



Impact of the Types of Clusters on the Innovation Output and the Appropriation of Rents from Innovation

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Abstract

The ability to generate innovations and capture the rents from innovation are important for firms' competitive advantage. Increasingly firms seek knowledge abundant locations, or industry clusters, to access novel knowledge and generate innovations through knowledge recombinations (Schumpeter, 1934). We examine how different types of clusters impact on the innovation output, the knowledge flows among the clustered firms and, ultimately, on who captures the rents from innovation. The type of cluster reflects the configuration of firms and the interactions among firms, individuals and agencies in the cluster and is likely to be a major driver of both the innovative output and of which firms will be more likely to capture the rents from innovation. Extant research has noted that the social and business networks binding firms in clusters are excellent vehicles for the flow of knowledge that eases innovations, but different types of clusters may lead to different outcomes.

Keywords: clusters; types of clusters; innovation; appropriation of rents; innovation rents.

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Introduction

Contemporary research has been placing knowledge as the core source of firms' competitive advantage and competition among firms as relying increasingly on knowledge and innovation (Grant, 1996; McGrath, et al., 1996; Teece, 1998, 2000; Argote and Ingram, 2000; Tallman, et al., 2004; Maehler, et al., 2011). Firms may develop knowledge and innovations in a number of different manners. They may develop internally new business and R&D capabilities, acquire it from competitor firms through acquisition of an incumbent firm, or absorb it from external agents. One stream of research that has continuously developed over the past fifty years has dealt with industry clusters, or agglomerations, as locations of excellence to absorb novel knowledge (Pinch, et al., 2003; Tallman et al., 2004; Saraceni and Andrade Júnior, 2012). This line of research may probably be traced back to Marshall's (1920) work and had grown into a substantial number of scholars questioning why and in which conditions similar firms, or firms operating in the same industry co-locate. Firms cluster geographically to benefit from the availability of a quality labor pool, complementary industries and services and suppliers, and to access knowledge flows that facilitate the gestation of novel ideas (Krugman, 1991). Indeed, to generate more innovations and absorb knowledge not yet held, firms seem to increasingly seek to locate in knowledge rich regions (Saxenian, 1994; Pinch, et al., 2003), such as many industry clusters around the world. The examples of such clusters are plentiful, in the more diverse industries and countries, but Silicon Valley in the US, the Formula one cluster in the UK, the tiles industry in Italy, the oil cluster in Houston, US, and the financial centers of London, in the UK, and New York, in the US, the Port wine cluster, in Portugal, are probably among the best known cases. Several regions and countries in the US, Europe and other regions follow industry cluster-based development strategies.

Extant research on industry clusters has advanced remarkably over the last decades. Most notably, research on clusters and on the national innovation systems has clarified many benefits of co-location, or proximity, the potential for traded and untraded dependencies, and scale and scope economies that build on Marshall's (1920) original ideas. Extant research has also focused on public policy implications namely delving into how creating industry clusters may be a mechanism to revitalize regional and national economies and modernize the industrial structure (Krugman, 1991; Porter, 1998). On entrepreneurship, scholars have noted that clusters are often rich spots for new firms foundation (Rocha, 2004; Ferreira, Tavares and Hesterly, 2006). Broadly, this research has had a few common elements and especially the focus on the firms' and the entrepreneurs' networks (Saxenian, 1994; Bas, Amoroso and Kunc, 2008).

However, despite the now long debate on the role and benefits of clusters and the equally extensive work on innovation, with a handful of exceptions the extant research has largely failed to probe on the actual innovation output gestated in clusters and on the firms that capture the returns from the innovations (see also Ferreira, et al., 2012). For instance, industry clusters do not have a common configuration (Markusen, 1996; Romanelli and Khessina, 2005) and it may be that different types of clusters impact differently both the innovative output and the innovators' ability to capture the benefits from the innovations.

In this paper we seek to complement and extend previous research on industry clusters and innovation. In specific we focus on how the different types of clusters – for which we use the typology advanced by Markusen (1996) - influence the rate and type of innovations and which firms will be more likely to capture the rents from innovation. Specifically, we suggest that we need to look into the characteristics of the cluster to observe how the flows of communication, information and knowledge and workers occur among firms co-located. If not all clusters are alike it seems reasonable that no single answer exist. The implications of this study extend to firms, since they are concerned with appropriating the benefits from their innovations, to public policy makers in designing policies to promote cluster formation and thus it does matter the type of cluster promoted, and to managers in deciding whether to locate, or not locate, in each type of cluster.

This paper is organized as follows. First, we review relevant literature on innovation and on industry clusters, namely highlighting the argument that clusters are locations of unusually high innovation activity. Then, we move to present Markusen's (1996) typology of industry clusters to discuss how different types of clusters are likely to have differentiated impact on the innovation output and on which firms will be more likely to capture the future returns accruing from innovation. We conclude with a broad discussion, implications and presenting avenues for future scholarly inquiry.

Innovation, rents and clusters

Firms across the world strive to innovate as innovation outputs are the sources of future returns. In this paper we take Schumpeter's (1950) and Henderson and Clark's (1990) definition of innovation as any (re)combination of existing and/or new resources and/or technologies that have the potential to generate rents for the entrepreneur. Levin, et al (1987: 783) also noted that "[t]o have the incentive to undertake research and development (R&D), a firm must be able to appropriate returns sufficient to make the investments worthwhile". Schumpeter (1950) suggested that it is through innovation that firms renew their assets base, and Amit and

Schoemaker (1993) that the inimitable, idiosyncratic assets are the basis of the firm's competitive position. Innovation thus, and specifically the ability to innovate and benefit from it, is essential in the competitive arena. Moreover, innovation ability is a primary source of competitive capacity.

However, innovating *per se* is not sufficient and firms need to capture the benefits from innovation to succeed and continue innovating (Bowman, 1974; McGrath, et al., 1996). Under conditions of "imperfect appropriability" firms will under-invest in new technologies, with well-known implications for welfare and economic development. Extant research has mainly focused on the issue of appropriation of rents by emphasizing the speed of imitation by rivals (as per Schumpeter, 1950; Teece, 1998, 2000; Gould, 2012; Ferreira, Serra and Maccari, 2012). In this view, firms' failure to capture rents from their innovations would be simply a function of both the ease of replication and the efficacy of protection mechanisms as barriers to imitation. Studies departing from this perspective emphasize the speed of imitation by competitors. The speed of imitation by competitors is a function of several characteristics: (a) potential rate of return of the innovation (depicted as the incentive to imitate by Hill, 1992), (b) effectiveness of the protection mechanisms such as patents (or barriers to imitation, according to Hill, 1992), (c) rivals' ability to imitate (Hill, 1992) or their skills, routines, (Nelson and Winter, 1982), resources (Barney, 1991), and complementary assets (Teece, 1986, 1997), (e) rivals' technological relatedness (or technological distance, Tallman and Phene, 2002), (f) competitors access to the details and knowledge involved in the innovation, (g) nature of the knowledge involved in the innovation (e.g., tacit or explicit, Winter, 1987; Polanyi, 1967), and (h) ease of transfer of the innovation and/or knowledge across organizational boundaries (Kogut and Zander, 1992, 1993; Maehler, et al., 2011).

Research on industry clusters is thus largely limited to noting how each of these factors is compounded when the innovator firm is located in an industry cluster. Hence is it worth noting that while clustering may favor innovation, clustering may also be an inappropriate decision for the appropriation of the rents from innovation (Pouder and John, 1996; Breschi, 2000). It is likely that when embedded in a network of social and business relationships with other firms, which is typical of co-located firms (Saxenian, 1994; Porter, 1998, 2000), the innovator may find it more arduous to appropriate the full returns that accrue from innovation. Moreover, the configuration of the cluster itself may matter in this equation.

Innovation in clusters

Clusters, also called industry clusters, industrial districts or geographic agglomerations, are conceptualized, in this pa-

per, as a set of firms operating in an industry, and related activities, located in geographical proximity in a region and with possibly extensive interactions which has the potential benefit of augmenting the firms' competitive advantages and improving the economic development of the region. Rosenfeld (1997: 10) defines a cluster as "a geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue, that share specialized infrastructure, labor markets and services, and that are faced with common opportunities and threats". Krugman (1991), Porter (1998) Shaver (1998), among several other scholars, have shown that there are significant benefits from clustering of firms in a delimited geographic space, following Marshall's (1920) work on economic externalities. Doeringer and Terkla (1995: 225) argued that the sole definition of industry clusters is "geographical concentrations of industries that gain performance advantages through co-location" (*italics added*). Porter (1998) conceives clusters as a concentration of related firms, suppliers, service providers and institutions connected to a certain industry, that are tied by common externalities that emerge from being embedded in a cluster. The clustering benefits accrue from the concentration of competitive and cooperative firms in related activities, up and downward the value chain, in a certain location (Saxenian, 1994; Porter, 1998).

Krugman (1991) noted that clustering benefits have elements of a self-perpetuating system due to the industry growth in that area that makes it ever more attractive for other firms to co-locate (see also Driffield and Munday, 2000). These benefits emerge on the form of agglomeration economies that may entail specialized factor inputs, supply of intermediate products and access to infrastructures (see also the work by Marshall, 1920; Porter, 1990). Other benefits of clustering may be characterized using institutional theory (Meyer and Rowan, 1977) and may be described as a quest for legitimacy. What it means is that by clustering in known clusters in a certain expertise firms may benefit from reputation, status and legitimacy spillovers, in addition to the knowledge or technology spillovers that take place due to the mobility of works and the social and business interactions among agents (Jaffe, et al., 1993, Saxenian, 1994; Porter, 1998; Ferreira, et al., 2006; Ferreira, et al., 2012). Finally, the benefits accruing from the relative abundance of resource endowments (Marshall, 1920; Wheeler and Mody, 1992; Saraceni and Andrade Júnior, 2012).

Clustering advantages are likely to be important in the context of innovation, technological changes, and the appropriation of rents accruing from R&D and innovation efforts. Porter (1998, 2000), for instance, argued that it is the competition between rival firms in the cluster that drives growth because it forces firms to be innovative, improve and create

new technology. Pouders and John (1996) refer to clusters as 'hot spots' of unusually high entrepreneurial activity, stimulating R&D and the introduction of new skills and services. One of the most highlighted features of clusters is the social interaction and inter-firm cooperation in the cluster (Saxenian, 1994; Doeringer and Terkla, 1995; Jacobs and DeMan, 1996; Porter, 1998; Driffeld and Munday, 2000; Balbinot et al., 2011). In terms of competition and maintenance of knowledge in-house, the clustering of firms presents interesting challenges. Verspagen (1999), for example, noted that the most important element in innovations developed in clusters is the social and business networks binding employees, managers and firms. Through networking with other firms, with both different and complementary specializations, the innovative potential increases and more innovations are likely to be gestated. Clustering increases the likelihood of knowledge spillovers (both intended and unintended spillovers) among clustered firms (Jaffe, et al., 1993; Ferreira, et al., 2012). Thus, the potential for new innovations is likely to be higher within clusters, where various firms are located and multiple resources, knowledges, and capabilities come into contact, than outside clusters. In sum, all these arguments and the received wisdom seem to point out to the reasoning that clusters are areas of munificent innovation. Or in a broad proposition forms: firms in clusters are more likely to be more innovative than firms that are not clustered, or in a cluster.

Appropriating rents in clusters

The social and business interactions that promote innovation in clusters may also make it harder for firms to protect their knowledge. According to Ferreira, Serra and Maccari (2012), co-located firms may face higher obstacles to the appropriation of innovation rents. Conversely, firms that are located outside the cluster, and thus more isolated from rivals, may find it more difficult to develop innovations, but once developed they will probably be able to keep knowledge in-house, maintaining secrecy and preventing unintended transfers of knowledge. In the clusters, these knowledge transfers occur rather naturally through the repeated interaction of employees, owners, managers and scientists (Pouders and John, 1996). It is this ease in the appropriation of returns from innovation for firms outside clusters that may have led to some conclusions that the best firms do not benefit from co-location (e.g., Shaver, 1998; Pouders and John, 1996).

The rationale here exposed, see also a recent work by Ferreira, et al. (2012), would lead to a proposition that could be spelled out in a quite straightforward manner as: the innovator firms are less likely to appropriate rents accruing from innovation if they are located in a cluster, than if located outside the cluster. In sum, clusters promote innovation through the technology and knowledge transfer among firms, the de-

velopment of a skilled labor force in related industries, and the social infrastructure. However, the same network ties that bind clustered firms and ease innovation also contribute to make knowledge a semi-public good, hindering the innovator firm from keeping the innovation internalized, thus impeding the innovator from capturing the full rents from its innovation.

What this traditional scrutiny does not do is to consider how the types of clusters matter for this dynamic. However, it seems reasonable to suggest that in some types of clusters there may not exist the same form of collaborative and "neighboring" environment. Furthermore, some clusters are clearly dominated by one firm over others, and extant research has not introduced how different power balances may partly drive both the innovative output and firms' relative ability to capture innovation rents. In the following section we use Markusen's (1996) typology of clusters to suggest a complementary interpretation of these phenomena. In doing so, we will use rather extensively and freely from Markusen.

Types of clusters and innovation

The extant research has to some extent overlooked that there are various types of clusters and each type actually entails profoundly different configurations, forms of collaboration and competition among firms co-located. It is likely that the innovation output and the hazards in appropriating the rents differ among types of clusters. That is, when focusing on industry clusters and understanding innovation and rents, we may need explanations that are beyond the speed of imitation by competitors. To each type of cluster corresponds a different model of organization of firms, who are the dominant firms, the type of ties connecting firms, the strength of the ties among entrepreneurs and employees operating in the cluster, forms of governmental intervention, and so forth. We thus now turn to discuss how these characteristics are important for the innovation output and the ability to capture the rents from innovation.

In this paper we use Markusen's (1996) distinction of four types of industrial districts: the marshallian and Italianate type, the hub-and-spoke, the satellite industrial platforms, and the state-anchored clusters. This typology is particularly suited for our analysis since Markusen's descriptive typology specifies various criteria such as (a) the configuration of firms, (b) internal or external orientation, or the embeddedness of firms within their cluster and with agents outside the cluster, (c) governance structures, (d) the role of the state, (e) the role of large firms, and (f) extent of cooperation and types of business relationships. These criteria are well suited for our ensuing analysis. Notwithstanding, it is worth noting at the outset that there are other typologies, that there may

exist variants within each of the four types of clusters and that other competing typologies of clusters will probably draw from many of the features that Markusen's typology entails. That is, while we use Markusen's typology, it is likely that most of the existing classifications hold many common features. For instance, Enright (2000) put forward a typology of five cluster types: working or overachieving clusters; latent or underachieving clusters; potential or wannabe clusters; Policy driven clusters; and 'Wishful thinking' clusters.

Markusen's (1996) four types of clusters are briefly characterized in the following table.

Marshallian clusters

The Marshallian industrial districts are seemingly the most well studied types of clusters, mostly because these correspond to Marshall's (1920) view and are the most abundant type in Europe; where there is a long tradition of studying regional clusters and innovation systems and policies. The Marshallian clusters are composed of multiple small, innovative and locally-owned firms that are deeply embedded in local and regional ties to other co-located firms in a broadly cooperative governance system, which favor their survival and adaptation. The intra-cluster exchanges are dense and the employees move frequently across firms but within the cluster. In fact, these firms do not have many ties to firms

outside the cluster, at least in Marshall's original formulation (albeit newer version of the Marshallian clusters have been formulated – see, for instance, Bellandi, 1989; Sforzi, 1989; Bull, Pitt and Szarka, 1991). Furthermore, a high degree of cooperation among competitor co-located firms who share risks, costs, and innovations and an idiosyncratic local culture are major traits of this type of cluster. Inter-firm cooperation in these clusters does not need to be purposeful, rather it emerges from proximity and because of the flow of workers between firms.

This type of cluster poses many indications that there will be frequent small product and process innovations, originated in the social and business interactions among small and innovative firms. Most notably the employee mobility across firms in the region make knowledge resemble a "local public good" – as Markusen (1996: 299) expressed "the secrets of the industry are in the air".

In terms of capturing the rents from innovation the situation is far more complex. First, small firms are less likely to protect their innovations through patents. Second, the innovations are often small and fairly explicit - they involve minor adjustments to the product or process, and the innovator is unable to extract additional rents from clients. Third, when the innovations are more "visible" it is possible that the social control mechanisms allocate a substantial share

Cluster type	Characteristics of member firms	Intra-cluster interdependencies	Prospects for employment
Marshallian	Many small, innovative, medium-sized and locally-owned firms well embedded in the regional social dynamics.	Substantial inter-firm transfers, joint R&D efforts, pool of assets for fulfilling clients' orders, in a milieu munificent in institutional support.	Dependent on the dynamism of the cluster given external evolutions. Regional entrepreneurship.
Hub-and-spoke	One, or a few, large firm – possibly oriented to external markets - that is surrounded by many small suppliers and service provider firms.	Large firm(s) dictate the terms of the business relations with the smaller firms in the surroundings. Few interactions among spoke firms that are focused on their ties to the hub firm.	Dependent on the evolution and success of the large hub firm(s).
Satellite	Driven by branch-plants – possibly subsidiaries of large multinationals.	Low level of inter-firm contact and very limited inter-firm ties in the cluster.	Depends on the growth of the branch plants and the success of the public policies adopted to attract more firms.
State-anchored	A government owned or supported, usually not for profit, entity surrounded by related suppliers and service firms.	The anchor institution is central to the majority of the inter-firm ties but there may coexist significant exchanges among co-located firms.	Depends on the public policy and the relative ability of the anchor institution to attract additional political support and funding.

Table 1. Markusen's typology of clusters

of any additional rents to the innovator. Fourth, because the firms in the cluster share a similar architectural knowledge (Tallman, et al., 2004) they have similar absorptive capacity and are easily able to understand and implement small innovations. Nonetheless, the expectations for inter-firm cooperation (see the work on open innovation by Gould (2012) and Lewrick, Raeside and Pelsi, (2007) on the innovators' networks) are likely to apply also in terms of sharing rents from innovation, and hence it is not likely that the innovator will capture more than a "fair" share of any innovation rents. Hence, the high degree of inter-firm cooperation and the social expectations for firms' behavior regarding the sharing of costs, risks and innovations, render that rents from innovations will be shared by the firms in the cluster.

Proposition 1.a. Marshallian-type clusters are likely to generate essentially small product and process innovations.

Proposition 1.b. Firms in Marshallian-type clusters are likely to appropriate a small part of their innovation rents that are shared with the other firms in the cluster.

Hub-and-spoke districts

The hub-and-spoke type clusters have one, or a few, dominant and externally oriented firms surrounded by multiple smaller suppliers. Two well documented examples of this type of cluster include Seattle, in the US (Boeing) and Toyota City, in Japan (Toyota). Albeit the specific configuration of this type of cluster may vary (see Markusen, 1996, for a discussion) the dominant firm(s) have extensive ties to suppliers, competitors and clients outside the cluster. Moreover, employees' mobility is substantially lower than in the Marshallian type, and the hub firm imposes the terms of the exchanges with the local spoke firms. For example, Dyer and Nobeoka (2000) noted how Toyota assumes a dominant position and controls the flow of resources in the region. Furthermore, the innovations generated seem to be specifically tailored to Toyota's needs and to at least some extent driven by Toyota itself, even if Toyota is not the innovator. Rather Toyota brokers the transfer of technologies between firms from which it is able to capture a share of the rents.

In this type of cluster the central hub firm(s) is surrounded by many small firms over which it exerts a dominating position and market power that allows it to tie clients and suppliers in long-term contracts. When more than one dominant firm resides in the hub-and-spoke cluster, such as is the case in Seattle, in the US, where three large multinationals - Microsoft, Boeing and Weyerhaeuser - coexist, there may be a low degree of cooperation among dominant firms in sharing risk and costs of innovations. However, it is likely these dominant firms will be tied by supply ties, where, for example, Microsoft serves Boeing with tailored software. Most

important are the ties of these firms to firms outside the cluster, even because the regional economy cannot absorb but a small part of these firms output.

Innovation in these clusters is mainly driven by the hub firms. These are large firms that have the capacity to patent any significant innovation to protect the property rights and that have the financial resources to enforce their rights. Furthermore, the employees' mobility is fairly low. Hence, the distinguishing feature of the Marshallian clusters - the extensive inter-firm cooperation and intended and unintended knowledge transfers - is absent from the hub-and-spoke type of clusters. Without employees exchange, knowledge flows considerably less between firms. In this type of cluster, the dominant hub firm is more likely to have developed in-house the innovation or to have it contracted in the market, but keeping any rights to potential future benefits. Therefore, it is likely that the hub firms will be able to capture the rents from innovations, whether these innovations were generated in-house or by a small, and non-dominant, supplier.

Proposition 2.a. The dominant firms in hub-and-spoken-type clusters are likely to drive the innovations generated, whether they are developed in-house or by other independent firm in the surrounding milieu.

Proposition 2.b. The dominant firms in hub-and-spoke-type clusters are likely to appropriate the majority of the rents from innovation, regardless of whether they developed the innovations.

Satellite platform clusters

The satellite platform clusters consist of an "assemblage of unconnected branch plants [subsidiaries of multinational firms] embedded in external organizational links" (Markusen, 1996: 293). Often these types of clusters are the outcome of public policy measures to attract foreign multinational corporations. These may be high-technology firms or firms that seek to exploit the low cost of local resource endowments (e.g., labor) but are generally large, foreign-owned subsidiaries of multinational corporations. The case of the clustering of unrelated research facilities of large multinational corporations in the Research Triangle Park, in North Carolina, in the US, is an example of this type of cluster (Markusen, 1996).

The satellite platforms are dominated by large and almost completely externally oriented firms. These firms have minimal intra-cluster exchanges in favor of stronger ties to the parent headquarters and other sister subsidiaries elsewhere. Therefore, firms located in satellite-type clusters are fairly detached from local agents. Hence, the source of knowledge for the innovations is likely to be developed in-house and

not require local content, rather it comes from the headquarters and sister subsidiaries through the exchanges of personal within the corporation that facilitates the recombination of knowledge acquired in multiple sites in the world. Interestingly it is reasonable to suggest that these firms may generate a substantial amount of innovations. Many of these branches were set up with a research purpose. Given that these firms are largely stand-alone operations, with scarce exchange flows with other co-located firms, imitation is more difficult. Hence, we suggest that in these instances, it is the innovator that will appropriate a very large share of the rents accruing from innovation.

While we addressed a specific type of satellite platform cluster – the research-oriented type - some satellite platforms have no research purpose whatsoever. For example, the region of Manaus in Brazil flourishes based on tax benefits. However, we should also point out that in these cases, innovation and appropriation of rents from innovation are not a concern.

Proposition 3.a. Firms in satellite platform-type clusters are likely to generate innovations independently in-house or with other sister subsidiaries.

Proposition 3.b. Firms in Satellite platform-type clusters are likely to appropriate the full rents from their innovations.

State-anchored clusters

The fourth type is one of the most interesting types of clusters to examine since it is often acclaimed by governments as a developmental path. Public officials often seek to promote clusters - state-anchored clusters - through location decisions of a major research center, a university, a military base, and so forth. These clusters are centered on one, or more, public institutions that anchor the local economic activity. The nature and scope of the local economic activity is determined by, and dependent on, these anchor institutions, and the cluster's characteristics will vary substantially according to the type of institution located. A myriad of suppliers may emerge around these large organizations, with which they establish short-term contracts. Given that these anchors are government-funded institutions, decisions may come from outside the region or be dependent on public policy choices and political shifts. In addition, ties of these large institutions to clients and suppliers tend to be of a local nature (albeit not necessarily) and involve such instrument as local content requirements.

This type of cluster is very diverse, and its characteristics and innovative dynamism will depend on which is the anchor organization. Some clusters will possibly require more innovations and be more knowledge intensive, such as those

anchored by the military or research-driven organizations and agencies, while others will be less knowledge demanding, such as those anchored by governmental bureaucracy (take the Brazilian case of its capital city Brasília, or Washington D.C., in the US. The examples of this type of cluster may extend to different activities such as cities that grow around Universities, such as Coimbra, in Portugal, or Montpellier, in France.

Determining who is more likely to appropriate the rents from innovation in this type of cluster seems fairly complex. A number of scenarios may be put forth but let us focus on one. When the anchor is, for example, a research defense facility and the innovator a small to medium firm, whether it is co-located or not, the rents from incremental innovations will tend to be short lived but appropriated by the innovator firm. In these situations, the diffusion of the innovation within and outside the cluster prevents the innovator from assuring a continuous stream of rents. Possibly the innovation was developed by contract to the research defense facility. Radical innovations are more likely to be developed in-house by the anchor firm or legally contracted out. In either case, the anchor firm is more likely to retain the rights to the innovation and be able to protect it from unintended diffusion for a longer period of time. The above discussion permits us to formulate the general propositions that:

Proposition 4.a. Firms in state-anchored-type clusters are likely to generate innovations that are specific to the anchor institutions and the innovators will be the anchor or a legally contracted firm.

Proposition 4.b. The anchor firms in State-anchored -type clusters are likely to appropriate the majority of the rents from innovations.

Discussion and concluding remarks

According to Schumpeter (1950) innovation results when different combinations of existing assets are found to have superior benefits and come to replace prior dominant combinations. Innovation is an for firms' competitive ability and is the mechanism through which firms gain access to resources with (superior) positive future value, and to valuable new resource combinations that are specific to the firm and that it alone may exploit (McGrath, et al., 1996: 390). However, innovation is also becoming increasingly dependent on the interaction among independent firms that contribute with complementary resources (Breschi, 2000; Balbinot, et al., 2011). Because the knowledge needed for innovations is increasingly distributed across organizations and geographies, firms need to expand to access both idiosyncratic business- and idiosyncratic location-specific knowledge. Firms thus seek to access knowledge not yet held by locating

in knowledge munificent clusters. However, not all clusters are alike and while some clusters may indeed favor knowledge access and innovations, other types of clusters do not. Why? Because the patterns of interaction among clustered firms, entrepreneurs and employees are not identical across all clusters. In addition, the institutional framework is also rather differentiated across clusters, as is the importance of dominant firms and governmental intervention.

Innovation is increasingly a social phenomenon and not the outcome of individual actions and strategies by isolated firms (Breschi, 2000). Many innovations are actually the outcome of pooling together different resources and bits of knowledge. Thus, it is likely that firms' ability to innovate is influenced by the spatial proximity to others, external sources of knowledge. However, the same dynamics that render the flows of knowledge among firms also makes it more difficult for the innovators to appropriate the rents from innovations. When relating to clusters and the co-location of firms in a region, the social and business interactions often give knowledge a quasi-public good nature.

When dealing with industry clusters as particularly innovative environments due to the well-known proximity among firms in related and supporting industries, universities, research centers, and an array of other dedicated institutions, we need to truly understand how innovation occurs and why should clustered firms endeavor in R&D efforts. Certainly, as recently put forth by Ferreira, Serra and Maccari. (2012) firms will only have an incentive to innovate if they are able to capture the rents from their innovations. Notwithstanding, we propose in this paper that different cluster types will render rather dissimilar prospects in two distinct matters: the innovation output and rent capture by firms in the cluster. The fact is that on occasion, the firms that will most likely capture the rents may even not be the innovators but rather other firms in the surroundings. That is most likely the case in Hub-and-spoke cluster, where the dominant firms are in better position to appropriate rents, but also in the state-anchored clusters, where it is the anchor firms that will probably capture those rents. These propositions are especially important for location decisions and call for a better assessment by managers of the regional configuration when deciding whether to locate, or not, in a given industry cluster.

Our discussion on the impact of type of cluster does not diminish the importance of other factors that may be explored in future research. For example, we implicitly assumed that the innovator firm was able to exploit the innovation. However, it is possible that the innovator lacks the complementary assets (Teece, 1986, 1997) to do so and, in fact, to capture even a small share of the rents from its innovation it may need to collaborate with other firms, and

share the rents. Examining how holding the complementary assets impacts on the appropriation of rents is a possible future research avenue and one that may involve employing the Resource-Based View of the firm (Barney, 1991).

In many instances innovations are developed in collaborative efforts in clusters. Thus, firms collaborate to pool together essential complementary assets to develop and to exploit the innovations. The fact is that collaborative efforts may come at the cost of losing a share of the future rents from innovation. It is even possible that some firms gain a bargaining position if they hold crucial complementary assets. For example, the North American IBM held a dominant position because of its large sales network and financial capital, not due to its technological strength (Verspagen, 1999). Assessing how holding the complementary assets to exploit innovations may shed additional insights into our discussion.

When advancing a set of propositions on who captures innovation rents we are implicitly assuming that either the innovators do not seek to protect their innovations, that they are not able to do so, or that the legal mechanisms (such as patenting) fall short of providing effective protection. For innovators to be able to capture the innovation rents the protection regime and mechanisms need to be effective and trustworthy (Teece, 1997, 1998, 2000). We thus need to understand each of these scenarios. For instance, small firms may not patent their innovations due to the costs involved. Firms may not patent when their inventions were developed through contract (which is likely to occur in some state-anchored clusters). And, more broadly, it is reasonable to suggest that clustered firms may not patent because patenting required making tacit, complex and systemic knowledge explicit which actually eases invent around behaviors and unintended knowledge transfers (Levin, et al., 1987; Teece, 2000). One of our core assumption in this regard is that the social and business interactions that characterize clusters also make it more difficult to keep secrecy of any innovation. Levin et al (1987), for example, argued that patents are not good protection mechanisms because of the ability of competitors to "invent around" them. Conversely, if the innovator firm is able to patent and effectively protect the knowledge, then the innovator will possibly be rewarded with rents. However, as Winter (1987) stated, patenting provides effective protection in only a few cases and industries (Levin, et al., 1987; Teece, 2000).

For public policy makers our paper raises several issues that must be assessed. First, the need to understand which types of clusters may hold the benefits aimed at. Different types of clusters are likely to have different impact on the regional and national economy and the creation of jobs. Perhaps more important is to design and implement effective legal and regulatory norms that promote and protect in-

novations. Firms' inability to capture the rents from their innovations may, in some instances, be the outcome of loose appropriability regimes, which may be changed by regulatory intervention. It is not rational to expect firms will devote substantial human, physical and financial resources to innovation if potential future rents steaming from their innovations are preempted by competitors or collaborators.

For practitioners this paper highlights that it is important to assess the specific characteristics of the cluster before advancing in any irreversible location decision. It is crucial to understand the different dynamics that exist in the cluster and figure out *ex ante* the benefits and hazards of operating in the cluster, including in what concerns innovation output and the appropriation of rents from innovation. Managers also need to know in which type of cluster to locate to benefit the most of knowledge spillovers.

In this paper we contribute to the debate on when innovator firms appropriate the benefits from innovation in a specific context: location in different types of industry clusters. While a majority of the extant research points to clusters being spots of particularly intense innovation activity due to the inter-firm networks that are formed among co-located firms, some challenges may exist. The current and dominant rationale is that firms increasingly need to access knowledge from other firms and that knowledge is increasingly a collaborative effort (Nagarajan and Mitchell, 1998; Rosenkopf and Nerkar, 2001). However, inter-firm relationships present difficulties associated to the flows of knowledge and the potential for dominant firms to reap the majority of the benefits from innovation. Hence, while co-located firms may be more innovative, and jointly they may have an advantage, the challenge remains: do innovator firms prefer to co-locate given the higher difficulty to appropriate the benefits from innovation? This paper intends to be a parsimonious contribution towards this debate.

The analysis of the types of clusters and their impact on the appropriability of returns from innovation presents yet additional discussion to existing research. First, we need to understand whether the innovation output is always larger in all types of clusters; second, who actually endeavors in innovation efforts; third, who captures the rents. The specific characteristics of the cluster, the ties among firms, the flows of employees, the dominant firms, and the broad configuration of the cluster determines who is more likely to appropriate the returns from innovation. The clustering of firms raises appropriability concerns due to the same mechanism that may lead to the innovations themselves. It is thus likely that the specific characteristics of the locations and the patterns of interaction between individuals and firms are major determinants of both innovation output and the greater beneficiary from the innovations that are generated.

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