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When the innovator fails to capture rents from innovation

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When the innovator fails to capture rents from innovation

ABSTRACT

Innovating firms face the dilemma of knowing when they will be able to appropriate the rents accruing from their innovations. Only the future value of the rents creates an incentive to innovate, and all innovations that are either imitated or improved upon by competitors preempt the innovator firms from capturing their rents. In this conceptual paper, we observe boundary conditions under which protection guarantees appropriation. A paradox emerges in that innovators benefit from networking and bandwagon effects but not from total diffusion of the knowledge. While networks are excellent vehicles for innovation, the business and social ties connecting firms deepen the hazards associated to the appropriation of rents.

Keywords: innovation, innovation rent, network ties, diffusion of knowledge, bandwagon effects, complementary assets

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INTRODUCTION

Modern competition has placed the emphasis of competition between firms on knowledge (Teece, 1998, 2000) and innovation (McGrath et al., 1996). This is largely because the traditional shelters for supra-competitive returns such as information or trade barriers are falling (Teece, 1998), and the access to physical, capital, and knowledge assets is becoming easier (Teece, 2000). The ability to manage knowledge and generate innovation determines firms' future returns and position in the market. Contemporary research places firms' ability to generate innovations as a primary source of their competitive advantage (Tushman & O'Reilly, 2002; Winter, 2006), but it is the ability to appropriate, or capture, the rents accruing from innovations that is a more accurate driver of firms' competitiveness (Harabi, 1995; Levin, 1988; Winter, 2006). The value of firms' knowledge and innovations is prone to be appropriated by less innovative rivals (Teece, 1986; Abrahamson, 1991; Liebeskind, 1996; Winter, 2006).

Despite the now long debate on innovation and rent appropriation, notably Teece's work (1981, 1986, 1992, 1997, 1998, 2000), Levin (1988) and Winter (2006) the question that remains to be answered is whether firms are able to capture the benefits, or rents, accruing from their innovative efforts. The conundrum is rather simple, if they are not, and the competitors have access to and/or are better able to exploit these innovations, there is seemingly no advantage of incurring in millions of dollars in R&D efforts to develop new products, processes and/or technologies. Levin et al. (1987: 783) claimed that "to have the incentive to undertake research and development (R&D), a firm must be able to appropriate rents sufficient to make the investments worthwhile". These rents are reduced when the competitors can imitate, or improve upon, the innovation without incurring themselves in R&D costs and efforts. Innovating firms may not always be able to fully capture the value from their innovations due to the diffusion of knowledge among firms (Wang & Chen, 2010).

Therefore, the important question is who wins from innovation? The innovator? The imitating competitor? Or other firm that has related capabilities or complementary assets that favor the appropriation of rents emerging from innovation whether developed in-house or imitated from other firm? Schumpeter (1950) suggested that rents resulting from innovation depend on the speed of imitation by rivals. Teece (1997) noted some examples of firms that were not able

to appropriate the rents from their innovations and rapidly lost product market leadership. One such example was EMI, Ltd who invented the CAT scan, and after eight years abandoned the CAT scan business altogether. Another example was Royal Crown that was not able to capture the rents from introducing Cola in cans and diet cola and Xerox Corporation was described due to its failure in the office computer business. If these innovator firms' followers won it was because the innovators failed to appropriate the benefits from their innovations. Nonetheless, extant research has been focused more on the innovative ability per se than on the innovators' ability to appropriate the rents from the innovations.

Why is the appropriation of rents from innovation important? First, because "imperfect appropriability" may lead to an under-investment in new technologies, which has substantial social and economic consequences. Second, because technological progress is a primary source of economic growth, and hence it is important to have a comprehensive understanding of appropriability, in particular to identify those industries and technologies in which patents are effective in preventing competitive imitation of a new process or product. Third, because the incapacity to appropriate rents is likely to be the result from loose appropriability regimes, requiring regulatory intervention to promote innovative efforts by private enterprises. Fourth, because innovation has an impact on both the internal resources of the innovator firms and on the models of inter-firm cooperation. These are four crucial aspects both from a practitioner's and a researcher's standpoint.

In this conceptual paper we seek to extend previous research by incorporating a more comprehensive understanding by analyzing some conditions under which firms will have greater difficulty in appropriating the rents of their innovations. The remaining of the paper is organized as follows. In the following section we develop theoretically-driven propositions based on a multi-approach discussion centered on two main areas: the conditions that favor innovative activity, and firms' ability, or inability, to capture rents from innovation. This section focuses on innovation and the types of discontinuities imposed by the innovation, the effectiveness of the protection mechanisms, the relevance of considering the possession of specialized complementary assets, potential bandwagon effects and also incorporate the elements of social networks, exemplified in the context of industry clusters to observe how inter-firm relationships impact on who captures the benefits that accrue from innovation.

These aspects are often debated for their role on firms' ability to capture rents from innovation. The final section presents an overall discussion, limitations, and avenues for future scholarly enquiry.

CONCEPTUAL DEVELOPMENT AND PROPOSITIONS

Innovation is an important activity for firms. Schumpeter (1950) suggested that it is through innovation that firms renew their assets base, and Amit and Schoemaker (1993) that the inimitable and idiosyncratic assets are the basis of firms' competitive position. In this paper we take Schumpeter's (1950) definition of innovation as a (re)combination of new or existing factors, resources and technologies that have the potential to bring rents for the entrepreneur (see also Henderson & Clark, 1990). Hence, innovations are important because they may generate future sources of revenues, but it is crucial that firms are able to appropriate those rents as a core incentive to innovate.

We use the terms 'appropriability' in the same way as in Teece (1998) to describe the ease of imitation. McGrath et al. (1996) and Bowman (1974) claimed that the benefits of innovative activity occur when the innovative firms capture above-normal rents. McGrath et al. (1974) argued that to be able to appropriate the rents accruing from innovation the innovative firms must have established an a priori competitive advantage over their rivals, otherwise it will be the rivals who will most likely capture the rents. Therefore, appropriability is a function both of the ease of replication and the efficacy of the protection mechanisms (McEvily et al., 2004) as a barrier to imitation. The speed of imitation by competitors is a function of eight main characteristics: (a) the potential rate of return of the innovation (depicted as the incentive to imitate by Hill, 1992), (b) the effectiveness of the protection mechanisms, or barriers to imitation, such as patents (Hill, 1992; Teece, 1998; McEvily et al., 2004), (c) the rivals' ability to imitate (Hill, 1992) or their pool of skills and assets, (d) the innovator's complementary assets (Teece, 1986, 1997), (e) the rivals' technological relatedness, (f) the competitors' access to the details and knowledge involved in the innovation, (g) the nature of the knowledge involved in the innovation (namely on whether it is tacit or explicit, Grant, 1996; Teece, 1995), and (h) the easiness of transfer of the innovation and knowledge across organizational boundaries.

Our conceptual debate is thus targeted to the understanding of a set of conditions under which innovator firms are likely to fail to capture the future rents emerging from their innovations.

Types of innovation: The extent of technological change

A core issue when examining the hazards involved in appropriating the rents from innovation is the understanding the extent of technological change involved in the innovation (Utterback, 1994). Based on the extant literature, a possible approach is to examine the degree of technological change identifying innovations as radical, or competence-destroying or, alternatively, as incremental or competence-enhancing (Tushman & Anderson, 1986; Anderson & Tushman, 1990). Tushman and Anderson (1986) noted that when faced with radical competence-destroying technological shifts the established firms are at a disadvantage *vis-a-vis* new entrants. This is largely due to established firms being stuck in their preexisting core competences which may develop into core rigidities (Cyert & March, 1963; Leonard-Barton, 1992) that hinder novel forms of adaptation to environmental shifts, either in a technological field or market-related. Tushman and Anderson (1986), on the other hand, suggested that technological shifts that build upon firms existing capabilities, or competence-enhancing shifts, provide incumbents with an advantage. That is because incremental technological shifts make incumbents more efficient and their internal and external systems are easily adjusted to incremental innovations.

The state of the art of the technology is an important driver of competition. In the initial stages of an industry, or after a major technological change, firms strive to create and impose standards. In this stage there is really no referent other (Shah, 1998) whom to imitate and competition is set through investments in R&D and on creating the market. However, once a dominant design is established, competition typically shifts gradually to manufacturing efficiency (exploiting economies of scale, scope and learning) and price, and away from R&D. Moreover, competition based on R&D is likely to move from product-based to process improvements that permit firms to manufacture at lower costs (Teece, 1997).

The more serious questions on the appropriability of the rents accruing from innovations are likely to emerge once a dominant design is set and when new innovations only build upon the existing knowledge base – that is, they are

incremental innovations. When the industry standards are defined and accepted, the basic technologies are known by a wide number of firms. Then, if imitation is easy, imitators may slightly change some feature of the product (or process), but still rely on the major features of the innovation. That is, it is easier to “invent around” and the innovators may even end up in a disadvantageous position.

Proposition 1. *The innovator firms are less likely to appropriate the rents accruing from innovation when the innovations are incremental.*

Conversely, in partial opposition to the above arguments, one may argue that it is when the innovations are radical that the innovator has greater difficulty in appropriating the rents. The rationale is that the inter-firm dynamics are substantially different in this case. For instance, to commercialize radical innovations the innovator firm may need to permit some diffusion of the innovations, and corresponding knowledge, to create: (a) bandwagon effects to other producers, (b) bandwagon effects from consumers (Ende & Wijnberg, 2001), and (c) to legitimize the new product, process, and technology. Thus, it is likely that radical innovations require some intended diffusion of the knowledge base. The appropriability hazards emerge from a possible uncontrolled or unintended diffusion of the innovation (Wang & Chen, 2010).

The replication of radical innovations may also require the knowledge embedded in the innovation be made explicit for intra-organizational transfer. Although the roots of radical innovations frequently reside in tacit knowledge, the need to make the knowledge explicit – for instance for patenting purposes or for intra-firm transfer – is likely to generate unintended diffusion to other competitors and potential new entrants. By making the knowledge codified competitors will have easier access to it. The innovator firms, in this situation, face the risk of not appropriating the full rents from innovation, as competitors access the “secrets” of the innovation and imitate it. A competing proposition may thus take the form:

Proposition 2. *The innovator firms are less likely to appropriate the rents accruing from innovation when the innovations are radical.*

Protection mechanisms: Patents

The above discussion highlights the importance of the protection mechanisms, namely that of patenting, for firms ability to capture the rents from their innovations. Technological innovation has uncertain outcomes, and even incumbent firms with cutting edge processes or products are challenged by

potential imitators (Dinopoulos & Syropoulos, 2007). Albeit patents may provide some protection, the knowledge and innovations made explicit in the patent may be captured by competitors. Moreover, innovations are rarely perfectly protected through patents or other formal/legal means available and instead they either diffuse to other firms through network ties, or are viable to “invent around” opportunistic behaviors.

Hence, since patents are frequently ineffective and often fail to confer perfect appropriation to the innovator firm, the question that remains is why firms continue to use patents. Several replies may be tentatively advanced. First, firms may patent to protect from opportunistic “free riders” and against legal suits. Second, firms patent as a manner to control and assess employees’ R&D productivity (Levin et al., 1987). Third, firms use patents as means of market entry into countries that require the filling of a patent (Levin et al., 1987) to promote technology transfer. Fourth, firms use patents to signal R&D expertise, which has a positive effect in the perception of the quality of the firms’ products or to build reputation as an innovator.

The appropriation issues of patenting relate to the extent to which innovations can be protected from imitation (Cohen & Walsh, 2001; Haumelinna-Laukkanen & Puumalainen, 2007). That is, we need to observe how well the protection mechanisms preempt other competing firms from accessing the innovation. A major factor in the innovator firms’ ability to capture the innovation rents stem from the protection regimes (Teece, 1997, 1998, 2000; McEvily et al., 2004) and the efficacy of patents.

When the innovators are able to protect their innovations through patenting, or are able to keep them secret, denying competitors access to the knowledge embedded in the innovation, they will surely be rewarded with rents for some time. At the very least, the innovator will benefit from licensing and royalties to interested parties that wish to use the innovation. Patents have the objective of preempting competitors from using the innovations at no cost for the imitator, but there are evidences that patents are frequently imperfectly enforced. By patenting the innovation the innovators attempt to lock-in their sole access to the use of the innovation. The goal of patents is to protect the knowledge embedded in the innovation and the innovators’ future rents (McGrath et al., 1996; McEvily et al., 2004). However, in those instances where the patenting system is loose, under-

regulated, or weak, the innovator firms find it more difficult to appropriate the rents from innovation and are subject to competitors' opportunistic actions.

Patents are arguably one of the most effective ways of assuring the appropriation of R&D rents. Albeit patents do have the potential to protect knowledge they also have the potential to make that knowledge more easily transferable. Levin and colleagues (1987), for example, argued that patents are not good protection mechanisms due to the possibility that competitors may "invent around". In some cases, given the requirement of the patents to make explicit the knowledge involved in the innovation, patents may actually facilitate the unintended and unwanted diffusion of knowledge, thus facilitating imitation by competitors. The degree to which the knowledge involved in the innovation is explicit or tacit (Teece, 1995; Grant, 1996) also determines the easiness and extent of imitation by competitors (Teece, 1997). Tacit knowledge is implicit and idiosyncratic, embedded in the firm's routines and capabilities. Notwithstanding, in some instances, patents do offer effective protection (Winter, 1987), namely in the chemical and petroleum refining industries [see also Levin et al. (1987) and Teece (2000)]. In the chemical industry, for example, patenting is effective because it is easier to demonstrate infringements involving a specific molecule. Hence, in proposition form:

Proposition 3. *The innovator firms are less likely to appropriate the rents accruing from innovation when legal protection mechanisms are weak and loose.*

In the next section, we develop the arguments on the importance of holding complementary assets (Teece, 1997), specifically emphasizing how these impact on the innovators' capacity to appropriate the rents from innovation.

Complementary assets

An additional perspective on the dilemma of who appropriates the rents from innovation entails examining how holding, or not, complementary or co-specialized assets may explain why the innovator firms fail to capture the rents from their innovations. For instance, Teece (1997) described how IBM's ability to capture rents was not due to the personal computer (PC) innovation itself but rather to the vast pool of complementary assets around the PC that IBM was able to rapidly assemble. Teece further argued that holding co-specialized complementary assets protects the innovator firms against the loss of innovation rents to competing firms.

Holding complementary assets to be used in conjunction with the innovation favors the exploitation of an innovation. For example, a new pharmaceutical drug may require a large pool of sales people, strong marketing skills/resources, and non-irrelevant manufacturing capacity to serve the global market. Sales personnel, marketing and manufacturing capacity are co-specialized complementary assets without which the pharmaceutical firms may be unable to capture rents. That is, the successful appropriation of rents may require firms hold a bundle of co-specialized complementary assets. Take the following example, Verspagen (1999) attributed IBM's dominant position to its large scale sales network and large slack financial resources, not to technological strength. If a competitor possesses these co-specialized assets and the innovation is easy to imitate through, for instance, reverse engineering, then the competitor may have an advantage *vis-a-vis* the innovator that does not hold these assets.

The innovator firm that lacks essential complementary assets may search to pool them together through tying multiple independent partners, establishing arm's length contractual relations with suppliers, other manufacturers or distributors. For this solution to be effective strong protection mechanisms in place (e.g., patents, as discussed above) must preempt the partner from behaving opportunistically (Williamson, 1985; Teece, 1997). The downside effect is the loss of a share of the innovation rents to partner firms.

Proposition 4: *The innovator firms are less likely to appropriate the rents from innovation if they do not hold the complementary assets and these are available to others through partnership relations.*

Notwithstanding, according to Teece (1986) the question may reside more on where the complementary assets of the firm lie, rather than whether the firm actually holds them. If the innovators may easily draw upon a large pool of complementary assets and re-orient them to exploit the innovation, neither a competence-destroying nor a competence-enhancing innovation should cause major hazards (Tushman & Anderson, 1986) in terms of the innovator firms' capacity to exploit the innovation [see also Tripsas (1997) and Teece (1986)] and capturing emerging rents. However, for many firms this basically means a shift towards vertical and horizontal integration with the internalization of multiple stages of the value chain, which is contrary to the contemporary emphasis on des-

internalization (Dunning, 1995) and focus on the firms' core competences and core businesses.

In sum, we suggest that even when the innovator firms do not own the complementary assets required to fully exploit the commercialization of the innovation, they may still succeed. And, even when they possess these assets they may fail. The innovators may be embedded in a network of business relationships with other firms that facilitate the access to similar or substitute assets. It is thus relevant to understand in which circumstances holding complementary assets matters.

Three conditions for the success of complementary assets

The previous discussion centers on how holding complementary assets, per se, may not be sufficient to appropriate innovation rents. However, we suggest three conditions that complementary assets must possess to increase the likelihood that the innovator firms will be able to appropriate the rents from innovation: *exclusivity*, *preemptiveness*, and *ownership*. These three conditions are discussed below.

The complementary assets need to be *exclusive*. Exclusivity means that complementary assets are owned by the firm and are not possible to replicate, or imitate, by competitors. It is not difficult to conceptualize situations of exclusive assets. For example, a brand is an exclusive asset in that it does not allow (at least not without the payment of a royalty) the use by other firms. Similarly, specialized distribution channels may be exclusive assets as may be norms and codes of conduct of the personnel that bound a corporate culture. Rival firms may develop a brand or a distribution chain and sales force but these will not be the same. Some imitation potential may emerge when the innovator firm needs to codify the knowledge for instance to replicate the innovation in other foreign subsidiaries. Replication is important for exploiting the innovation and to maximize the share of the rents captured. Therefore, the condition of exclusivity may still not be sufficient to guarantee that exclusive complementary assets leads to the appropriation of rents from innovation.

The complementary assets also need to be *preemptive*. Being preemptive signifies that because one firm holds those assets other firms cannot replicate them, either by partnering to access similar or substitutable assets, or by acquiring the assets in the factor market (Barney, 1986). Preemptive complementary assets

may be envisioned as a barrier to the entry of other firms, whether firms that have a similar pool of assets or firms that are able to bring together a network of independent firms to replicate those assets. Because the assets are exclusive the possession of preemptive assets by the innovator is also a barrier to novel internal configurations of resources, skills or routines (Nelson & Winter, 1982).

Finally, complementary assets need to be *wholly-owned*. This condition assures that only the innovator will have a “right” to capture the rents accruing from the innovation. This condition further requires that the innovation was absolutely developed in-house, and did not count with the cooperation of external partners. In addition, the successful commercialization of the innovation requires only the set of complementary assets that the firm already holds. In sum, wholly-owned assets are not built through partnerships with other firms or research centers, nor do they depend on other firms’ resources.

Proposition 5. *The innovator firms that possess exclusive, preemptive and wholly-owned complementary assets are more likely to appropriate the rents accruing from innovation.*

Bandwagon effects and diffusion

The success of any innovation in the marketplace requires its acceptance by users and other producers. Thus, at least in some instances, to understand who appropriates the innovation rents we need to observe to what extent the innovators need some diffusion of the innovations. The rationale lies beneath network externalities and bandwagon effects among both users and producers. Network externalities refer to “the utility of specific products for a user depends on the number of other users” (e.g., telephone, fax, cellular phones and e-mail) (Ende & Wijnberg, 2001). That is, a significant share of the rents emerging from an innovation is tied to the number of people that use it. Then, diffusion of the innovation to other competing rivals enlarges the market creating additional demand for the product. Network externalities may also exist in interrelated technologies (Ende & Wijnberg, 2001). For example, the consumers’ adoption of vehicles using natural gas is likely to increase as the overall infrastructure of gas distribution improves. Therefore, both bandwagon effects and network externalities are more important for path-breaking radical innovations, and arguably the less so for incremental innovations.

Bandwagon effects mean that individuals are influenced by behaviors and decisions of other individuals, namely those of competing firms. Rosenkopf and Tushman (1998) argued that firms' decisions regarding which technologies to pursue are partly driven by the choices of other firms. That is, individuals imitate others' choices and it is the communities of firms that generate technological evolution. Abrahamson and Rosenkopf (1997), for example, observed bandwagon effects among producers in regard to their adoption of innovations. Diffusion through bandwagon effects presumes that agents are somehow connected and have access to the intended knowledge/innovation spillovers from the innovator (Wang & Chen, 2010). The access to the innovation, however may foster imitation by competitors and preempt the innovator from capturing the rents accruing from the innovation. In proposition form:

Proposition 6. *The innovator firms are less likely to appropriate the rents accruing from innovation when the innovations are radical, particularly when they require bandwagon effects.*

Networks and localized innovative activity

Firms are embedded in a larger external environment that shapes how and what organizations do (Aldrich, 1979; Scott, 1991). Several studies have focused on understanding and explaining why and for what purpose firms engage in networks of relationships. The resource dependence theory, for instance, advances that firms are rarely self-sufficient and they engage in exchanges with other firms to obtain needed reputational, social, financial and physical resources (Pfeffer & Salancik, 1978). A network consists of a "finite set or sets of actors and the relationship or relationships defined on them" (Wasserman & Faust, 1994: 20). The fact is that networking has the potential to bring in several benefits such as information gains from the flow inside networks (Grannovetter, 1983), market opportunities (Coviello & Munro, 1995), the transfer of tacit and explicit knowledge inside the networks which is essential for organizational learning (Hansen, 1999), and innovation. Astley and Fombrun (1983), for example, studying the telecommunications industry, showed that technological innovations were carried out mainly by a complex and wide range of interfirm networks.

A specific type of network is the industry clusters, or geographic agglomerations. The role of clusters has been extensively emphasized on innovative dynamics. Industry clusters are locations where similar, related or

complementary firms and businesses exist in proximity, sharing a pool of specialized infrastructures, labor markets and services (Saxenian, 1996; Doeringer & Terkla, 1995; Jacobs & DeMan, 1996; Rosenfeld, 1997). The social and professional networks in clusters are reasonably understood (Saxenian, 1996) and the co-location of firms in a region, or cluster, provides performance advantages (Doeringer & Terkla, 1995). According to the institutional theory (e.g., Meyer & Rowan, 1977) by locating in known areas of expertise, firms benefit from reputation, status, and legitimacy spillovers, but also from better infrastructures and access the local resource endowments (Wheeler & Mody, 1992).

Innovation in clusters may be more munificent. The localized concentration “of high technology facilities strengthens the relationship between R&D spending and productivity growth” (Driffield & Munday, 2000: 24). Michael Porter (1990) argued that the competition between co-located rival firms in the cluster forces firms to be more innovative and create new products, processes and technologies. Clustering favor the likelihood of knowledge spillovers (both intended and unintended spillovers to proximate firms and employees). These knowledge spillovers are also likely to promote the overall cluster competitive advantage and reinforce the attractiveness of the cluster (Krugman, 1991) inducing other leading domestic and foreign firms to search for these locations for their operations (Driffield & Munday, 2000).

A core aspect in innovation developed in regional innovation systems (such as clusters) is networking (Verspagen, 1999). Through networking with other firms with both different and complementary specializations the innovative potential increases and more innovations are likely to be gestated. Agglomeration economies may also spur competition, encouraging information, knowledge, and technology transfer among related networked firms. Because many of the industries within the cluster employ a similar labor force, the labor force may freely move to other firms within the cluster, thus transferring knowledge to extant firms and new entrants, and continuing to promote competition and growth. It is reasonable to suggest that the transfer of knowledge and technology among these firms will likely lead to new innovations and drive the growth of the cluster, following the received wisdom.

Proposition 7. *Innovation activity is likely to be more intensive in industry clusters, than outside clusters.*

Notwithstanding the clustering and network advantages firms located in industry clusters will probably face multiple hazards and higher obstacles to the appropriation of rents from innovation. These clustered firms are likely to find it harder to maintain the knowledge in-house, keep their key employees, and develop R&D projects independently of the other firms that participate in the same network or regional cluster. Ultimately, the difficulty associated to the appropriation of innovation rents for clustered firms may even extend to the appropriation of the innovation itself. That is, when multiple firms converge to undertake an innovation it may be fuzzy to whom that innovation belongs. Conversely, firms more isolated from rivals and partners (that is, firms located outside the cluster) may find it harder to develop innovations. However, once developed they manage more easily to maintain secrecy and prevent the diffusion of knowledge that occur in the regional cluster through the repeated interaction of employees, owners, managers and scientists.

In sum, network effects are important in the context of innovation but they are also relevant in seeking who appropriates innovation rents. Networks, as industry clusters, may promote innovation through knowledge transfer among firms, but the same social and business-related ties that bind those firms also facilitate the diffusion of knowledge. Ultimately, following a social networks rationale, it seems reasonable to suggest that the innovator firms' will have greater difficulties in capturing the rents from their innovations in these instances. In proposition form:

Proposition 8. *The innovator firms are less likely to be able to appropriate rents accruing from innovation if they are embedded in a network (or cluster) than if located outside the network (or cluster).*

DISCUSSION

In this conceptual paper we set to discuss not whether firms are able to generate innovations and all conditions that may apply but rather whether innovating firms will be able to capture the rents from their innovations. More specifically, we discuss a set of conditions of failure to capture those rents. In doing so, we discuss the types of innovations, the effectiveness of patents as protection mechanisms, the diffusion of the innovations to other firms, bandwagon effects, the role of complementary assets and network effects. To a large extent, we posit that understanding the opposite - or the conditions that may lead to

success in rent appropriation - involves defining the mechanism to overcome the barriers we identified.

According to Schumpeter (1950) innovations occur when different redeployments and recombination of assets are found to have superior benefits, and come to replace existing ones. In other words, innovation 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). To the extent that these new combinations incorporate difficult to imitate resources, skills and routines (Nelson & Winter, 1982; Barney, 1991) it will probably take longer for competitors to match the innovation and imitate upon it. While at first glance it may seem that innovators should try to keep innovations private thus restricting access to rival firms, in some cases that may not be the best strategy. Some innovations may require bandwagon effects generate demand and be successful. Other innovations need to be developed in a network of firms because the knowledge required to innovate is increasingly distributed across firms and geographic space. Hence, firms access knowledge through business and social ties, which hinder the capacity to maintain knowledge in-house, and appropriate innovation rents.

Teece (1997) suggested that firms should seek a balanced strategy of exploration beyond and exploitation within the current technological knowledge already held (see also March's (1991) work on exploration and exploitation strategies). By diversifying their R&D portfolio innovators maximize the likelihood that technological innovations will fall outside the firms' existing capabilities and in business areas in which they lack the necessary complementary assets. Therefore firms are likely to benefit from concentrating their R&D efforts in areas related to their core business. That is because in the core business the innovator has a larger pool of general, specialized and complementary assets and may more easily capture future rents from innovation.

Every innovation is embedded in knowledge either made explicit or that rests implicit. Patents have the role of protecting this knowledge. However, it is ultimately up to the manager to figure out how to protect and retain the knowledge in-house (Teece, 2000). In some industries patenting is not feasible or outright impossible and in other industries does not seem to be an effective manner to protect the innovator; as such we observe reasonably low levels of patenting.

Moreover, the nature of the technological innovation is also likely to play a role in firms' ability to keep knowledge private, as well as on the importance of holding complementary assets. For both practitioners and researchers it is important to understand to what extent, during competence-destroying technological discontinuities, firms that invested in complementary assets may be doomed. Multiple studies have indeed documented the failure of established firms facing radical technological innovations (Tripsas, 1997) but it is less clear whether innovators are able to capture rents from innovations and whether those firms that do not innovate are the ones that fail.

In discussing innovations and the choices on whether to patent an innovation, one may also take a social benefits perspective. If on the one hand, the incentive to invest in R&D is attenuated by the easiness with which the competitors are able to imitate, on the other hand, there are concerns of social optimization on the allocation of resources. For instance, easy imitation avoids wasteful duplication of expenses in R&D aimed at the same technology, product or process. Notwithstanding, future research may clarify whether stronger appropriability systems generate more innovations in all contexts, and one may foresee that it may depend on, for instance, the industry of the firm (Levin et al., 1987).

Future research may evolve in a number of additional avenues. It is still ill understood how much does government matter in the appropriation of rents from innovation, beyond the role in enforcing patents and other protection mechanisms. Much of the discussion on how government matters has been centered on generating innovations and its role in building an innovation system, and the less so on the issue of capturing innovation rents. The impact of the government is more likely to increase when it imposes patenting requirements that favor the disclosure of too much information, or when the government restricts market entry through investment in favor of licensing or other contractual arrangements.

Other lines of research may entail empirical studies addressing Teece's (1997) claim on the importance of co-specialized assets for the ability to appropriate rents from innovation. Scholars may observe, for example, the relative (dis)advantages of the three main players suggested in Teece's work: innovators, imitators, and owners of co-specialized assets. The general tenant is that firms should be able to capture the benefits of their efforts and future research ought to delve deeper in this regard.

It is possible that, contrary to conventional thought, innovator firms at least in under some circumstances do not attempt to reap all the rents generated by an innovation. Future research may seek to understand, for example, to what extent innovators are likely to pursue simply a rent satisfying behavior. That is, the innovators may attempt to capture only a *share* of the rents and *not all* the rents that will accrue from the innovation. It is reasonable to suggest that the innovator firms may be willing to share the future rents with strategic partners. Future research may empirically test whether innovators pursue a rent satisfying strategy.

Moreover, a number of specific effects may be clarified, such as how firms' size may matter for appropriating rents from innovation, in accessing complementary assets and for the formation of business networks (Christensen, 2001). The debate on how firm size plays a role permits conflicting arguments. For instance, large size may be associated to the possession of a variety of resources – financial, physical and social - and co-specialized complementary assets that ease capturing future innovation rents (Chandler, 1990; Teece, 1997). An alternative view suggests that large firms may have a competitive disadvantage over small firms. Large size may induce some degree of organizational inertia (Hannan & Freeman, 1984) and path dependent technological trajectories. Large firms are posited to have strongly ingrained routines, procedures, practices and to rely on internally established "ways of doing things" (Nelson & Winter, 1982). Therefore they are less flexible and less capable of reacting to innovations. The examination of size is important even because the contemporary research has been emphasizing the benefits of "smallness" and innovative ability (Christensen, 2001). Empirical research is warranted to clarify whether large or small firms are in better position to appropriate rents from innovations.

CONCLUDING REMARKS

Albeit conceptual, in this paper we aim at contributing to the essential question of when do innovator firms appropriate the benefits from innovation. This matter has straightforward implications for practitioners, government officials, and the broader society. In this paper we partially shifted our attention from a simple analysis of complementary assets or of firms' internal characteristics to the likelihood of the innovator being able to capture rents accruing from innovation, to network effects and to technological factors. Managers do generally realize that developing novel knowledge and innovations configures the contemporary

competitive arena (McGrath et al., 1996; Teece, 1998, 2000), but involving a substantial amount of the firms' physical, technological and financial resources should guarantee future rents.

The debate on knowledge and innovation as sources of competitive advantage is maturing but to develop a clearer theory of rent appropriation following innovations requires additional research, useful for private decision makers and public policy. One such avenue rests on a fuller comprehension of the ties binding firms and the resources held but in the context of the types of innovations and all the environmental milieu surrounding firms.

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