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From new to the firm to new to the world. Effect of geographical proximity and technological capabilities on the degree of novelty in emerging economies

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Abstract

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Keywords: degree of novelty, technological capabilities, technological sourcing, research collaboration, region

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This paper investigates empirically what it takes for a firm to move from new to the firm to new to the domestic market and new to the world innovations. More specifically, the paper analyses the relationship between, on the one hand, the degree of novelty of product innovation and on the other hand the accumulation of technological capabilities at firm level as well as the geographical spread of the innovation activities of the firm. The analysis is based on a unique firm level data collected in Pune (India) and Beijing (China) in 2008. The paper shows that the role of the region supporting the move from new to the firm to new to the world is limited. In order to achieve a higher degree of innovation global networks are more important than local networks.

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1. Introduction

The spatial distribution of innovation activities and its impact on innovation performance and growth is one of the most important topics addressed in Economic geography in the last decade, both from a theoretical (Bathelt et al., 2004; Storper and Venables 2004; Boschma, 2005) and empirical perspective (Asheim and Isaksen, 2002; Coenen et al., 2004; Moodysson et al., 2008). Scholars in this line of research have made fundamental contributions to our understanding the interplay between local and global knowledge linkages, the stickiness of tacit versus codified knowledge and the observable differences across industries or even activities within the same industry in terms of the spatial patterns of their innovation activities (Bathelt et al. 2004; Coenen et al., 2006; Moodysson et al., 2008). However, almost all contributions in this line of research are based on evidence collected in firms and regions in developed countries.

Firms in developing countries are very seldom ‘new to the world’ innovators. They innovate often by acquiring technology developed abroad and adapting it to the local needs. In this respect, innovation in developing countries has traditionally been equal to new to the firm innovations. However, in the last decade we have witnessed a growing number of cases of new to the world innovations coming from developing countries, particularly from fast growing countries like China and India which have triggered the increasing interest of economic geographers on the changing geography of innovations at a global scale (Bunnell and Coe, 2001; Scott, 2000).

Whilst a handful of firms have achieved ‘new to the world’ innovations, the majority of firms in new industrialized economies still experience some difficulties in reaching a certain degree of novelty of their innovation, in particular for what concerns product innovation (Kim and Nelson, 2000; Zhou and Xin, 2003; Srholec, 2008). There are several possible causes for this relatively low performance in terms of innovation

In line with the resource-base theory of the firm (Barney, 1996, Foss, 1997, Wernefelt, 1984) scholars in development economics and innovation argue that it is the lack of internal technological capabilities (Lall, 1992, Bell and Pavitt, 1993) what hampers the ability of the firm to upgrade and engage in innovation activities. Higher technological capabilities are thus expected to lead to higher degrees of novelty in product innovation.
Firms that collaborate with their partners and access knowledge from external sources have usually better conditions for sustaining a higher degree of novelty of product innovation (Nieto and Santamaria, 2007; Tether 2002 cf Nieto and Santamaria, 2007). In this respect the economic geography literature highlights the role of the regional innovation system (RIS) in which the firms are embedded and the importance of the interactions with local actors in the immediate environment as factors sustaining the firms’ innovative performance (Bathelt et al., 2004; Storper and Venables, 2004; Asheim and Gertler, 2005; Cooke, 1996; Maskell and Malberg, 1999).
Scholars in development studies and international business literature, on the other hand, stress the relevance that international linkages and the transfer of knowledge and collaboration have for the innovation performance of firms, particularly in developing countries (Dantas et al., 2005; Humphrey and Schmitz 2002; Morrison et al., 2006;

Gereffi 1999; Pietrobelli and Rabellotti, 2007). The link with the international actors allow the firms to access resources and skills that can not be produced by the firms themselves or directly in the local environment. As stress by Coe et al. (2004), to understand the development of regions and countries both the regional territorialized networks and the global networks need to be taken into account.

Hitherto, few empirical analyses have contemporarily studied which internal and external factors may positively affect the degree of novelty and the frontier of innovation. and none of these studies have investigated the phenomenon in developing countries. Amara et al. (2008), for example, studied the relation between leaning and novelty of innovation in Canada arguing that learning by interacting has an impact on the degree of novelty. They suggest that firms should invest in their research and information network, but they fail to distinguish between short and long distance interactions. Nieto and Santamaria (2007), who conducted a study in Spain, link also the novelty of product innovation and the type of collaborative networks, but they focus only on the types of partners ignoring completely their geographical location.

Moreover, no studies related to the external factors have empirically investigated how changes in the geographical spread of the network can impact the degree of innovation or, in other words, which internal and external factors can support the transition from new to the firm to new to the world innovations. As stressed by Metcalfe and Ramlogan (2008), innovation should be perceived as a continuous learning process that happens at different stage. It is therefore necessary to understand the mechanisms that can lead firms in developing countries to increase their innovation capabilities beyond the innovation that is only new to the firm, and consequently that may sustain their competitive position with respect to the firms in developed countries.

This paper aims to contribute to this research gap by analyzing the linkages between the degree of novelty, firms' technological competences and the geographical spread of external networks using unique data collected in Beijing (China) and Pune (India) regions in 2008. More specifically, this paper addresses the following research questions:

- How are firms in Beijing and Pune performing in terms of product innovation?
- What factors can facilitate the transition from new to the firm to new to the market innovation?
- How does the geographical proximity/distance of technological sources and of R&D partners affect the degree of novelty of firms' product innovation?

The paper is organized as follows. Section 2 of this paper discusses the theoretical framework and presents the hypotheses to be tested, section 3 presents the Beijing and Pune regions and their performance in terms of innovation; section 4 introduces the data and the variables used for the econometric analysis. Section 5 discusses the main results. Section 6 concludes.

2. Theoretical framework

2.1. Degree of novelty in innovation

Even since the seminal work of Joseph Schumpeter, the issue of the degree of novelty of product innovations and its impact on growth has been present in innovation studies. While Schumpeter makes a clear distinction between radical and incremental innovations attending to the technological content of the innovation, other sources propose to distinguish between new to the firm, new to the industry or market and new to the world innovations by focusing on the market of that specific innovation. Far from being exclusive, these two approaches (technology versus market) are complementary (Garcia and Calantone, 2002).

Probably, the most widely used definition of the degree of novelty, at least in surveys, is that of the OECD (1992, 1997, 2005). The OECD distinguishes between technologically new and significantly technologically improved innovations[1] on the one hand as well as new to the firm, industry and world innovations on the other. Technologically new product is defined as "a product whose technological characteristics or intended uses differ significantly from those of previously produced products. Such innovations can involve radically new technologies, can be based on combining existing technologies in new uses, or can be derived from the use of new knowledge" (OECD, 1997: 32). Technologically improved innovations are, on the other hand, existing products whose performance has been significantly enhanced or upgraded through the use of higher-performance components or materials or one of its subsystems (OECD, 1997: 32). Additionally, the OECD proposes to distinguish between three degrees of novelty of innovation, from new to the firm, to an intermediate level that is new to the market or industry and to new to the world as the highest possible degree of novelty. An innovation is new to the world if the firm has introduced a new or significantly improved good or service onto the global market before competitors. It is new to the market or industry if the firm is the first in that specific market or industry to have implemented it. It is new to the firm if the innovation was already available from its competitors in its market. These are the definitions that are used in this paper.

It has been generally argued that the proportion of firms introducing innovations that are new to the firm versus new to the world varies significantly between developed and developing countries. Whilst most of the new to the world innovations are being implemented by firms headquartered in the North, the product innovation in the South is often behind the technological frontier: it is mainly imitative innovation, therefore more related to the acquisition of technology developed somewhere else and adaptated to the local needs that to the development of new products (Bell, 2002; Bell and Pavitt, 1993; Kim, 1997; Knell and Shrolec, 2009; Shrolec, 2008; Hobday, 2000).

However, the rapid growth of countries like China and India in the last decades is challenging this (Altenburg et al., 2006; Altenburg et al., 2008). In the last few years we

[1] Refer to as major product innovations and incremental product innovations in previous versions of the manual, more in accordance to the general distinction between radical and incremental innovations.

have witnessed an increase in the number of new to the world innovations coming from these new emerging economies. In this paper we investigate if the global distribution of innovation activities is beginning to shift in directions of these new industrialized economies. For doing so, we consider more appropriate to assess the degree of geographical extension of the product innovation in the market following the OECD guideline (2005) that distinguishes between innovations that are: ´new to the firm´ ´new to the domestic market´ (instead of new to the industry) or ´new to the world´. The distinction between new to the domestic market and new to the world will allow us to indirectly assess if the innovation is new only to a developing country market or also to developed countries' markets. This, as we will discuss later, has important implications in terms of the technological capabilities and networks needed to move from a lower degree of innovation to a higher degree of innovation.

2.2. Internal and external factors impacting the firm's innovation performance

The literature on innovation has abundantly discussed which factors can lead to an improvement of firms' innovation performance in terms of the novelty of its innovations. Most of the literature distinguishes between internal and external factors (Romijin and Albaladejio, 2002).

Among the internal factors, skills and technological capabilities (Srholec, 2008) are a crucial determinant of the effective innovative capacity of the firms, since these type of capabilities have often a positive direct and indirect effect on the innovation output (Dantas et al, 2007; Vega-Jurado et al., 2008). Human capital is crucial for innovation (Acs et al, 1987). It determines not only the ability of the firm to produce innovations but also its absorptive capacity, that is, the ability to utilise available information and knowledge that comes from interaction with other organisations, such as other firms, users or knowledge providers (i.e. research institutions) (Cohen and Levinthal, 1990; Giuliani and Bell, 2005). With regards to technological capabilities, Lall (1992) proposes to distinguish between product related technological capabilities and process related technological capabilities. In product related technological effort, Lall (1992) includes, among others, R&D expenditures and patents, while in process related technological effort he includes the (investment in) acquisition of machinery, certifications and standards as well as the introduction of new processes that may increase the technological performance of the firm.

The presence and intensity of internal R&D activities both performed at formal and informal level (Romijin and Albaladejio, 2002, Cohen and Levinthal 1989, 1990) increases the absorptive capacity of the firms and consequently the ability of the firms to acquire, use and access new knowledge to develop innovation, thus having also an indirect impact on the ability of the firm to innovate. Some authors argue that the firm's internal capacity to develop patents also affects the ability of the firm to innovate beyond new to the firm innovations (Caloghirou et al, 2004; Griliches et al., 1987, 1990; Schilling and Phelps, 2007). However, the empirical evidence using patents as an indicator of internal capabilities is somehow limited to certain industries in which patents are used as a means for protection of the innovations.

Eventually, the process-related technological capabilities of the firms are measured also by the presence in house of advanced machinery and equipment that may help the firm to sustain the quality and performance of its innovation outputs as it may improve the technological processes of the firm (OECD, 2005).

We may expect that:

Hp. 1: *Internal technological competences of the firms such as qualified human capital, the presence of intramural R&D, patents and the quality of machinery and equipments affect positively the degree of innovation*.

If part of the literature stresses that a minimum of internal technological competences are required to increase the firm's innovative performance, the economic geography literature and the international business literature highlight that it is the external linkages of the firm what supports innovation in the firm. Firms do not innovate in isolation but in continuous interaction with other organizations in their environment (Freeman, 1987; Lundvall, 1992; Nelson, 1993). Firms interact for research collaboration, to source technology or simply to access new ideas that will serve as an input for the innovation process.

Interactions can take place both at local, national or international level. The Economic Geography Literature has long emphasized that it is the regional innovation system (RIS) and the local buzz[2] where firms are embedded what determines firm's innovative capacity (Bathelt et al., 2004; Storper and Venables, 2004; Asheim, 1995; Asheim and Gertler, 2005; Asheim and Isaksen 1997; Cooke, 1992; Cooke, 1996). This stream of the literature, which found historical roots in industrial districts and cluster studies, emphasizes the impact of locality for knowledge spillovers and innovation (Marshall, 1920; Piore and Sabel 1984; Porter 2000; Storper, 1997). Firms and organizations located within short proximity distance share among them network relations of (mainly) tacit and informal nature that are crucial for innovation. Together they constitute a specialized pool of knowledge from which it is possible to derive localized competitive advantages in term of innovation due to the common and collective cumulative path of learning and coordination, and close face to face interaction (Storper 1997; Storper and Venables 2004).

We may therefore expect that:

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[2] Bathelt et al. (2004) defines local buzz as: '*[…]information and communication ecology created by face-to face contacts, co-presence and co-location of people and firms within the same industry and place and region [..where is apply..] the same interpretative schemes and mutual understanding of new knowledge and technologies, as well as shared cultural traditions and habits within a particular technology field .*', p. 38.

Hp. 2: *The presence of local sources of technology and local research collaboration affect positively the degree of innovation*

The initial regional innovation system literature put almost an exclusive emphasis on the endogenous local capacity to develop innovation almost ignoring the interplay between regional and global linkages (Altenburg et al. 2008; Maskell and Malberg, 1999)[3]. In the last years there has been an increase in the amount of studies related to the role of the extra- regional linkages for innovation capabilities, complementing the role of the regional network in sustaining the firm's innovative performance (Bathelt et al., 2004; MacKinnon et al., 2002; McKelvey et al., 2003; Giuliani et al., 2005, Gertler and Levitte, 2005; Moodysson 2008; Moodysson et al., 2008; Gertler 2008; Chang, 2009).

Extra-regional networks are particularly important for firms in developing countries which relay strongly on the international acquisition of technologies (Gereffi, 1999; Gereffi and Kaplinsky, 2001; Gereffi et al., 2005; Ernst, 2002; Ernst and Kim, 2002; Giuliani et al. 2005; Humphrey and Schmitz, 2000, 2002; Lee et al., 1988; Morrison et al. 2006) and on the spillovers from MNCs located in their proximity (Cantwell and Piscitello, 2007; Saliola and Zanfei, 2009). As described by Morrison et al. (2006), it is in particular the 'internationalist' approach that emphasizes international actors' strategic and primary role on technological development and upgrading of firms in less developed countries. Successful firms in the path of technological developments are therefore those able to internalize and assimilate the foreign technologies and knowledge in order to acquire higher level of novelty and to improve actively their innovation performance.

We may expect that:

Hp. 3: *Firms with global sources of technology and global research collaboration have a high propensity to develop higher degree of innovation*

These three hypothesis will be tested using firm-level data collected in Pune and Beijing in 2008.

3. Pune and Beijing regions

Beijing is considered to be the scientific and technological heart of China and thus the leading Science and Technology (S&T) region both in terms of its research infrastructure as well as its innovation performance (Guan et al. 2009)[4]. In total, 71 universities and 371

[3] Only recently economic geographers dealing with regions and clusters have started to consider the presence and the effect of global knowledge flows into the spatial endowments where firms are embedded. Moreover, empirical and theoretical studies on these issues refer still mainly to conceptual and geographical frameworks developed on the basis of well-known spatial phenomena concentrated in developed countries.

[4] However, Beijing's centrality as a knowledge center in China has been declining over time as other centers emerge as active players in the national innovation system, notably Shanghai and Guangdong (Hong, 2008)

research institutes were located in Beijing at the end of 2003 (Beijing statistical Information Net, 2005 cf Chen and Kenney, 2007). Among them, are some of the Asian best known universities and research institutions like the Chinese Academy of Sciences (CAS), Peking University and Tsinghua Univesity. In 2005, CAS employed more than 37000 scientists and engineers, while in 2002 Peking University and Tsinghua University employed approximately 26000 scientists and technicians (Chen and Kenney, 2007). One of the most important IT science park, the Zhingguancun Science Park (ZGC) is also located in Beijing, in the Haidan district and in close proximity to CAS, Peking University and Tsinghua University. Moreover, it is estimated that around 400 R&D centers from multinational corporations are located in Beijing and Shanghai, which represents approximately 50% of all R&D centers located in China in 2005-2006 (China Knowledge, 2009).

This large concentration of research institutes and universities in Beijing explains the high performance of the region in terms of innovation. With regards to the later, almost 40% of S&T initiatives in mainland China are performed in Beijing (Research Group of Chinese S&T development strategy, 2002 cf Guan et al., 2009). In 2000, a quarter of the government S&T funds ended up in institutions located in Beijing and about 18% of all patents were also granted to firms in Beijing (Chen and Kenney, 2007). Furthermore, Beijing is considered as the most active municipality in terms of technology transfer from university to industry (Hong, 2008).

Industrially, Beijing has a specialization in high-tech industries. In recent years, approximately between one forth and two thirds of the city's total industrial added value corresponded to high-tech business (Chen and Kenney, 2007; Guan et al., 2009). Some of the world champions in ICT technologies like Lenovo or ZTE are headquartered in Beijing.

Pune is increasingly calling the attention of academics as a growing research and innovation center in India, gradually catching up with Bangalore[5]. Its proximity with Mumbai as well as the combined presence of foreign companies, research labs and good education and research institutions are considered to be attraction factors for multinational companies to establish their production and, more recently, R&D activities in Pune. In 2008, it was estimated that around 600 R&D centers of multinational corporations were established in India. Of those, approximately a hundred were set in Pune, and around 312 in Bangalore (Zinnov, 2009).

In 2007 in the Pune region there were 9500 manufactured units in contrast with the 4529 in 1985, showing a continuous growth in particular in the last years. The majority of firms in the area are micro (4790), small and medium firms (4600), while large firms are few (1.15% of the total units), but contributing about 15% of the total employment (MCCIA, 2008). Pune is characterized by a strong presence of firms in the IT, auto-component, chemical and pharmaceutical industries. Biotechnology is also represented nowadays as an emerging sector in the local cluster (Basant and Chandra, 2007). The

[5] Although still at a significant distance, other important regions in India in terms of research and education are Delhi, Chennai, Hyderabad, Mumbai and Kolkota.

automotive industry, one of the oldest industry in Pune, had an expansion period between 1960 and 1990 and at the beginning of 2000. Between 2001 and 2005 more than 5000 SMEs manufacturing auto-related product have registered with the local District Industries Centre. Pune region has also a long tradition in agro-processing and nowadays the food-processing industry is becoming a new important hub. Around 1700 firms and a total of 30000 employees belong to this last subsector (MCCIA, 2007). The IT industry and the biotech industry represent the two new drivers of the Pune Economy. For the IT industry in the area it is possible to count over 1000 IT and ITES companies, and about 200 IT Parks and set up hosting the companies (MCCIA, 2009).

The Pune area, as the Bangalore area, offers a large amount of educational facilities such as important academic institutions and technology development centers (e.g. Tata Research Development Center) able to maintain a variety of linkages with the local industry (Basant and Chandra, 2007). The city of Pune counts 6 universities and 600 functional colleges and PG departments (MCCIA, 2008). The presence of a certain number of educational institutions in Pune allows a good access to skilled labor, training and R&D facilities devoted to implement the need of the local market. Technical and engineering education aimed at training in particular the employees in the ICT and auto-component industries in the area is ensured by the presence of engineering and professional colleges such as the Pimpri Chinchwad College of Engineering and the Modern Education Society’s college of Engineering. The colleges sustain the current growth of local expertise in the field of engineering services and design.

Other institutions are instead relevant for training and research in biotechnology and pharma, e.g. the Indian Drugs Research, the Agharkar Research Institute and the National Chemical Laboratory (NCL). The latest, funded in 1950 and part of the Council for Scientific and Industrial Research, is recognized as one of the most important research-oriented academic institutions in India in the field of chemical and biochemical sciences and it is well known for its flourishing patents activity and the numerous contract researches, consultancies and training services offered not only to Indian firms but also to foreign MNCs companies (Basant and Chandra, 2007).

Both Beijing and Pune are considered to be knowledge hubs in their respective countries, hosting some of the most innovative domestic companies as well as a large amount of very innovative multinationals. But they are also home for a large number of indigenous firms with medium to low tech capabilities, as will be discussed next.

4. Methodology and empirical analysis

4.1. The sample

The empirical analysis is based on firm-level primary data collected through a survey in the Pune (India) and Beijing (China) regions in 2008. In total, 884 questionnaires were collected. The survey targeted firms in three sectors in both regions: automotive component, green-biotech and software[6].

After having cleaned the data and isolated the firms that during 2007 declared that had introduced product innovations with a positive impact on the firms' performance, the total number of observations was reduced to 368.

The survey enquired firms about their innovation activities, internationalization strategies, competences and local-global linkages, and targeted firms in three sectors in both regions: automotive components, green-biotech and software.

For the Pune area, we used a random sample out of different databases bought from Indian industry associations. The survey was conducted using face to face interviews, followed up by phone calls when necessary. For small and medium enterprises, in most cases the interviewee was the owner-manager, while in larger firms the interviewee was usually the R&D Head or his/her deputy. The response rate was around 40%.

In the Beijing area, we used a sample extracted from different databases from a market research company (Sinotrast) as well as from a software testing center (CSTC) for the software industry only. The survey was conducted mainly by phone with an average response rate of 20%. The firms from the CSTC database were contacted by email. The response rate in this last case was around 7%. Few interviews were conducted face to face. Like in Pune, the interviewee was mainly the owner for SMEs and the R&D manager for large firms.

4.2. Data and variables used for the econometric analysis

To understand the relationship between the degree of novelty and the internal and external factors that may affect the innovative performance of the firms in the two emerging regions (Pune and Beijing), we ran an econometric analysis.

4.2.1. Degree of novelty (Dependent variable)

To assess the degree of novelty of product innovation[7] introduced by the firms we have chosen to qualify it with 3 nominal categories: *New to the firm*; *New to the domestic market*; *New to the world***.**

We represented these three different degrees of novelty through a dependent variable equal to 0 when the firm introduced a product innovation new to the firm; 1 when the firm introduced a product innovation new to the domestic market and 2 when the firm introduced a product innovation new to the world.

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[6] According to Pavitt's view the geography of knowledge flows is also influenced and characterized by different industrial patterns depending on the specific driver of technological change prevailing in a industry (Pavitt 1984). For the project we decided to include a science-driven industry -green biotech-; scale-intensive -automotive sector-, and specialized supplier -software industry.

[7] Product innovation refers here to the introduction of new products as well as new services

4.2.2. Internal and external factors (Independent variables)

The internal technological competences

As mentioned in section 2 the level of the technological competences of the firm can affect the innovation performance. Empirically the technological capabilities can be measured by different proxies, as for example, the presence of R&D activities, the capacity of the firm to develop own patents; the quality of the machinery and equipment used for the production activities.
In our analysis we included all these types of proxy with the following variables:

R&DINTRA: a dummy variable that indicates as 1 the presence of intramural R&D activities undertaken within the enterprise during 2007, and 0 otherwise.

PATENT: a dummy variable equal to 1 if the firm has registered patents during the year 2007, and 0 otherwise.

highMACHINEQUIP: a dummy variable valuing 1 if the firm declared to have machinery and equipment more advanced than the average of the domestic industry.

Beyond these proxies of the technological competences, we included in our regressions two other proxies for human resources competences and organizational competences.

For the proxy related to human resource competences we considered the qualification of human resources. In our regression we used the variable EDU: the percentage of employees with formal qualification equal to, or higher than, a university degree.

To assess the firms´ organizational competence, as previously applied by Padilla (2006) and Plechero and Chaminade (2010), we counted the number of complex organizational techniques currently used by the firm (quality control systems, just in time, continuous improvement, quality circles and team work, the use of internal manual). We have built 3 dummy variables based on this categorization; and assigned 1 to the firm included in that specific category, and 0 otherwise.

LowSYSTEMPROD: if the firm uses from 0 to 2 systems of production
MediumSYSTEMPROD: if the firm uses between 3 and 4 systems of production
HighSYSTEMPROD: if the firm uses 5 or more systems of productions

Local, domestic and global linkages for knowledge sourcing and R&D collaboration

We seek to understand the relationship between the degree of novelty and the geographical extension of the firms´ network in terms of:

a) *Sourcing of technology*, meaning the acquisition of technologies and knowledge. We counted in this category all the firms which have acquired externally at least one of the following technologies: patents, other non-patented inventions, know-how, creative work and other types of knowledge; machinery and equipments.

b) *Research collaboration*, meaning the research activities conducted in collaboration with other firms or with universities and research centres.

In our econometric analysis we consider the geographical spread of the partners from which the technology was acquired or with whom the firm was collaborating. We distinguish mainly between local, domestic or global interactions.

On this basis, we created geographically mutual exclusive categories to assess the maximum extension of the network and to build the relative dummy variables. The categories GSOURC and GRDCOLLAB include all firms that have declared to have done global sourcing or global collaboration irrespectively of the presence of linkages at local or domestic level. DSOURC and DRDCOLLAB include all the firms that have declared to have done domestic but not global sourcing and collaboration, irrespectively of the presence of linkages at local level. Eventually, the categories local sourcing (LSOURC) or collaboration (LCOLLAB) exclude all the firms that have declared to have a network at global or domestic level. In the specific sample considered in this paper, only two firms declared to have no external sources of technology, and therefore we decided to exclude them from the analysis. 156 firms have instead declared to have no external R&D collaboration (NORDCOLLAB).

4.2.3 Control variables

To capture the differences between the two regions in terms of the degree of innovative performance we introduced the dummy variable REGION equal to 1 if the firm belongs to Pune, and 0 to Beijing.

To control for the sector specificities of the firms in the sample we created three dummy variables AUTO, SOFTWARE, BIOTECH equal to 1 if the firm belongs to the indicated sector, and 0 otherwise. These because the three industries have different characteristics in terms of the type of knowledge used for knowledge creation and innovation processes and in terms of modes of innovation (Pavitt, 1984; Malerba 2002, 2005; Asheim et al., 2007). The specific sector could therefore affect also the different degree of novelty.

We accounted also for the foreign and domestic ownership of the firm assuming that firms owned or partially participated by foreign companies (in particular from developed countries) could have a higher degree of novelty in product innovation (Sadowski and Sadowski-Rasters, 2006; Knell and Srholec, 2009). We consider a firm as foreign-owned when it has a minimum of 30% of foreign capital, and mark this firms with 1 in the dummy variable *FOREIGN*[8] (as Saliola and Zanfei, 2009)

[8] In our analysis we obtained similar results using a minimum of foreign capital of 50%.

Eventually we controlled for the size of the firm. As stressed by Amara et al. (2008) the impact of size on the degree of novelty of an innovation is still debated. Some authors argue that large firms reach often a lower degree of novelty of innovation (Shumpeter, 1942 cf Amara et al. 2008; Acs and Audretsch 1988 cf Vega-Jurado et al. 2008), while for some others (OECD, 2004; Chandy and Tellis, 2000 cf Amara et al. 2008; Tether 2002) large firms have advantages in terms of capabilities and capital with respect to SMEs, favoring the development of innovation. On this purpose we created the dummy variables (*SME, LARGE*) using 250 as the number of employees discriminating between a SME and a large firm. The variables are equal to 1 when the firm belongs to that specific size category, and 0 otherwise.

4.3. The model

In order to analyze the relationship between the degree of novelty, technological competences and the geographical spread of the innovation linkages (technological sourcing and research collaboration) we chose to run a multinomial logistic regression and calculate the associated relative-risk ratios (RRR's) (tab. 1)[9]. The Hausman test is in favor of the Independence of Irrelevant Alternatives (IIA) and thus assures the validity of the logistic multinomial model.

Table 1 - Multinomial logistic regression

Mlogit (baseline = new to the firm)	**New to the domestic market**	**New to the world**
REGION	0.678	5.137**
	[0.279]	[4.143]
AUTO	0.258***	0.201*
	[0.125]	[0.181]
BIOTECH	0.530	0.487
	[0.240]	[0.402]
LARGE	1.374	0.292*
	[0.548]	[0.201]
FOREIGN	3.219**	4.190**
	[1.504]	[2.533]
R&DINTRA	2.250**	0.392
	[0.825]	[0.231]
PATENT	2.123*	5.219***
	[0.872]	[3.055]
highMACHINEQUIP	2.692***	5.517***
	[0.935]	[3.143]
EDU	1.000	1.018*
	[0.006]	[0.010]
mediumSYSTEMPROD	0.531*	0.293*

[9] We are not interested in what affects firms' decision to innovate in general, as opposed to not innovating at all. Instead, we focus on what leads firms to increase the novelty of their innovations from new to the firm to new to the market, distinguishing then between domestic and global markets. As a consequence, we chose to focus on innovative firms and use 'new to the firm' as the baseline dummy for our multinomial logistic regression.

	[0.203]	[0.188]
highSYSTEMPROD	0.914	2.031
	[0.509]	[2.017]
GSOURC	2.197	10.907*
	[1.160]	[13.831]
DSOURC	2.223*	3.656
	[1.051]	[4.616]
GRDCOLLAB	3.538**	10.419***
	[2.099	[8.217]
DRDCOLLAB	1.552	2.236
	[0.636]	[1.608]
LRDCOLLAB	0.824	0.995
	[0.410]	[0.982]
N	368	368
Ll	-232.22	-232.22
chi2	251.99	251.99
P	0	0
Pseudo R2	0.3517	0.3517

5. Discussion

5.1. The orientation towards novel product innovation in Pune and in Beijing region

In Beijing and Pune regions the total percentage of firms that in 2007 introduced a product innovation is 58.9%[10]. 51 percent of these firms introduced product innovation within the context of firm's operations. The innovation is mainly new to the firm, confirming in general that this is the most frequent form of innovation that it is possible to find in the context of less industrialized countries. As many authors point out countries that are below the technological frontiers tend to introduce product innovation that are already present in the market (Knell and Srholec, 2009).

Nevertheless, if we take into account the regional specificities, we can observe two different trends in the two regions (tab. 2). The percentage of firms in Beijing with an innovation only new to the firm is indeed only 36%, therefore much less than the percentage in Pune (58.5%).

We can observe that in Beijing even if firms lack of product innovation new to the world, they have started to introduce a certain amount of innovation new to the domestic market

[10] The firms in the sample that have introduced some types of product innovation are indeed more. For this paper we have considered only the innovations with the most important impact on firms performance during 2007 (to exclude in this way firms that during that year have focus their goal more on process or organizational innovations.)

(59% of the firms) while in Pune this percentage is only 27.5%. In Pune region we can also observe that the percentage of product innovation new to the world is much higher than in Beijing (15% of the firms) showing a better competitive position in the global market. As we will discuss later, these results are also confirmed in the multinomial logit regression where the relative risk ratio of the variable region for the innovation new to the world (5.137) shows that firms in Pune have a higher probability to have this type of innovation with respect to the firms in Beijing region.

Tab 2- Degree of novelty of product innovation in Beijing and Pune regions

Degree of Novelty	Beijing	Pune
New to the firm	36%	58.5%
New to the domestic market	59%	27.5%
New to the world	0.5%	15%
Tot.	100%	100%

5.2 Internal and external factors sustaining the degree of novelty of product innovation

5.2.1. The relevance of the internal technological capabilities for improving the degree of novelty

From the multinomial logit (tab. 1) we observe that firms introducing innovation 'new to the domestic market' are likely to be firms that have developed intramural research activities, confirming that a certain degree of internal technological capabilities is associated to an increase in the degree of novelty, at least from new to the firm (the baseline of the model) to new to the domestic market (the RRR of the variable RDINTRA is greater than 1 and significant at 1% level for the innovation new to the domestic market).

The other two variables PATENT and highMACHNEQUIP result to be associated positively both with the innovation new to the domestic market and new to the world. Moreover, we observe how these last two technological competences result to be more relevant when the innovation is more radical and therefore new to the world. The pattern of significant RRR's change indeed between one type of innovation 'new to the domestic' and the other 'new to the world' (i.e. between the two columns in table 1), doubling the effect. Even if this discussion of the RRR is only limited to a percentage changes in the dependant variables induced by a unit change in the independent variable when all the variables are set to their mean, the fact that the RRR ratio of PATENT changes from 2.123 to 5.219 while the RRR ration of highMACHINEQUIP changes from 2.692 to 5.517 shows how innovations new to the world hinges more upon these last two technological competences.

Concerning the human resources competences captured by the proxy EDU, we observe a very marginal positive and significant effect when innovation is new to the world. The related RRR ratio is only 1.018 showing that the level of education does not seem to be so determinant for increasing the degree of innovation, even though an effect exists.

The results corroborate the hypothesis 1:

Hp. 1 (confirmed): *Internal technological competences of the firms such as qualified human capital, the presence of intramural R&D, patents and the quality of machineries and equipments positively affect the degree of innovation*.

With regard to the organizational competences (mediumSYSTEMPROD and highSYSTEMPROD) the results are unclear, since a medium level of organizational competences seems to be associated negatively with innovation new to the domestic market and new to the world.

5.2.2. Outside the regional borders: The importance of a geographical extended network of technological sourcing and R&D collaboration for improving the degree of novelty

Our model suggests that a network limited to local sourcing of technology and local R&D collaboration leads to no increase in the degree of innovation. Both the variable LRCOLLAB capturing the local R&D collaboration, and the excluded dummy LSOURC capturing the local sourcing of technology have no impact on the degree of novelty, meaning that the local network alone is not enough to foster a higher degree of product innovation.

The results therefore do not confirm the hypothesis 2.

Hp. 2 (not confirmed): *The presence of local external sources of technology and local research collaboration affect positively the degree of innovation*

Instead, the model suggests that a broader network of technological sourcing and research collaboration, larger than the regional one, positively affects the degree of innovation for innovation both new to the domestic market and new to the world.

Concerning the specific technology-seeking strategies of the firms, we noticed that the RRR (2.223) representing the relationship between 'new to the domestic' and national technology sourcing (DSOURC) is greater than 1 and significant, i.e. the national technology sourcing is related to an increase of the degree of innovation.

However, when analysing the variables associated to the production of 'new to the world' innovation, it is possible to see that domestic sourcing of technologies is not enough to foster this more radical innovation (the coefficient of DSOURC is not significant), while global sourcing seems to be fundamental (RRR of the variable GSOURC is significant and extremely large: 10.907).

The relation between the degree of novelty and the geographical extension of the R&D collaboration network shows an even more interesting pattern. Only the variable GRDCOLLAB has a RRR significantly greater than 1 for both new to domestic and new to the world innovation, meaning that R&D collaboration with global partners may become crucial for achieving a degree of innovation higher than new to the firm. Moreover, the importance of global collaboration is much higher in the case of new to the world innovation where the RRR is 10.419, almost three times higher than that for new to the domestic market (3.538).

The clear indication we draw from this analysis is that higher degrees of novelty are associated to global knowledge flows rather than local ones.

The results corroborate therefore the hypothesis 3

Hp. 3: *Firms with global sources of technology and global research collaboration have a high propensity to develop higher degree of innovation*

The model shows also other interesting results. As said, the RRR of the variable REGION for new to the world is 5.137, meaning that in the Pune region innovations new to the world are more likely to happen than in Beijing. This is also in line with a previous study (Plechero & Chaminade, 2010) that shows how firms in the former region perform better in terms of globalization of innovation. Differences exist also in terms of sectors: Firms in the software sector seem to perform better than firms in the automotive sector (the RRR of the variable AUTO is always significantly smaller than 1).

Also large firms and SME differ, as large firms seem to find more obstacles in creating innovation new to the world (the RRR of the variable LARGE is less that 1 and significant). Our results also confirm the ones by Knell and Srholec, 2008 in that foreign owned firms have higher propensity to develop a higher degree of novelty in their product innovation (the RRR of the variable FOREIGN is larger than 1 and significant for both innovations new to the domestic market and new to the world).

6. Conclusion

We saw from the literature that firms may acquire innovative capacity both investing in internal factors or getting access to external sourcing of technology and R&D collaboration. With our analysis we confirmed that both internal and external factors are important to improve the degree of novelty of product innovation in emerging regions, showing the co-occurrence of these factors for improving the firms innovative performances.

Among the internal technological competences, the presence of intramural R&D is associated to a broadening of the innovation reach from new to the firm to innovation new to the domestic market. Nevertheless, when considering innovation 'new to the world', intramural R&D becomes insufficient to foster this more radical type of innovation, probably because for many firms R&D remains an activity performed at the informal and 'basic' level. Instead, the capacity of the firm to develop its own patents and the establishment of international R&D collaborations appear to be more important to achieve the highest level of novelty.

Even though the literature on RIS, local buzz and clusters has stressed the relevant role of the local environment where the firms operates ((Bathelt et al., 2004; Storper and Venables, 2004; Asheim and Gertler, 2005; Cooke, 1996; Maskell and Malberg, 1999), our analysis show that local sourcing of technologies and local research collaboration seem not enough to help firms to move from an innovation that is just new to the firm to new to the domestic market or new to the world. This suggests that even though local interaction with other firms and other organizations may be useful to reach a certain amount of innovation (e.g., new to the firm), the same interaction may not be so relevant to create innovation that can potentially be new to the world. The positive effect of the local clusters and networks in these new industrialized regions seems to be still limited, probably because these are learning regions where -despite the great investment in the recent years in S&T, institutions and organizations fostering innovation-, some gaps with respect to more mature RISs are still present. As stressed by Padilla-Pérez et al. (2009) RISs in developing countries do not show the high degree of integration and interaction that characterises RISs in developed countries, revealing a more unstable or weaker nature.

In our analysis firms in Pune regions are performing better than firms in Beijing in terms of radical innovation (new to the world). This can be explained by differences in the strategy rather than in capabilities. As demonstrated by recent studies (Niosi and Tschang, 2009) firms in China are more focused on developing their domestic market, paying more attention to 'new to the domestic market innovation'; while in India the longer tradition in terms of international research collaboration and international sourcing (see in particular the international openness of the software industry, Chaminade and Vang, 2008) could have created an incentive to develop product innovation that can compete at the global level.

With our analysis we show also that firms that have already established networks of technological sourcing and R&D collaboration outside the regional borders and mainly at international level are also the ones that perform better in terms of innovation new to the domestic market and new to the world. In particular we confirm the importance of global sourcing of technologies and of global R&D collaborations for sustaining a competitive position of these firms in the international markets. These results are also in line with a more recent trend in the Economic Geography literature that shows how important are the non-local sources of knowledge for stimulating innovation and how under certain conditions the knowledge shared and acquired in the global network increase the variety of the local knowledge (e.g. Gertler, 2008).

At the policy level, regional institutions need therefore to be better preparer to invest in infrastructures and resources required for enhancing the local value of innovation (Coe et al. 2004, p.475) but also to invest in the creation of global pipelines for global interaction (Bathelt et al., 2004). Firms in these regions need to cross the borders of their local geographical agglomerations to access knowledge produced elsewhere, especially when their activities imply a certain degree of knowledge capabilities and knowledge resources that are not present in their local and regional pools.

Appendix A

Definition of variables and descriptive statistics

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
DEPENDENT VARIABLE	Variable equal to 0 if the innovation is new to the firm; 1 new to the domestic market and 2 if new to the world	368	0.6304348	0.6919922	0	2
REGION	Dummy variable equal to 1 if the firm belongs to Pune, and 0 to Beijing	368	0.638587	0.4810639	0	1
AUTO	Dummy variables equal to 1 if the firm belongs to the indicated sector	368	0.4293478	0.495657	0	1
SOFTWARE	Dummy variables equal to 1 if the firm belongs to the indicated sector	368	0.4429348	0.4974092	0	1
BIOTECH	Dummy variables equal to 1 if the firm belongs to the indicated sector	368	0.1277174	0.3342293	0	1
SME	Dummy variables equal to 1 if the firm has less or equal to 250 employees	368	0.8179348	0.3864237	0	1
LARGE	Dummy variables equal to 1 if the firm has more than 250 employees	368	0.1820652	0.3864237	0	1
FOREIGN	Dummy variables that take value1 with a minimum of capital owned by foreign investors of 30%	368	0.173913	0.3795507	0	1
R&DINTRA	Dummy variable equal to 1 if the firm engaged in intramural R&D during the year 2007	368	0.5788043	0.494423	0	1
PATENT	Dummy variable equal to 1 if the firm registered patents during the year 2007	368	0.1902174	0.3930069	0	1
highMACHINEQUIP	Dummy variable equal to 1 when the set of the machinery and equipment of the firm is more advanced than the average of the technological equipment in the domestic industry	368	0.2853261	0.4521844	0	1
EDU	Variable indicating the % of employees with at least a university degree	368	46.45272	37.19002	0	100
lowSYSTEMPROD	Dummy variable equal to 1 if the firm uses between 0 and 2 systems of productions	368	0.4048913	0.4915393	0	1
mediumSYSTEMPROD	Dummy variable equal to 1 if the firm uses between 3 and 4 systems of productions	368	0.4076087	0.4920587	0	1
highSYSTEMPROD	Dummy variable equal to 1 if the firm uses 5 or more systems of productions	368	0.173913	0.3795507	0	1
GSOURC	Dummy variable equal to 1 when the firm have done at least global technological sourcing	368	0.3532609	0.4786336	0	1
DSOURC	Dummy variable equal to 1 when the firm have done at least national technological sourcing	368	0.4646739	0.4994295	0	1
lSOURC	Dummy variable equal to 1 when the firm have done at least local technological sourcing	368	0.1820652	0.3864237	0	1
GRDCOLLAB	Dummy variable equal to 1 when the firm have done at least global research collaboration	368	0.1440217	0.3515898	0	1
DRDCOLLAB	Dummy variable equal to 1 when the firm have done at least national research collaboration	368	0.3233696	0.4683993	0	1
LRDCOLLAB	Dummy variable equal to 1 when the firm have done at least local research collaboration	368	0.1086957	0.3116807	0	1
NORDCOLLAB	Dummy variable equal to 1 when the firm have not done any research collaboration	368	0.423913	0.4948497	0	1

Appendix B

Correlations between main variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) NEWFIRM	1.0000							
(2) NEWDOMESTIC	-0.7798*	1.0000						
(3) NEWWORLD	-0.3672*	-0.2958*	1.0000					
(4) REGION	0.2084*	-0.3100*	0.1427*	1.0000				
(5) AUTO	0.4863*	-0.3267	-0.2567*	0.2983*	1.0000			
(6) BIOTECH	-0.0345	0.0813	-0.0683	-0.2375*	-0.3319*	1.0000		
(7) LARGE	-0.0839	0.1178*	-0.0471	0.0031	-0.0109	0.1359*	1.0000	
(8) FOREIGN	-0.2937*	0.0487*	0.3758*	0.0915	-0.1952*	-0.0897	0.0065	1.0000
(9) R&DINTRA	-0.2066*	0.3144*	-0.1520*	-0.3439*	-0.2830*	0.1615*	0.0174	-0.1894*
(10) PATENT	-0.2275*	0.0710	0.2418*	-0.0245	-0.1686*	-0.0817	0.0764	0.1795*
(11) highMACHINEQUIP	-0.3207*	0.2779**	0.0764	-0.3013*	-0.1712*	0.0467	0.2165*	0.0435
(12) EDU	-0.3448*	0.3023*	0.0770	-0.4069*	-0.6851*	0.1218*	0.0153	0.0045
(13) mediumSYSTEMPROD	0.1352*	-0.0214	-0.1746*	-0.0436	0.1072*	-0.0357	0.0815	-0.0742
(14) highSYSTEMPROD	-0.1216*	0.1518*	-0.0400	-0.5353*	0.0076	0.2540*	0.0994	-0.0025
(15) GSOURC	-0.2722*	0.0448	0.3489*	0.0708	-0.2046*	-0.0443	0.1817*	0.3058*
(16)DSOURC	-0.0012	0.1457*	-0.2147*	-0.2064*	-0.0376	0.0842	-0.0725	-0.1975*
(17)GRDCOLLAB	-0.3107*	0.0723	0.3666*	0.0830	-0.2151*	0.0054	0.1474*	0.3631*
(18) DRDCOLLAB	-0.2618*	0.3112*	-0.0630	-0.4231*	-0.3649*	0.0662	-0.0853	-0.0566
(19) LRDCOLLAB	0.0581	-0.0257	-0.0504	-0.0826	-0.0560	0.1018	0.0615	-0.0681
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
(9) R&DINTRA	1.0000							
(10) PATENT	0.0348	1.0000						
(11) highMACHINEQUIP	0.2465*	0.1231*	1.0000					
(12) EDU	0.4032*	0.1017	0.2041*	1.0000				
(13) mediumSYSTEMPROD	0.1924*	0.0207	0.0759	0.0796	1.0000			
(14) highSYSTEMPROD	0.1446*	-0.0397	0.1705*	-0.0015	-0.3806*	1.0000		
(15) GSOURC	-0.0834	0.1343*	0.2003*	0.0490	-0.0346	0.0509	1.0000	
(16)DSOURC	0.1989*	-0.1045*	-0.0095	0.1059*	-0.0521	0.0900	-0.6886*	1.0000
(17)GRDCOLLAB	-0.0420	0.0970	0.1007	0.0282	-0.1198*	0.0364	0.4255*	-0.2580*
(18) DRDCOLLAB	0.3897*	0.0350	0.2579*	0.4183*	0.0768	0.1886*	-0.0734	0.2761*
(19) LRDCOLLAB	0.1741*	-0.0135	0.0307	0.0470	0.0124	0.0471	-0.0572	-0.0453
	(17)	**(18)**	**(19)**					
(17)GRCOLLAB	1.0000							
(18) DRCOLLAB	-0.2836*	1.0000						
(19) LRDCOLLAB	-0.1432*	-0.2414*	1.0000					

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