



The Effects of Innovation Partnership, Foreign Ownership and Enhanced Management Practices on the Use of Patents in Brazilian Manufacturing

Henrique M. Barros



Inspirar para Transformar

Copyright Insper. Todos os direitos reservados.

É proibida a reprodução parcial ou integral do conteúdo deste documento por qualquer meio de distribuição, digital ou impresso, sem a expressa autorização do Insper ou de seu autor.

A reprodução para fins didáticos é permitida observando-se a citação completa do documento

The Effects of Innovation Partnership, Foreign Ownership and Enhanced Management Practices on the Use of Patents in Brazilian Manufacturing

Henrique M. Barros

Inspere Institute of Education and Research

R. Quata 300

São Paulo, SP Brazil 04546-042

Phone: 55-11-4504-2424; Fax: 55-11-4504-2350

E-mail: henriquemb@insper.edu.br

Abstract

The bulk of evidence regarding firms' patent behaviour derives from institutional environments where a relatively strong protection can be obtained even if patents per se are imperfect protection mechanisms. Our knowledge as to the determinants of firms' propensities to patent in weak appropriability regimes is still unclear. Thus, this paper explores the effects of firms' innovation partnerships, ownership, and adoption of new management practices on the likelihood of using patents in Brazilian manufacturing. Our analysis derives from responses of firms to questions in the Brazilian Industrial Survey of Technological Innovation (Pintec) and is based upon logit model estimates indicating the likelihood that firms' various attributes make them more inclined to pursue patents. The findings indicate that firms that have adopted more sophisticated management practices are those less likely to use patents, and this runs against documented evidence from more developed settings where patents have become a prominent managerial device. In addition, the results reveal that domestic and foreign firms in Brazilian manufacturing have no dissimilarity as to their inclination to use patents. Finally, and counter-intuitively, despite the weakness of the Brazilian appropriability regime firms engaged in innovation-oriented collaborations rest on patenting to avoid unintended knowledge spillovers.

Keywords

Patents; appropriability; institutions; innovation; collaboration; multinationals; management.

Acknowledgements

The author gratefully acknowledges the financial support of FAPESP.

Introduction

Despite the limitations of patent protection firms have increasingly pursued this appropriability mechanism to reap the returns from innovation (Lerner, 2002 & 2009). Hence, firms' patent behaviour has received considerable attention in the academic literature (Granstrand, 2003; Scotchmer, 2004). Yet, the bulk of evidence regards firms operating in institutional environments where a relatively strong protection can be obtained even if patents per se are imperfect protection mechanisms. Our knowledge as to the determinants of firms' propensities to patent in weak intellectual property rights (IPR) regimes remains unclear (Hanel, 2006; Keupp, Beckenbauer, & Gassmann, 2009; Sarkissian, 2008). Thus, it is this void that this piece of research will primarily try to fill. Our focus is on three potential determinants: innovation-based partnerships, firms' ownership (i.e., foreign vs. domestic), and the adoption of enhanced management practices.

We concentrate upon those factors for a number of reasons. Firstly, innovation-oriented collaborations have become widespread (Hagedoorn, 2002; Laursen & Salter, 2006) but as far as we know there have been only few studies that attempted to directly address the effects of partnerships on firms' propensities to patent. Brouwer and Kleinknecht (1999), for example, provide strong evidence that firms become more inclined to patent when they engage in innovation partnerships. In turn, Blind, Edler, Frietsch, and Schmoch (2006) furnish less consistent evidence. So, the results are not fully conclusive. In addition, the effects of partnerships on firms' propensity to patent are to a large extent attributed to the increase in the likelihood of unintended knowledge spillovers. Patents are deemed safeguards against partners' opportunistic behaviour (Blind et al., 2006; Brouwer & Kleinknecht, 1999). Yet this might not be necessarily the case in settings characterized by judicial system dysfunctions within which firms are likely to pursue alternative means to avoid rent expropriation such as informal, relational mechanisms of governance (Mesquita & Lazzarini, 2008). As prior studies on the effects of partnerships on a firm's propensity to patent concentrated upon countries with strong IPR systems our knowledge of these effects in business environments characterized by higher judicial uncertainty is still scant.

Secondly, the literature on patenting has not devoted much attention to the effects of ownership (i.e., domestic vs. foreign) on firms' propensities to patent. While it is widely known that MNEs tend to have larger portfolios of patents than indigenous single-market firms as a result of patent families¹ (Bertin & Wyatt, 1988), and that MNEs' scale and market power may be substitutes for patenting (Grupp & Schmoch, 1999), their patent behaviour has not been fully examined. The purpose of this paper is not to dig down to figure out MNEs' patent behaviour, but rather to address an intriguing aspect of their patent behaviour (*vis-à-vis* domestic firms) within weak appropriability regimes. More specifically, innovation theory suggests that in weak appropriability regimes patents are less useful for firms to reap the benefits from innovation (Teece, 1986), and hence one would not expect foreign firms to be more inclined to patent than domestic ones. In addition, institutional theory advocates that firms operating within the same context should behave similarly, that is they become "isomorphic" (DiMaggio & Powell, 1983). Thus, institutional theory proposition is in line

¹ A patent family is a set of patents taken in different countries to protect the same invention.

with innovation theory as to the prediction of MNEs patent behaviour in weak appropriability regimes. Nevertheless, recent empirical evidence indicates that MNEs' average number of patents might be larger than domestic firms' average number of patents (Albuquerque, 2000), and that MNEs tend to replicate abroad their patent conduct in the home country even if the new market is an emerging economy with more fragile institutions (Keupp et al., 2009). These findings seem to contradict innovation and institutional theories, and suggest that we are not fully acquainted with the effects of ownership on firms' propensity to patent.

Finally, the literature on propensity to patent builds to a large extent upon the economic neoclassical notion that firm size, market structure, and technological characteristics are central to determine firms' patent behaviour (Griliches, 1990). Recent research, however, has suggested that other organizational aspects (i.e., managerial issues) also have a role to play (Webster, 2004). Actually, the innovation literature suggests that an era of 'intellectual capitalism' has emerged (Granstrand, 1999), at least in countries where the scientific and technological infrastructures are at the forefront. Thus, firms' patent behaviour have also reflected changes in management practices (Hall & Ziedonis, 2001). As patent systems have been strengthened worldwide (Forero-Pineda, 2006) we expect firms in latecomer industrialized countries to follow an evolutionary pattern so as to become more patent-oriented as long as they adopt novel management practices. That is, firms in evolving, though weak, IPR regimes that have adopted enhanced management practices are likely to become more inclined to patent than firms that have not changed their managerial approach.

This paper, thus, explores the effects of firms' innovation partnerships, ownership, and adoption of new management practices on the likelihood of using patents. Our analysis derives from responses of firms to questions in the Brazilian Industrial Survey of Technological Innovation (Pintec) and is based upon logit model estimates indicating the likelihood that firms' various attributes make them more inclined to pursue patents. The paper is organized as follows: In the next section we briefly review the literature from which hypotheses are derived. Then, in the third section we give details about the data set as well as the analytical framework employed to carry out our analysis. The estimation results are shown and discussed in the fourth section. Finally, conclusions are drawn.

Literature Review and Hypotheses

Partnerships and propensity to patent

The competitive environment in many countries has gone through significant changes over the years. Firms have come across rapid advances in technology development, amplified turbulence, and increased competition with the globalization of markets as well as the internationalization of innovation activities (D'Aveni, 1994; Ito & Wakasugi, 2007; Wolf, 2006). Thus, firms are often plunged into contingencies where they have neither the time nor the resources to internally generate valuable innovations (Sherwood & Covin, 2008). As a result firms have engaged in collaborations to tap into knowledge (or distinct resources) necessary to strengthen their competitive position. Some claim that this is a new model of innovation generation based on the recognition that valuable knowledge may derive from both within and outside firms' boundaries (Chesbrough, 2003). Even if the newness of this 'Open Innovation' model is disputed (Mowery, 2009), there is clear evidence that innovation

partnerships have escalated since the 1980s, in particular in Europe, Asia and North America (Hagedorn, 2002). For many firms, therefore, innovation is no longer a sole endeavor (Bekkers et al., 2002).

Building upon on transaction costs economics (e.g., Williamson, 1979) and the property rights theory of the firm (e.g., Hart and Moore, 1990) the literature has addressed the choice between external sourcing and internal development as the make or buy decision (Veugelers & Cassiman, 1999). In turn, Conner and Prahalad (1996) argue that knowledge-based transactions can occur regardless of opportunistic considerations as a net effect of the absorption of knowledge creation. However, knowledge-based transactions may not take place efficiently in the market since the relevant knowledge for innovation activities is difficult to be traded on neoclassical ‘spot markets’ (Galende, 2006). Thus, collaborative agreements emerge as a hybrid solution between the organization and the market (Williamson, 1991). As the division of innovative labor between different organizations includes the exchange of information between the parties involved (Fritsch and Lukas, 2001), collaborative arrangements tend to adjust to the degree of specificity of the asset traded in order to avoid rent expropriation (Keil et al., 2008; Nieto & Santamaria, 2007).

Innovation partnerships increase the likelihood of involuntary knowledge spillovers, and firms pursue safeguards against opportunistic behavior. One type of safeguarding mechanism is patenting which reduces transaction costs by documenting and formalizing a firm’s knowledge in such a way that resembles an ordinary tradable asset (Blind et al., 2006). In fact, Brouwer and Kleinknecht (1999) observed that a firm becomes more inclined to patent (and patents more frequently) when it is involved with innovation collaborations. The findings of Blind et al. (2006) suggest the same, though at a lower statistical significance level (i.e., 10%) of the econometric estimates. Both papers furnish evidence from institutional environments marked by stable and reliable governing rules with clear dispute settlement mechanisms. Emerging countries, however, tend to suffer from market inefficiencies caused by weak regulatory institutions (Miller et al., 2008; Johnson et al., 2000; LaPorta et al., 1998). In these settings, firms’ ability to use patents as protective devices against unintended knowledge spillover may be rather limited.

Innovation partnerships ask not only for strong commitment of the parties involved (Hagedorn, 2002) but also for mutual reliability regarding confidentiality of the proprietary information exchanged. As parties continue transacting over time, social norms and trust also tend to emerge and further support collaborative arrangements (Gulati, 1995). As Singh and Perlmutter (2000) observe strong relational capital emerges due to close interaction between partners. As a result exchange and transfer of information and knowhow are facilitated. Thus, relational norms promote greater support for the exchange of proprietary information even in the absence of a legally binding mechanism. Thus, informal, relational mechanisms of governance can be argued to be substitutes for adequate legal enforcement (Granovetter, 1985; Uzzi, 1997; Zaheer & Venkatraman, 1995). However, Poppo and Zenger (2002, p.721) have detected that “managers tend to employ greater levels of relational norms as their contracts become increasingly customized, and to employ greater contractual complexity as they develop greater levels of relational governance”. Yet, their findings originate from a strong institutional environment where contracts can be enforced. In weak institutional settings firms are likely to resort even more to relational mechanisms. For example, using data from a group of Argentine furniture manufacturers Mesquita and Lazzarini (2008) have

detected that relational governance promotes the provision of collective inputs, product innovation, and productivity gains. That is, relational governance helps those firms to supplant weak institutions and to overcome infrastructure constraints. This suggests that patents in weak appropriability regimes are unlikely to play the same role as they play in more developed institutional settings. That is, relational governance may be more prevalent than patents as a mechanism to mitigate unintended knowledge spillovers. As a result, we do not expect firms that engage in innovation partnerships within weak institutional settings to be more inclined to patent. We then hypothesize that:

Hypothesis 1: In a business environment characterized by a weak patent system, there is no difference in the likelihood of using patents between firms that engage and firms that do not engage in innovation partnerships.

Foreign ownership and propensity to patent

As firms are better able to reap the gains from innovation when they have a sufficient degree of internationalization – i.e., cross-country boundary expansion (Kafouros et al., 2008), we have observed not only the internationalization of sales but also a growing trend of innovating abroad (Athukorala & Kohpaiboon, 2010; von Zedwitz & Grossman, 2002). This poses challenges to firms since there are compelling reasons for either keep innovative activities at the home base or to take them abroad. The risk of leakage of proprietary knowledge creates an incentive to keep R&D in the home country. Yet, it also creates expectations that local knowledge could be absorbed by an R&D facility abroad. In any case knowledge spillover, and hence appropriability, is a concern (Cantwell & Piscitello, 2002). Therefore, the nature of intellectual property rights legislation in the host country seems a relevant element to the decision as to whether or not R&D activities should be located elsewhere. However, while there is evidence indicating that a stronger IPR is associated with knowledge creation (as opposed to knowledge adaptation) and with an increase in the level of patent applications by MNEs in the host country (Branstetter et al., 2006; Ito & Wakasugi, 2007), there is evidence that the strength of the patent system of the host country is not related to the intensity of innovation activities of MNEs in that market (Athukorala & Kohpaiboon, 2010; Kumar, 2001). Thus, our understanding of the effects of the host country IPR system on the engagement of MNEs' affiliates in innovative activities is not conclusive, and even less so for their patenting behaviour. Although the literature on patenting has long documented the interest of MNEs in this practice (e.g., Bertin & Wyatt, 1988; Taylor & Silberston, 1973), little is known as to how firms' ownership (i.e., foreign vs. domestic) affects the likelihood of using patents. Patent behaviour differences between foreign and domestic firms are attributed to a large extent to the level of competition in the host country and to the absorptive capacity of firms in that country (Meyer & Sinani, 2009). Moreover, it is intuitive that MNEs (parent and affiliates) are likely to collectively hold more patents than firms operating in a single market. But a larger portfolio of patents held by MNEs (as compared to single-market firms) can be simply an artefact of patent families.

Innovation theory posits that patent systems characterized by administrative and legal constraints are weak appropriability regimes within which alternative means of appropriation (e.g., secrecy, control of complementary assets) are more effective than patents. As a result, firms become less prone to pursuing patent protection regardless of their ownership (Teeces,

1986). In addition, institutional theory argues that firms behave according to the set of fundamental political, social and legal ground rules – also known as institutions – which “establish (...) the basis for production, exchange and distribution” (Davis & North, 1971, p.6). Waguespack et al. (2009), for example, have shown that the political instability of countries adversely affects local firms’ patent behaviour. While cross-country institutional variability produces cross-national distances (i.e., economic, social, cultural, or political differences) that impact on firms’ behaviour (Berry et al., 2010; Peng, 2008), inter-firm differences are less pronounced when organizations face a similar institutional context that drives them to conform to that domain (DiMaggio & Powell, 1983). That is, firms operating within the same context should present similar behavioural pattern; they become “isomorphic” (DiMaggio & Powell, 1983). Collectively, innovation and institutional theories suggest that both domestic and foreign firms present similar inclination to patent when they come across similar institutional environments.

But foreign-owned and domestic firms present asymmetries in value creation and value capture. For example, in the short-term domestic firms can only benefit from doing business in their home market whereas MNEs can benefit from leveraging resources across numerous business environments (Ghoshal & Barlett, 1990). Thus, MNEs’ inclination to patent may be boosted by unobservable reasons peculiar to this corporate structure that do not affect domestic firms which are, in turn, more concerned with the business environment of their home country, especially if they do not trade abroad. As a result, MNEs are likely to use different knowledge protection strategies across countries. de Faria and Sofka (2010), for instance, have identified that foreign-owned firms in Portugal use patents twice as much as indigenous firms whereas foreign affiliate firms in Germany use patents 40% more often than local firms. Moreover, in weaker appropriability regimes where most foreign-owned firms come from more developed economies, and hence from more stable and stronger patent systems, one could expect foreign-owned affiliates to follow their home country blueprint of using patents to assure rights over innovations².

For example, Albuquerque (2000), using simple statistics of patents issued by the Brazilian Patent Office³ during the period of 1980-1995, found that despite a larger (absolute) number of patents granted to domestic firms foreign affiliates were relatively more intense regarding the number of patents per firm. Costa and de Queiroz (2002) suggest that this might be so because foreign affiliates in Brazil undertake relatively more innovative efforts than local firms, a proposition that was actually corroborated by Kannebley Jr et al. (2005). Therefore, a higher inclination to patent by foreign-owned firms may be simply a result of their superior engagement with innovative activities. Zhao (2006), for example, observed that despite the weakness of some patent systems MNEs are very active in patenting in these countries. According to the author, this behaviour is a result of the integration of subsidiaries into global activities of MNEs so as to compensate for the vulnerability of the local appropriability regime. Keupp et al. (2009) and Yang et al. (2004), for example, have detected that foreign firms adapted to the weak appropriability regime in China. According to the authors, MNEs entered the Chinese market making vast use of patents but as long as they got acquainted with the fragile IPR regime in China they started using other mechanisms to defend their ‘property

² Our argument is based upon the likelihood of using patents since the level of patent activity abroad is known to depend amongst other things on the level of competition, firms’ market power in the focal country, and the current or potential relevance of the market (Bertin & Wyatt, 1988; Granstrand, 2003; Zhao, 2006).

³ Also known in Brazil as the National Institute for Industrial Property, whose Portuguese acronym is INPI.

rights' (e.g., connections with government officials). Thus, MNEs have not abandoned their inclination to use formal IPR but now they use patents in concert with other mechanisms. Kostova and Roth (2002) argue that this behaviour is not unexpected since parent-companies demand their foreign-affiliates to follow their home country institutional pattern. Thus, according to them foreign-affiliates come across an institutional duality since they have to cope with pressures of both the home country and the host country institutional domains. Insofar as a subsidiary's response to the parent's demand is influenced by the appropriateness of that demand in the host country institutional context (ibid.), one should expect domestic and foreign firms to become isomorphic. We thus formulate the following hypothesis (ceteris paribus):

Hypothesis2: In a business environment characterized by a weak patent system, there is no difference in the likelihood of using patents between foreign-owned firms and domestic firms.

Management practices and propensity to patent

Firms' propensities to patent have been largely examined through the lens of neoclassical economics to which firm size, market structure, and technological characteristics are part of an innovation production function (Griliches, 1990). This approach has been useful in explaining firms' patent behavior but it has neglected one potential factor that is likely to affect firms' orientation towards IPR: management practices. Bloom and van Reenen (2007), for example, have observed that the adoption of best management practices can positively affect firms' productivity. Webster (2004) has also shown that management style can have a significant (statistically) relationship with firms' innovativeness. Actually, extant literature has suggested that the managerial approach explains part of firms' heterogeneity as to their patent behavior (Hall & Ziedonis, 2001; Reitzig et al., 2007; Somaya, 2003). For example, Reitzig and Puranan (2009) have examined the impact of organizational factors on the speed of obtaining patent protection. The authors have found that cross-functional involvement of individuals along the IP-value chain (i.e. generation, protection, and utilization) outperforms functional specialization. In addition, prior empirical endeavors have consistently supported the findings of Kortum and Lerner (1999, p.21) who observed that "the increase in patenting has been driven by changes in the management of innovation". In fact, it has become usual to assume that a pro-patent era has emerged, and that the strategic use of patents is widespread (Blind et al., 2009). While these thoughts seem to represent the original picture in more developed institutional settings little is known as to the effects of managerial discretion on firms' propensities to patent in less favorable legal environments for the enforcement of IPR. Hu and Jefferson (2009), for example, have noticed a patent surge in China for which the amendment of patent law, the voluminosity of foreign direct investment, and the accelerated ownership restructuring of state-owned enterprises (toward private-owned) were found to be the most relevant economic forces. Even if indirectly this evidence is consistent with changes in managerial behavior. In particular, a stronger IPR regime and the ownership reform have created incentives for managers to consider patenting more often in China. Thus, the question we bear is whether firms become more likely to patent as a result of adoption of enhanced management practices.

Our question is underpinned by both the role of human capital and incentives in innovation activities. The literature on innovation has long stressed the role of knowledge stock as a critical element to foster innovation (Cohen, 1995). Knowledge, and hence learning, opens up

new opportunities for exploration and exploitation activities (Cohen & Levinthal, 1990). In our research setting, Brazil, a recent report by the World Bank has indicated that human capital is the missing link between innovation and productivity in that country (Rodríguez et al., 2008). The scarcity of a well educated labor force is likely to hinder not only the generation of valuable ideas but also the deployment of sophisticated tools that enhance the capture of value of innovation activities (Mumford, 2000). Although a patent per se is unlikely to be interpreted as an advanced management tool, the increasing adoption of this device could be argued to be in line with prior evidence of changes in the way innovation and patents have been managed (Blind et al, 2009; Granstrand, 2000; Hall & Ziedonis, 2001; Kortum & Lerner, 1999; Reitzig et al., 2007). As for the ‘incentive factor’, after the Uruguay round of the General Agreement on Tariffs and Trade a worldwide harmonization of patent systems has emerged (Forero-Pineda, 2006). The major impact of the 1994 agreement on trade-related aspects of intellectual property rights (TRIPs) on the Brazilian patent system was an amendment of the Brazilian patent law (as of 1996) which allowed patents to be issued for both product and process inventions⁴. Thus, it is expected that managers are responding accordingly, that is, patenting is becoming more widespread. It is disturbing, however, that there is so little empirical evidence on firms’ propensities to patent in weak IPR regimes so as to assess whether changes in management practices have impacted firms’ propensities to patent.

On the one hand the weakness of the patent system in certain countries does not create a proper environment for the use of IPR as a competitive tool (Teece, 1986). Bloom and van Reenen (2007) also observe that there are static and dynamic reasons for the late adoption of better management practices. The former implies that the costs outweigh the benefits of adoption, especially when there is heterogeneity among firms. Also, agency considerations drive managers to entrench themselves in low productive practices. The latter implies that learning is an important component of the diffusion process, and that adjustment costs preclude firms from moving immediately to the best practice.

On the other hand firms in weaker institutional settings mimic their counterparts in stronger institutional contexts. In particular, the fragility of institutions promotes higher uncertainties, and hence managers are more receptive to information implicit in the action of others so as to attain legitimacy to their actions. Westphal et al. (1997), for example, observed that firms’ late adoption of total quality management practices was motivated by managerial pursuit of legitimacy (differently from early adopters whose motivation was driven by efficiency gains). Lieberman and Asaba (2006) advocate that the reasons for business imitation derive from followers’ perception that either others have superior information or that mimetic behaviour will maintain competitive parity (or limit rivalry). So, despite the fragility of the IPR regime managers in weak institutional settings are likely to gradually conform to managerial behaviour more prevalent in stronger institutional settings. So, on the basis of a gradual worldwide patent harmonization and firms’ mimetic behaviour, we hypothesize that even if a business environment is characterized by a weak patent system:

Hypothesis 3: In a business environment characterized by a weak patent system, the likelihood of using patents increases with the adoption of enhanced management practices.

⁴ The Brazilian patent law only allowed inventors to claim property rights over process innovations by 1996.

Methodology

Data

The dataset used to test the hypotheses above come from the Brazilian Industrial Survey of Technological Innovation (also known as Pintec). The Pintec was administered by the Brazilian Institute for Geography and Statistics (IBGE) for the purposes of collecting information on firms' innovative activities in Brazil. The survey instrument employed mirrors the one used in the European Community Innovation Survey (CIS).

The second round of the Pintec was administered in 2004 and relates to innovative activities of firms in Brazil over the period 2001-2003, but this is no time series. This period was used just as a reference for several questions. Therefore, we shall be working with a cross-section of firms. The Pintec was a voluntary survey addressed to firms with more than 10 employees in both manufacturing and services industry. For the purposes of this study we will focus only on the manufacturing industry since this is the context where patents are generated mostly, in particular in Brazil where software cannot be patented.

The achieved sample was 10624 firms, drawn from a population of 84262 records of CEMPRE (an IBGE database with records of firms operating in Brazil). Our analysis, however, relies upon a smaller number (around 1700), since we only use valid responses. The questionnaire raised qualitative and quantitative information of various firms' attributes. The dataset, however, is only accessible at the headquarter of IBGE in Rio de Janeiro by former appointment, which takes from three to six months to be scheduled. After the researchers run the analyses of the dataset IBGE's personnel cross-check the results. The findings are made available to the researchers around one month later. The purpose of this practice is to assure confidentiality of the information in the dataset since the enforcement of the non-disclosure agreement signed by the researchers is unlikely.

The setting

Brazil has been engaged with patent issues for a long time. Although the Brazilian patent system is not among the oldest ones it dates back to the beginning of the nineteenth century. Brazil was one of the earliest signatory countries of the Paris Convention in 1883 as well as of the Patent Cooperation Treaty⁵ (PCT) in 1978. Its patent office was created in 1970 though. Prior TRIPS agreement patents were granted only to process innovations but from 1996 product innovations could also be patented (Rosa, 1998). But despite the effort of the Brazilian authorities to keep pace with the best practices on patent matters the strength of the Brazilian patent system is questionable. Starting with the duration of the examination procedure, the Brazilian Patent Office (also known as INPI, which is the Portuguese acronym for National Institute of Industrial Property) has announced in its home page that it takes around 8 (eight) years for a patent to be granted in Brazil (INPI, 2010). In addition, the difficulty to enforce contracts in Brazil poses another challenge for those seeking patent protection. As illustrated above by an anecdotal case of the researchers having access to the dataset used in this research, the enforcement of contracts in Brazil is not easy. According to

⁵ The Patent Cooperation Treaty (PCT) is an international agreement which came into force in 1978 with 18 member states. It provides a unified procedure for filing patent applications in each of its contracting states (Cornish & Llewelyn, 2003).

Park's (2008) index for patent rights the Brazilian system scored 3.59 (in a scale from 1 to 5) in 2005. Countries like the US and the UK, for example, scored 4.88 and 4.54, respectively. While the Brazilian score for patent rights is not so low, it clearly reinforces that the Brazilian setting is not amongst the conventional contexts within which prior studies have been conducted. Also, the Brazilian score lags behind China (4.08), India (3.76), and Russia (3.68). In addition, other indexes support our argument as to the weakness of institutions in Brazil. The World Bank Enterprises Survey, for example, indicates that less than 20% of the surveyed firms in Brazil believe the court system is fair, impartial and uncorrupted (The World Bank, 2009). Zhao (2006) also compiled a bunch of indexes to categorize the strength of IPR of various countries, and Brazil is amongst those with weak IPR systems.

Variables

Response variable

- *Propensity to patent.* This information was extracted from a survey question which asked respondents whether they used patents over the period 2001-2003. So, our proxy is a binary variable. While this information limits our understanding of the intensity of patents applied for or granted, it allows us to distinguish those that have patents from those that do not have patents as part of their innovation routine.

Explanatory variables

- *Partnership.* A dummy variable was employed to capture the effects of innovation partnerships on firms' propensities to patent. The questionnaire asks companies whether they set up innovation co-operation with other organizations over the period 2001-2003.
- *Ownership.* This attribute derives from a question in Pintec that asks about the ownership of firms, and allows respondents to choose one of the three categories: domestic, foreign, and domestic and foreign.
- *Management.* Pintec's questionnaire also raised questions related to whether firms had gone through organizational changes from 2001 to 2003. In particular, it asked respondents whether enhanced managerial practices had been implemented during the period 2001-2003.

Control variables

We adopt a set of control variables, described below, which should influence both the adoption of meritocracy and the innovative potential of the firm.

- *Firm size.* Size may pick up a set of firm characteristics, such as scale economies in the patenting application process. So, different number of patent applications can be a result of firms' capacity to allocate more resources to patenting rather than being more (or less) innovative (Licht & Zoz, 2000; Scherer, 1983). To measure firm size we used the logarithm of the number of employees in the year 2003⁶.
- *Innovative capacity (ex-ante).* It is commonly accepted in the literature (Hall & Ziedonis, 2001; Cincera, 1997) that the number of patents is a result of firms

⁶ In models used in this study log values are commonly employed because they tend to result in a better fit (as measured by the log-likelihood) than the gross values (Liao, 1994).

knowledge stock, for which R&D expenses are widely used as a proxy. R&D expenses were used in logarithmic form to linearize the relationship with patents, and were also normalized by firm turnover to avoid confounding the effects of the R&D and size variables. As a consistency check we also employed the percentage of staff holding a scientific/ engineering degree to measure firms' innovative capacity. The percentage of firms' staff educated to science and engineering degree level or above was employed to overcome, at least in part, a common criticism of using R&D, that is, smaller firms may be neglected during estimations

- *Innovative capacity (ex-post)*. A dummy variable for whether or not a firm introduced an innovation new to its industry was used. This variable may portray firms' degree of innovativeness because by being novel to the whole industry the product is not only new to the innovator itself, and therefore it differs from current innovations. We use an ex-post variable for innovative capacity because it may supplement any deficiency that the ex-ante innovative capacity variable may have, since this characteristic may be pivotal in determining patenting activity (Cohen, 1995). In our case, its relationship with ex-ante measures is not strong enough to cause colinearity.
- *Degree of competition*. The degree of competition may impact on the use of patents in a number of ways, though this is not unambiguous (Cohen, 1995; Scherer, 1983). We expect firms operating at international/ national level to be in a more competitive environment than those operating at local/regional level. In our empirical models an indicator variable representing the firm's largest market is used as a proxy for the degree of competition. The reference market was the national one, and other markets were i) the state where firms are located (Brazil is geographically divided by states), ii) the region where firms are located (in Brazil regions are well delimited groups of states), and iii) international.
- *Government support*. The literature advocates that patents may become less important for those firms that receive support from the government, especially financial support. The argument is that governmental support is given in exchange for, at best, a modicum license fee to be charged if other firms become interested in the innovation (Griliches, 1990). So, innovators would have minor incentive to pursue patent protection. Although this argument may not necessarily hold nowadays we introduced a dummy variable to account for this possibility.
- *Industry*. It is widely known that firms' patent behavior varies across industrial sectors (Scherer, 1983). Thus, a series of dummies reflecting different market conditions are controlled for.

Method

As we are willing to detect how certain attributes impact on the likelihood of using patents we employ logit models to test our hypotheses. These models have a well known structure. They assume that the dependent variable y is generated by a latent variable y^* whose values are not observed but are a function of the vector x , and of the vector β of unknown parameters. It also has a disturbance term which is assumed to be independent and identically distributed, with zero mean and a shared cumulative density function F which is known up to a scaling parameter (Gourieroux, 2000). This latent variable can be considered random and is defined by the equation below. What we observe is the value of each alternative (y) of the choice set.

$$y^* = \mathbf{x}'\beta + \varepsilon$$

Results and discussion

Estimation results

Covariates	(1)	(2)	(3)	(4)
Innovation partnerships	0.678** (0.298)	0.640** (0.284)	0.743** (0.304)	0.715** (0.287)
Foreign control	0.354 (0.269)	0.286 (0.265)	0.351 (0.246)	0.263 (0.242)
Domestic & foreign control	-0.398 (0.506)	-0.489 (0.516)	-0.387 (0.485)	-0.493 (0.500)
Number of employees	0.417*** (0.092)	0.344*** (0.082)	0.437*** (0.094)	0.335*** (0.087)
R&D intensity	0.181** (0.080)		0.202*** (0.076)	
% Personnel sci./ eng. degree		5.784*** (2.145)		5.575*** (2.022)
Product Novelty	1.116*** (0.228)	1.181*** (0.232)		
Process Novelty			0.420 (0.287)	0.595* (0.345)
State market ^c	-0.278 (0.398)	-0.305 (0.393)	-0.355 (0.357)	-0.400 (0.356)
Regional market ^c	-0.483 (0.410)	-0.557 (0.393)	-0.532 (0.380)	-0.626* (0.368)
International market ^c	0.849** (0.374)	0.890** (0.419)	0.898** (0.392)	0.924** (0.415)
Government support	-0.042 (0.263)	-0.107 (0.290)	-0.022 (0.265)	-0.100 (0.279)
Constant	-4.204*** (0.852)	-6.034*** (0.590)	-3.605*** (0.824)	-5.507*** (0.580)
Industry dummies	Yes	Yes	Yes	Yes
<i>N</i>	1728	1733	1728	1733
Log-Likelihood	-476.62	-477.30	-494.49	-496.20
Model Chi-square	294.34***	301.40***	289.95***	294.75***
Pseudo R ²	0.1971	0.1971	0.1670	0.1653
BIC	1199.25	1200.69	1234.99	1238.51
AIC	1019.24	1020.59	1054.98	1058.41

Table 1. The effects of partnership and ownership on firms' propensities to patent in Brazilian manufacturing

Table 1 presents the estimates of the econometric models employed to test hypotheses one and two. As should be clear from previous section, the dataset is a cross-section and the unit of analysis is the enterprise, henceforth referred as firms. The estimates were obtained using maximum-likelihood methods and the logistic density function. The estimation results derive from models with different control variables for innovative capacity (*ex-ante* and *ex-post*, respectively). The distinction of proxies for *ex-ante* innovative capacity attempts to avoid the impact of non-reporting R&D in the results. It is expected that firms reporting R&D are on

average larger than those not reporting. The distinction of proxies for *ex-post* innovative capacity refers to the type of innovation (i.e. product or process) introduced. Past research has detected that process innovators tend to use secrecy as opposed to patents (Levin et al., 1987), and hence prior studies on firms' propensities to patent have assumed that the control of *ex-post* innovative capacity should focus on product innovation. Nevertheless, as far as we know no prior study has systematically tested whether the effects of other factors are consistent regardless of the innovative capacity accounted for.

Table 1 indicates that the results are consistent across the econometric models. The variability of proxies for innovative capacity has no strong effect on the estimates. The sample enlargement achieved was marginal when the 'percentage of personnel holding a science or engineering degree' was used to represent innovative capacity. So, non-reporting R&D is not a problem, at least within the sample firms. In addition, the best fit (i.e., lower AIC and BIC) was obtained by the first structural model. The results also reinforce that process innovations tend not to be patented. Moreover, market power does not seem to fully compensate for imitation. While a higher degree of competition is conducive to patenting, larger firms are those keener on patenting. Interesting perhaps is that competition matters only when firms depend on trading abroad. Firms competing at national level are not more inclined to patent than are firms competing at local level. Government support does not make firms more active in patenting either.

As for the main effects Table 1 reveals that the impact of innovation partnerships on firms' propensities to patent is contrary to our expectation. The positive and (statistically) significant effect of this factor is in line with the findings of prior studies and, hence, runs against our institutional-based argument. Despite the weakness of the Brazilian patent system (as compared to more developed countries), hypothesis one is rejected since firms engaged in innovation-oriented collaboration are more active in patenting than firms not involved in this kind of collaboration.

Regarding ownership our preliminary analysis of the dataset indicated that foreign controlled firms in Brazilian manufacturing had a higher share of firms that used patents over the period 2001-2003. More specifically, 21% of foreign firms in Brazil used patents whereas 6% of domestic-controlled firms used this appropriability mechanism. While this finding is in line with prior evidence for Brazil (i.e. Albuquerque, 2000) it is not consistent with our second hypothesis. Nevertheless, this preliminary analysis does not account for other confounding effects which we attempted to control for in our econometric approach. By doing so, the dataset revealed that, according to our suspicion, ownership has no effect in determining how inclined a firm is to use patents. As one can observe from Table 1, *ceteris paribus*, foreign firms are not (statistically) different from domestic firms as to their propensity to patent.

In order to assess the effect of the adoption of enhanced management practices we extended model one since this was the model that presented the best fit among the models in Table 1. A somewhat counter-intuitive result emerged: firms that have adopted enhanced management practices have also become less likely to use patents (model 4 in Table 2). Thus, as a consistency check we tested variations of organizational changes so as to assure that the adoption of new managerial practices was not masked by respondents' perception of changes in other organizational dimensions. Pintec's questionnaire asked respondents about their firms' changes in strategy (model 5) and organizational structure (model 6). Models 5 and 6

clearly produce distinct results from model 4. Also, the extended models furnish the same interpretations for the effects of other independent and control variables on the propensity to patent. In addition, model 4 (Table 2) presents a better fit than model 1 (Table 1).

Covariates	^(a) Adoption of Enhanced Management Practices (4)	^(b) Strategy Re-alignment/ Re-formulation (5)	^(c) New Organizational Structure (6)
Organizational changes^{(a),(b),(c)}	-0.638** (0.251)	-0.012 (0.289)	0.087 (0.246)
Innovation partnerships	0.706** (0.301)	0.679** (0.299)	0.678** (0.299)
Foreign control	0.453 (0.272)	0.356 (0.267)	0.351 (0.270)
Domestic & foreign control	-0.311 (0.508)	-0.396 (0.504)	-0.409 (0.507)
Number of employees	0.469*** (0.094)	0.418*** (0.091)	0.415*** (0.093)
R&D intensity	0.193** (0.078)	0.182** (0.078)	0.181** (0.080)
Novelty of innovation	1.201*** (0.223)	1.116*** (0.228)	1.117*** (0.227)
State market ^c	-0.258* (0.379)	-0.279 (0.397)	-0.273 (0.396)
Regional market ^c	-0.427 (0.422)	-0.483 (0.410)	-0.482 (0.406)
International market ^c	0.885** (0.368)	0.849** (0.372)	0.852** (0.375)
Government support	-0.021 (0.250)	-0.0411 (0.264)	-0.056 (0.278)
Constant	-4.089*** (0.827)	-4.200*** (0.839)	-4.230*** (0.867)
Industry dummies	Yes	Yes	Yes
<i>N</i>	1728	1728	1728
Log-Likelihood	-470.97	-476.62	-476.50
Model Chi-square	293.77***	296.75***	293.11***
Pseudo R ²	0.2066	0.1971	0.1973
BIC	1195.39	1206.70	1206.46
AIC	1009.93	1021.24	1021.00

Table 2. The effects of organizational changes on firms' propensities to patent in Brazilian manufacturing

Analysis and discussion

Our motivation to probe into firms' propensities to patent in a weak patent system comes from both existing theoretical and empirical approaches. Theory suggests that institutions are pivotal in shaping firms' behaviour (North, 1990), and empirical evidence has supported this proposition. Weguespack et al. (2005), for example, have examined that political stability

affects firms' patent behaviour. The findings on patenting in Brazilian manufacturing, however, reveal an intriguing pattern. Notwithstanding the characteristics of the Brazilian patent environment, the evidence is ambiguous. Starting with innovation partnerships, our findings reinforce prior evidence that engagement in collaborative activities differentiate firms more inclined to patent from firms less inclined to patent. The literature on firms' propensities to patent (Brouwer & Kleinknecht, 1999; Blind et al., 2006) has advocated that patents are safeguards against opportunistic behaviour in situations of knowledge disclosure. In fact, Hertzfeld et al. (2006) have detected that the issue of dealing with proprietary information is a fundamental one when agents engage in joint-innovation efforts. Nevertheless, due to the weakness of legally binding mechanisms in fragile judicial systems, we expected relational norms (as opposed to contracts) to promote greater support for the exchange of proprietary information (Mesquita & Lazzarini, 2008). The results, however, led us to reject hypothesis one that there is no difference in the likelihood of using patents between firms that engage and firms that do not engage in innovation partnerships in a business environment characterized by a weak patent system. One could argue that this is a result of the innovation-orientation of firms engaging in partnerships, that is, innovation-based collaborations are pursued by more innovative firms and hence more patent-active firms. Yet our econometric models controlled for firms' innovative capacity.

The management literature has indicated that formal and informal mechanisms can be complements for each other in inter-organizational relationships (Poppo & Zenger, 2002). Our interpretation of this finding, however, is similar to Geroski's (1995). That is, by taking out patents firms purchase a not particularly expensive option, and in purchasing this option they will be able to assess whether enforcement is a feasible alternative by the time their IPR is infringed. Moreover, despite the limitations of the institutional setting, and hence the difficulty as to the enforceability of property rights, patents' various attributes seem to justify their joint-innovation collaboration. By codifying knowledge, patents reduce transaction costs, and present an added benefit of signalling for third parties that retaliation is an option in cases of rent expropriation (Gambardella et al., 2007).

As for the ownership issue, Albuquerque (2000) had noticed that in the Brazilian context the share of patents held per firm is larger for foreign-owned firms than for domestic owned ones. Costa and de Queiroz (2002) and Kannebley et al. (2005), however, have suggested that the reason underlying this difference rests with foreign-controlled firms' superior innovative capacity as compared to their domestic counterparts. Our preliminary analysis was in line with Albuquerque's finding, but our econometric does not reject hypothesis two that there is no difference in the likelihood of using patents between foreign-owned and domestic firms. Therefore, despite MNEs' particular advantage over single-market firms as to their potential ability to leverage assets and capabilities (Ghoshal & Barlett, 1990), their propensities to patent in the focal market seem to conform to the institutional context to the extent that their inclination to patent is no different from indigenous firms. Thus, unobservable reasons peculiar to MNEs are not strong enough to make them more likely to patent than domestic firms. All in all, in spite of potential differences in knowledge protection strategies between domestic and foreign firms, they do not seem to differ as to their inclination to patent when other firms' attributes are accounted for. Most prominent determinants of firms' inclination to patent are their size, and innovative capacity. These results for ownership however stress the relevance of institutional theory as to isomorphism between foreign and domestic firms with respect to patent behaviour.

The results above are indicative that regardless of the strength of the patent system firms' propensities to patent are governed by regular factors, though this does not mean a similar patent behaviour (i.e., the way patents are used). These findings could be suggestive that firms in Brazil are facing a pro-patent era as well. Nevertheless, hypothesis three that the likelihood of using patents increases with the adoption of enhanced management practices was rejected. In fact, the result is straightforward: the adoption of enhanced management practices reduces the likelihood of using patents. The better fit of this model as compared to a traditional model that embed an innovation production function without encapsulating managerial behaviour is in line with Webster's (2004) findings, and thus has added value to our understanding of firms' propensities to patent. Our findings are suggestive that not only management matters to determine a firm's inclination to patent but also that the adoption of improvement management practices has led firms to pursue alternative ways to appropriate the returns from innovation. That is, firms in Brazil seem to compensate for deficiencies in the patent system by pursuing alternative managerial approaches. Interesting, perhaps is that they do not differ from their counterparts from more developed institutional settings (as prior studies revealed) when it comes down to using patents as safeguarding devices in innovation partnerships. While prior studies in stronger institutional settings have indicated that firms have become more pro-active in patenting as a result of the way they manage the innovation process (Hall & Ziedonis, 2001; Kortum & Lerner, 1999), this does not seem the reality of firms in Brazil. Neither worldwide patent harmonization (Cornish & Llewelyn, 2003) nor firms' potential mimetic behaviour of their counterparts in more developed settings (Lieberman & Asaba, 2006) was able to induce firms in Brazil to become more inclined to patent.

Concluding remarks

Using firm-level data from the second Brazilian Industrial Survey of Technological Innovation (Pintec), this paper attempted to examine whether firms' propensities to patent are affected differently when operating in a weak institutional environment. Controlling for several common explanatory factors, such as a firm's innovative capacity, size, government support, industrial sector, and the level of market competition, we focused our investigation on three determinants, namely partnership, ownership and management. Our analysis therefore not only builds upon standard models of firms' propensities to patent, but also contributes to the growing research in emerging markets about how the institutional context influences firms' behaviour. Our results indicate that while firms' propensities to patent in Brazil are explained largely by the same factors that explain firms' propensities to patent elsewhere, their inclination to patent differs considerably as a result of improvement in management. In line with institutional and innovation theories, our findings indicate that ownership has no effect on a firm's propensity to patent whereas the engagement in innovation collaboration is a critical determinant for a firm to become more inclined to patent. In addition, our departure from standard models of firms' propensity to patent has shown that the adoption of enhanced management practices by firms in Brazil has made them to avoid using patents as a way to appropriate the returns from innovation.

Our study contributes to both theory and practice. We show that despite changes in Brazilian patent law towards tougher protection, they have not been strong enough to make firms incorporate patenting as a central element of their innovation routine. Firms seem to

compensate for the Brazilian patent system deficiencies by replacing patenting by other managerial tools. At the same time, should partnering be part of a firm's innovation strategy patents are regarded as an important component. On the public policy side, our findings indicate that patent law harmonization has produced no material effect as to firms' widespread engagement with patent practices. Insofar as patent systems are expected to incentivize innovation our finding raises serious concern about Brazilian public policy ability to foster firms' innovativeness.

As for the innovation theory, our findings reinforce that management is pivotal in affecting firms' patent behaviour, and hence deserve further consideration as to the role it actually plays. In addition, our study adds to a growing stream of research on institutional theory by indicating that despite different knowledge strategies firms may have they, at least with respect to patenting, conform to a pattern regardless of their origin (i.e., domestic vs. foreign). Most importantly, despite the apparent fragility of the judicial system transaction costs explanations seem to prevail over the relational governance argument.

Admittedly, our research is limited in several ways. For example, we do not examine whether the adoption of more sophisticated management practices are directly related to the innovation process. In addition, our understanding of the role of patents in the establishment of partnerships is modest. A higher propensity to patent of those involved in innovation partnerships does not indicate that relational mechanisms are unimportant. Finally, we do not make distinctions between innovation partners to assess whether the effectiveness of patents in reducing transactions costs vary across partnership. These are all potential avenues of future research.

References

- Albuquerque, E. M. (2000). Domestic patents and developing countries: arguments for their study and data from Brazil (1980-1995). *Research Policy*, 29(9), 1047-1060.
- An, G., Maskus, K. E., & Puttitanun, T. (2008). Duration of Rent Extraction and the Entry Mode Decision of Multinational Enterprises. *Review of Development Economics*, 12(4), 861-876.
- Arundel, A., & Kabla, I. (1998). What percentage of innovations are patented? Empirical estimates for European firms. *Research Policy*, 27(2), 127-141.
- Athukorala, P.-c., & Kohpaiboon, A. (2010). Globalization of R&D by US-based multinational enterprises. *Research Policy*, 39(10), 1335-1347.
- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.
- Bekkers, R., Duysters, G., & Verspagen, B. (2002). Intellectual property rights, strategic technology agreements and market structure: The case of GSM. *Research Policy*, 31(7), 1141-1161.
- Berry, H., Guillén, M. F., & Zhou, N. (2010). An institutional approach to cross-national distance. *Journal of International Business Studies*, 41, 1460-1480.
- Bertin, G. Y., & Wyatt, S. (1988). *Multinationals and industrial property: the control of the world's technology*. Harvester: Humanities Press International.
- Blind, K., Cremers, K., & Mueller, E. (2009). The influence of strategic patenting on companies' patent portfolios. *Research Policy*, 38(2), 428-436.
- Blind, K., Edler, J., Frietsch, R., & Schmoch, U. (2006). Motives to patent: empirical evidence from Germany. *Research Policy*, 35(5), 655-672.
- Bloom, N., & Van Reenen, J. (2007). Measuring and explaining management practices across firms and countries. [Article]. *Quarterly Journal of Economics*, 122(4), 1351-1408.
- Branstetter, L. G., Fisman, R., & Foley, C. F. (2006). Do stronger intellectual property rights increase international technology transfer? Empirical evidence from U.S. firm-level panel data. [Article]. *Quarterly Journal of Economics*, 121(1), 321-349.

- Brouwer, E., & Kleinknecht, A. (1999). Innovative output, and a firm's propensity to patent.: An exploration of CIS micro data. *Research Policy*, 28(6), 615-624.
- Cantwell, J., & Piscitello, L. (2002). The location of technological activities of MNCs in European regions: the role of spillovers and local competencies. *Research Policy*, 8(1), 69-96.
- Chesbrough, H. W. (2003). The Era of Open Innovation. [Article]. *MIT Sloan Management Review*, 44(3), 35-41.
- Cohen, W. (1995). Empirical studies of innovative activity. In P. Stoneman (Ed.), *The handbook of the Economics of Innovation and Technological Change* (pp. 182-264). Oxford: Blackwell.
- Conner, K. R., & Prahalad, C. K. (1996). A resource-based theory of the firm: knowledge versus opportunism. *Organization Science*, 7(5), 477-501.
- Coombs, J. E., & Bierly III, P. E. (2006). Measuring technological capability and performance. [Article]. *R&D Management*, 36(4), 421-438.
- Cornish, W. R., & Llewelyn, D. (2003). *Intellectual property: patents, copyright, trademarks and allied rights* (5th ed.). London: Sweet and Maxwell.
- Costa, I., & de Queiroz, S. R. R. (2002). Foreign direct investment and technological capabilities in Brazilian industry. *Research Policy*, 31(8-9), 1431-1443.
- Cuervo-Cazurra, A. (2007). Sequence of value-added activities in the multinationalization of developing country firms. *Journal of International Management*, 13(3), 258-277.
- D'Aveni, R. A. (1994). *Hypercompetition: Managing the dynamics of strategic maneuvering* (1st ed.). New York, NY: The Free Press.
- Davis, L. E., & North, D. C. (1971). *Institutional Change and American Economic Growth*. Cambridge: Cambridge University Press.
- de Faria, P., & Sofka, W. (2010). Knowledge protection strategies of multinational firms--A cross-country comparison. *Research Policy*, 39(7), 956-968.
- Duguet, E., & Kabla, I. (2000). Appropriation strategy and the motivations to use the patent system: An econometric analysis at the firm level in French manufacturing. . In D. Encaoua, B. H. Hall, F. Laisney & J. Mairesse (Eds.), *The economics and econometrics of innovation* (pp. 267-305). Boston: Kluwer Academic Publishers.
- Economist Intelligence Unit. (2004). Scattering the seeds of invention: The globalisation of research and development. London: The Economist.
- Forero-Pineda, C. (2006). The impact of stronger intellectual property rights on science and technology in developing countries. *Research Policy*, 35(6), 808-824.
- Fritsch, M., & Lukas, R. (2001). Who cooperates on R&D? *Research Policy*, 30(2), 297-312.
- Galende, J. (2006). Analysis of technological innovation from business economics and management. *Technovation*, 26(3), 300-311.
- Geroski, P. (1995). Markets for technology: knowledge, innovation, and appropriability. In P. Stoneman (Ed.), *The Handbook of the Economics of Innovation and Technological Change* (pp. 90-131). Oxford: Blackwell.
- Ghoshal, S., & Bartlett, C. A. (1990). The multinational corporation as an interorganizational network. *Academy of Management Review*, 15(4), 603-625.
- Granovetter, M. S. (1985). Economic action and social structure. *American Journal of Sociology*, 91, 481-510.
- Granstrand, O. (1999). *The economics and management of intellectual property: towards intellectual capitalism*. Cheltenham: Edward Elgar.
- Granstrand, O. (2003). Innovation and intellectual property studies. In O. Granstrand (Ed.), *Economics, law and intellectual property* (pp. 9-40). Boston, MA: Kluwer Academic Publishers.
- Griliches, Z. (1990). Patent statistics as economic indicators: a survey. *Journal of Economic Literature*, 28(4), 1661-1707.
- Hagedoorn, J. (2002). Inter-firm R&D partnerships: an overview of major trends and patterns since 1960. *Research Policy*, 31(4), 477-492.
- Hall, B. H., & Ziedonis, R. H. (2001). The patent paradox revisited: An empirical study of patenting in the U.S. semiconductor industry, 1979-1995. *The RAND Journal of Economics*, 32(1), 101-128.
- Hanel, P. (2006). Intellectual property rights business management practices: A survey of the literature. *Technovation*, 26(8), 895-931.
- Hu, A. G. (2010). Propensity to patent, competition and China's foreign patenting surge. *Research Policy*, 39(7), 985-993.
- Hu, A. G., & Jefferson, G. H. (2009). A great wall of patents: What is behind China's recent patent explosion? *Journal of Development Economics*, 90(1), 57-68.

- Hurmelinna-Laukkanen, P., Sainio, L.-M., & Jauhiainen, T. (2008). Appropriability regime for radical and incremental innovations. *R&D Management*, 38(3), 278-289.
- Ito, B., & Wakasugi, R. (2007). What factors determine the mode of overseas R&D by multinationals? Empirical evidence. *Research Policy*, 36(5), 1275-1287.
- Johnson, S., LaPorta, R., Lopez-de-Silanes, F., & Shleifer, A. (2000). Tunneling. *American Economic Review*, 90(2), 22-27.
- Kafouros, M. I., Buckley, P. J., Sharp, J. A., & Wang, C. (2008). The role of internationalization in explaining innovation performance. *Technovation*, 28(1-2), 63-74.
- Kannebley-Jr, S., Porto, G. S., & Pazello, E. T. (2005). Characteristics of Brazilian innovative firms: An empirical analysis based on PINTEC—industrial research on technological innovation. *Research Policy*, 34(6), 872-893.
- Keil, T., Maula, M., Schildt, H., & Zahra, S. A. (2008). The effect of governance modes and relatedness of external business development activities on innovative performance. [Article]. *Strategic Management Journal*, 29(8), 895-907.
- Keupp, M. M., Beckenbauer, A., & Gassmann, O. (2009). How managers protect intellectual property rights in China using *de facto* strategies. *R&D Management*, 39(2), 211-224.
- Kortum, S., & Lerner, J. (1999). What is behind the recent surge in patenting? *Research Policy*, 28(1), 1-22.
- Kumar, N. (2001). Determinants of location of overseas R&D activity of multinational enterprises: the case of US and Japanese corporations. *Research Policy*, 30(1), 159-174.
- LaPorta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. (1998). Law and finance. *Journal of Political Economy*, 106(6), 1113-1155.
- Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27(2), 131-150.
- Lederman, D. (2010). An international multilevel analysis of product innovation. *Journal of International Business Studies* 41, 606-619.
- Lerner, J. (2002). 150 years of patent protection. *American Economic Review*, 92(2), 221-225.
- Lerner, J. (2009). The Empirical Impact of Intellectual Property Rights on Innovation: Puzzles and Clues. *American Economic Review*, 99(2), 343-348.
- Lev, B. (2001). *Intangibles: management, measurement, and reporting*. Washington, DC: Brookings Institution Press.
- Levin, R. C., Klevorick, A. K., Nelson, R. R., & Winter, S. G. (1987). Appropriating the returns from industrial research and development. *Brookings Papers on Economic Activity*, 18(3), 783-820.
- Lieberman, M. B., & Asaba, S. (2006). Why do firms imitate each other? *Academy of Management Review*, 31(2), 366-385.
- Lieberman, M. B., & Montgomery, D. B. (1998). First-mover (dis)advantages: Retrospective and link with the resource-based view. [Article]. *Strategic Management Journal*, 19(12), 1111-1125.
- Mansfield, E. (1986). Patents and innovation: An empirical study. *Management Science*, 32(2), 173-181.
- Mansfield, E., Schwartz, M., & Wagner, S. (1981). Imitation costs and patents: an empirical study. *The Economic Journal*, 91(364), 907-918.
- Marin, A., & Bell, M. (2010). The local/global integration of MNC subsidiaries and their technological behaviour: Argentina in the late 1990s. *Research Policy*, 39(7), 919-931.
- Mesquita, L. F., & Lazzarini, S. G. (2008). Horizontal and vertical relationships in developing economies: Implications for SMEs' access to global markets. *Academy of Management Journal*, 51(2), 359-380.
- Meyer, K. E., & Sinani, E. (2009). When and where does foreign direct investment generate positive spillovers? A meta-analysis. *Journal of International Business Studies*, 40(7), 1075-1094.
- Miller, S. R., Li, D., Eden, L., & Hitt, M. A. (2008). Insider trading and the valuation of international strategic alliances in emerging stock markets. *Journal of International Business Studies*, 39(1), 102-117.
- Mowery, D. C. (2009). *Plus ça change: Industrial R&D in the "third industrial revolution"*. *Industrial & Corporate Change*, 18(1), 1-50.
- Mumford, M. D. (2000). Managing creative people: strategies and tactics for innovation. [Article]. *Human Resource Management Review*, 10(3), 313-351.
- Nieto, M. J., & Santamaría, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation*, 27(6-7), 367-377.
- OECD. (2006). *Emerging Multinationals: Who are They? What Do They Do? What is at Stake?* Paris: OECD.
- Pearce, J. L., Dibble, R., & Klein, K. (2009). The Effects of governments on management and organization. *The Academy of Management Annals*, 3(1), 503-541.
- Peng, M. W., Wang, D. Y. L., & Jiang, Y. (2008). An institution-based view of international business strategy: a focus on emerging economies. *Journal of International Business Studies* 39(5), 920-936.

- Poppo, L., & Zenger, T. R. (2002). Do Formal Contracts and Relational Governance Function as Substitutes or Complements? *Strategic Management Journal*, 23(8), 707-725.
- Prahalad, C. K., & Bettis, R. A. (1986). The dominant logic: A new linkage between diversity and performance. *Strategic Management Journal*, 7(6), 485-501.
- Reitzig, M., Henkel, J., & Heath, C. (2007). On sharks, trolls, and their patent prey--Unrealistic damage awards and firms' strategies of "being infringed". *Research Policy*, 36(1), 134-154. doi: DOI: 10.1016/j.respol.2006.10.003
- Reitzig, M., & Puranam, P. (2009). Value appropriation as an organizational capability: the case of IP protection through patents. [Article]. *Strategic Management Journal*, 30(7), 765-789.
- Rodríguez, A., Dahlman, C., & Salmi, J. (2008). Knowledge and innovation for competitiveness in Brazil. Washington, DC: The World Bank.
- Sarkissian, A. (2008). Intellectual property rights for developing countries: Lessons from Iran. *Technovation*, 28(11), 786-798.
- Scherer, F. M. (1965). Firm size, market structure, opportunity, and the output of patented inventions. *American Economic Review*, 55, 1097-1125.
- Scherer, F. M. (1983). The propensity to patent. *International Journal of Industrial Organization*, 1(1), 107-128.
- Schmookler, J. (1962). Determinants of inventive activity. *The American Economic Review*, 52(2), 165-176.
- Scotchmer, S. (2004). *Innovation and incentives*. Cambridge, MA: The MIT Press.
- Sherwood, A. L., & Covin, J. G. (2008). Knowledge acquisition in university–industry alliances: An empirical investigation from a learning theory perspective. *Journal of Product Innovation Management*, 25(2), 162-179.
- Taylor, C. T., & Silberston, Z. A. (1973). *The economic impact of the patent system: a study of the British experience*. Cambridge: Cambridge University Press.
- Teece, D. J. (2000). Strategies for managing knowledge assets: the role of firm structure and industrial context. *Long Range Planning*, 33(1), 35-54.
- Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42: (1), 35-67.
- van Zeebroeck, N., van Pottelsberghe de la Potterie, B., & Guellec, D. (2009). Claiming more: The increased voluminosity of patent applications and its determinants. *Research Policy*, 38(6), 1006-1020.
- Veugelers, R., & Cassiman, B. (1999). Make and buy in innovation strategies: evidence from Belgian manufacturing firms. *Research Policy*, 28(1), 63-80.
- Villalonga, B. (2004). Intangible resources, Tobin's q, and sustainability of performance differences. *Journal of Economic Behavior and Organization*, 54(2), 205-231.
- von Zedtwitz, M., & Gassmann, O. (2002). Market versus technology drive in R&D internationalization: four different patterns of managing research and development. *Research Policy*, 31(4), 569-588.
- Waguespack, D. M., Birnir, J. K., & Schroeder, J. (2005). Technological development and political stability: Patenting in Latin America and the Caribbean. *Research Policy*, 34(10), 1570-1590.
- Webster, E. (2004). Firms' decisions to innovate and innovation routines. [Article]. *Economics of Innovation & New Technology*, 13(8), 733-745.
- Williamson, O. (1979). Transaction-cost economics: The governance of contractual relations. *Journal of Law and Economics*, 22(2), 233-261.
- Williamson, O. (1991). Comparative economic organization: The analysis of discrete structural alternatives. *Administrative Science Quarterly*, 36(2), 269-296.
- Yang, D., Sonmez, M., & Bosworth, D. (2004). Intellectual property abuses: How should multinationals respond? *Long Range Planning*, 37(5), 459-475.
- Zaheer, A., & Venkatraman, N. (1995). Relational Governance as an Interorganizational Strategy: An Empirical Test of the Role of Trust in Economic Exchange. *Strategic Management Journal*, 16(5), 373-392.
- Zhao, M. (2006). Conducting R&D in countries with weak intellectual property rights protection. *Management Science*, 52(8), 1185-1199.