}{y_{iR}}$  if there is no (static) externality and  $p_i^* = \frac{1}{\lambda_i y_{iR}}$ , if

there is a static externality. The latter shows that clustering causes a lower international price of good  $i$ , eroding in this way the benefits of the *Cl* MoP.

Theoretically,  $R$  economy can opt either by allocating all labour to the *Cl* MoP producing each good with productivity  $(y_{iR}\lambda_i)$  higher than the one associated with the *Is* mode of production  $(y_{iR})$  or by placing all labour on the *Is* mode of production<sup>6</sup>. If we assume, in order to simplify the analysis, that there are clusters in all sectors of  $R$ , equilibrium

prices can be written as  $p_i^* = \frac{1}{\lambda_i y_{iR}}$ .

Focusing on  $P$ , several situations can occur. Table 2 shows these situations.

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<sup>6</sup> Also in this case, productivity will be higher than with the *Cl* MoP, which would be zero since no labour is allocated to the *Cl* MoP.

Table 2. Possible equilibria with static externalities in P (poor region)

	Specialization of P	Income gap
No comparative advantages and $\lambda_i = \lambda$	<ul style="list-style-type: none"> <li>P specializes in a sector with a cluster (it could be either good 1 or good 2)</li> <li>No trade and no clusters in P</li> </ul>	<p>No income gap between R and P  <i>(i.e., <math>\frac{1}{w} = 1</math>)</i><sup>*</sup>  <math>\lambda &gt; 1</math></p>
Comparative advantages and $\lambda_1 \neq \lambda_2$	<ul style="list-style-type: none"> <li>Complete specialization in sector 1 with <i>Cl</i> MoP</li> <li>P specializes completely in sector 1, which uses the <i>Is</i> MoP</li> <li>P specializes completely in sector 2. This would only happens if good 2 was produced with <i>Cl</i> MoP and if <math>\frac{y_{1P} / y_{1R}}{y_{2P} / y_{2R}} &lt; \lambda_1</math></li> </ul>	<p><math>y_{1R} / y_{1P}</math>  <math>\frac{\lambda_1 y_{1R}}{y_{1P}}</math>  <math>&lt; \lambda_1 (y_{1R} / y_{1P})</math></p>

<sup>\*</sup> Where  $w$  denotes the wage in  $P$ .

Table 2 summarizes possible equilibria in a (small) poor region where static externalities are present. It embodies two situations. First, the inexistence of comparative advantages together with equal externality intensity across sectors. In this case, we face two possible equilibria: one equilibrium where  $P$  specializes in a sector with a cluster from which results no income gap between  $R$  and  $P$ ; the other is an isolation situation, no clusters and no trade in the  $P$  economy. Second, if we assume different comparative advantages and different externality intensity there are three possible equilibria in  $P$ . 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. This is an equilibrium if, and only if, nobody wants to deviate and produce good 1 with the *Is* MoP. What are the conditions needed to this equilibrium?

In order to derive conditions for this equilibrium, consider that if  $P$  specializes in sector 2 with a cluster, then it must be that the unit cost of good 2 produced in  $P$  without a cluster would be equal to the international price of good 2. That is:

$$\frac{w}{\lambda_2 y_{2P}} = p_2^* = \frac{1}{\lambda_2 y_{2R}} \quad (2)$$

Where  $w$  denotes the wage in  $P$ .

And consequently,  $w = (y_{2P} / y_{2R})$ .



On the other hand, the unit cost of good 1 produced in  $P$  without a cluster would be  $\frac{w}{y_{1P}} = \frac{y_{2P}/y_{2R}}{y_{1P}}$ . For complete specialization in good 2 with a cluster to be an equilibrium, it is necessary that its unit cost be higher than the international price of good 1,  $p_1^*$ , or:

$$\frac{y_{2P}/y_{2R}}{y_{1P}} > \frac{1}{\lambda_1 y_{1R}} \quad (3)$$

And, rearranging condition (3), we have:

$$\frac{y_{1P}/y_{1R}}{y_{2P}/y_{2R}} < \lambda_1 \quad (4)$$

Condition (4) shows that for complete specialization in good 2 with the  $CI$  MoP to be an equilibrium it is necessary that comparative advantage in good 1 relatively to good 2 be weaker than the benefits of the externality in production of good 1.

As is visible from table 2, the equilibrium with specialization in good 2 has an intermediate level of income, while the highest income level is associated to the good 1 produced with the  $CI$  MoP, where  $P$  has a comparative advantage. Of course, the equilibrium with specialization in a sector without clustering generates the lowest income level. It is also apparent in table 2 that  $\lambda_2$  does not affect income when  $P$  specializes in good 2 with  $CI$  MoP. The reason for this no interference is that the higher productivity generated by the stronger static externalities in sector 2 is exactly compensated by a lower international price.

So we can take a first conclusion: the power of static externalities is not significant for the choice among equilibria. If policy tries to maximize welfare, it must choose among the possible equilibria one with clustering, but the choice must not be exclusively guided by the greatness of external economies. The target would be the sector with highest externalities if, and only if, the strongest comparative advantage corresponds to this sector. Otherwise, policy makers must opt by the sector with the strongest comparative advantage, irrespective of the dimension of positive externalities. But, this conclusion was made only with base on the presence of static externalities. Can the dynamic externalities and international spillovers alter these results? To answer this question we need to introduce some additional assumptions. The key one is that production with the clustering MoP generates both static as well as dynamic externalities.

To take in account the effects of dynamic externalities, we introduce an additional productivity variable,  $Z_{ijt}$ , which increases with time,  $t$ , thanks to dynamics externalities. Just as with  $y_{ij}$ ,  $Z_{ijt}$  is independent of the MoP used, but dynamic externalities are produced only with the  $Cl$  and their amount depends on the type of economy. Accordingly, labour productivity across sectors is now also multiplied by this variable,  $Z_{ijt}$ .

So, if there is no trade between regions, production with the  $Is$  MoP generates no dynamic externalities whatever the sector, whereas production with  $Cl$  generates external but sector-specific dynamic economies, which lead to increasing productivity in manufacturing. For instance, in  $R$  economy, in steady state, with the  $Cl$  MoP,  $Z_{ijt}$  grows at an  $x$  rate (i.e., we have  $\frac{\dot{Z}_{iRt}}{Z_{iRt}} = x$ , where a dot above the variable means the time derivative of the same variable).

However, if we consider interregional trade, poor region may be able to benefit also from the advantages of backwardness as exposed in the previous section. In this case, in steady state, the  $Z_{ijt}$  growth in  $P$  is added with  $\hat{z}$  (i.e.,  $\frac{\dot{Z}_{iPt}}{Z_{iPt}} = x + \hat{z}$ , if we define  $\hat{z}$  as  $Z_{iPt} / Z_{iRt}$ ).

In other words, if there is interregional trade, productivity increases caused by dynamic externalities in one economy eventually diffuse to the other economy even if there is not a cluster there. Thus, in this model, clusters are important to generate knowledge but benefiting from knowledge (knowledge spillovers) is independent of the MoP. Profiting from these benefits only depend on the technology gap between  $P$  and  $R$ . Suppose for concreteness that  $R$  has a cluster in sector  $i$  but the  $P$  does not. Then it is assumed that the rate of growth of the productivity variable  $Z_{iPt}$  is governed by:

$$\frac{\dot{Z}_{iPt}}{Z_{iPt}} = \hat{z} \quad (5)$$

But if besides the technology gap there is also a cluster in  $P$ , we have:

$$\frac{\dot{Z}_{iPt}}{Z_{iPt}} = x + \hat{z} \quad (6)$$

Focusing on the right hand side of equation (6), the first term captures learning by doing, whereas the second term captures the spillovers coming from the advantages of backwardness.

Given these assumptions governing dynamic externalities and catching up, if  $P$  does not have a cluster in sector  $i$ , its labour productivity in steady state would be  $y_{iP}Z_{iPt} = y_{iP}\hat{z}Z_{iRt}$ , at time  $t$ . In contrast, the  $R$ 's productivity in sector  $i$ , where we are assuming a cluster exists, would be  $y_{iR}\lambda_i Z_{iRt}$ . Thus, the ratio of productivities in  $R$  versus  $P$  in sector  $i$  under these circumstances would be  $(y_{iR}/y_{iP})\lambda_i(1/\hat{z})$ . The first term captures the comparative advantage (i.e., pure Ricardian productivity differences) whereas the second and third terms capture the impact of the static and dynamic benefits of clustering, respectively.

To draw lessons from this model we have to analyse the steady state equilibrium in  $P$ , considered as a small open economy (region). Since  $P$  is a small region, prices are derived from the equilibrium in  $R$  as if this was an isolated economy. Assuming for simplicity that the  $R$  has clusters in all sectors, the steady state equilibrium in  $R$  has productivity given by  $y_{iR}Z_{iRt}\lambda_i$  in sector  $i$  at time  $t$ . Thus, steady state international prices are:

$$P_{it}^* = \frac{1}{y_{iR}Z_{iRt}\lambda_i} \quad (7)$$

Considering the poor region, several situations can occur. Table 3 summarizes these possible situations where both static and dynamic externalities are present.

Table 3. Possible equilibria in a Poor region with dynamic externalities

Specialization	Income gap
Without comparative advantages and with $\lambda_i = \lambda > 1$	
• $P$ specializes in a sector with a cluster	No income gap
• $P$ has no clusters, there is no trade, and $Z_{iPt} = \hat{z}Z_{iRt}$	Income gap is given by $(\lambda/\hat{z}) > 1$ .
With comparative advantages and with $\lambda_1 \neq \lambda_2$	
• $P$ is specialized in good 1 with a cluster	$y_{1R}/y_{1P}$
• $P$ is specialized in good 1 with no cluster	$(\lambda_1/\hat{z})(y_{1R}/y_{1P})$
• $P$ is specialized in good 2 with a cluster	$<(\lambda_1/\hat{z})(y_{1R}/y_{1P})$

Imagine first that there are no comparative advantages, i.e.,  $y_{ij} = 1$  for all  $i, j$  and also that  $\lambda_i = \lambda > 1$  for  $i=1, 2$ . In this case two equilibria are possible. First, there is an equilibrium where  $P$  specializes in a sector with a cluster (in which case there would be no income gap). Second, an equilibrium where  $P$  has no clusters, there is no trade, and  $Z_{iPt} = \hat{z}Z_{iRt}$  for all  $i, t$ .

Thus, in the *Is* MoP equilibrium the income gap is given by  $(\lambda/\hat{z}) > 1$ . The term  $\lambda$  captures the benefits of static externalities, while  $1/\hat{z}$  captures the benefits of dynamic externalities (although restricted by the advantages of backwardness). If the *P* region moves from the isolated MoP to an equilibrium with a cluster in sector *i*, 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  $Z_{iPt}$  above  $x$ . Clearly, in this case,  $Z_{iPt}$  would eventually converge to  $Z_{iRt}$  and the income gap would disappear.

With comparative advantages and differences in the intensity of static externalities across sectors (i.e.,  $\lambda_1 \neq \lambda_2$ ), the set of equilibria is analogous to the set of equilibria derived in the model without dynamic externalities: a) there is an equilibrium where *P* is specialized in good 1 with a cluster and the income gap corresponds to the ratio between exogenous productivity in the production of good 1 ( $y_{1R}/y_{1P}$ ); b) another equilibrium where the *P* is specialized in good 1 with no cluster, in this case the income gap is  $(\lambda_1/\hat{z})(y_{1R}/y_{1P})$ ; accordingly, both *R* and *P* grow at the same rate, so there is no convergence. Convergence would occur if *P* managed to develop clusters, so that it too could generate both static and dynamic externalities. c) and finally, there is another equilibrium where *P* is specialized in good 2 provided that it satisfies a condition equivalent to condition (4):

$$\frac{y_{1P}/y_{1R}}{y_{2P}/y_{2R}} < \frac{\lambda_1}{\hat{z}} \quad (8)$$

That is, if condition (8) is satisfied: the ratio of comparative advantages is less than the combined effect of externalities.

To summarize, the results obtained with the static externalities remain valid when we move to a more realistic setting with dynamic externalities including the external economies derived from the “advantages of backwardness”. Regions with no clusters suffer from the lack of both static and dynamic externalities. There are multiple equilibria, and the equilibrium with the highest welfare in a poor region is the one where there is clustering in the sector with the strongest comparative advantage. Policy should focus on promoting clustering in this sector and avoid price distortions.

There are important implications of these results regarding the income gap of the different equilibria. As expected, if the government could choose the equilibrium, it would always choose equilibrium with clustering, but it would also choose equilibrium with

specialization in the sector with the strongest comparative advantage; the power of externalities is not relevant for the choice among equilibria.

## **6. Conclusion**

This paper revolved around a paradox: why so many policy makers use the competitiveness rhetoric inspired in the competitive advantages of Porter but, in practice, go on using the industrial targeting that is opposed to Porter's arguments? The answer to this question is closely associated to the policy makers' faith on the superiority of clusters over the isolation MoP, given the expected association between positive externalities and clusters. However, this faith has some weaknesses: our literature review shows that both the cluster concept is usually poorly defined and very often some cluster characteristics, which are difficult to be manipulated by policy, are overlooked (spontaneity, informality, tacit knowledge, etc.). The vagueness in the definition of cluster concept enforced by the appealing of the "cluster brand" drives to an exaggerated voluntarism in cluster policy and to the use of the traditional industrial policy targeting externality friendly activities.

Also the association between positive externalities and clusters is overemphasized. Not only because usually only positive externalities are considered but also, and more importantly, given the difficulty in computing the dimension of the externalities usually they are assumed instead of computed. However, in spite of this difficulty, policy acts as if externalities were the decisive factor in guiding regional cluster policy, using external economies as a justification to promote activities that have shown externalities elsewhere independently of the regional context. But, in this context a question is imperative: Should policy promote the creation of new clusters in activities that have verified large positive effects elsewhere or, conversely, be focused on developing the traditional activities embedded in the region, which allegedly have shown lower externalities?

In order to answer the above question, our paper has made an analysis of possible static and dynamic externalities and includes them in a model that allows for trade with other regions. Often externalities are associated to more advanced sectors and consequently policy should target these sectors, to benefit from stronger externalities. In contrast, since we are dealing with externalities that arise from the clustering process, and this is assumed as territorially grounded, our model considers externalities as not associated to the characteristics of the sector but, on the contrary, originated from the way a good is produced.

The model presented here shows that it is the traditional comparative advantage approach that must go on guiding policy. The main policy implication of this finding is that the strength of positive externalities does not matter in choosing which clusters to promote. This has an additional implication: governments should not try to create entirely new clusters, as already stated by Porter.

To sum up, when a region has a comparative advantage in producing a good or in a sector, promoting an entirely new cluster in other sector may be inferior to non-intervention, and is always dominated by the promotion of a cluster in sectors where the region is already showing comparative advantage. Additionally, our model shows that it is not the case that governments should support clustering in industries with stronger externalities, since such stronger externalities lead to higher productivity and hence to lower international prices.

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