In Search of Opportunities

Three Essays on Global Linkages for Innovation

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Gouya Harirchi

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HANDELSHØJSKOLEN

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PhD School in Economics and Management
Copenhagen Business School

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ENGLISH SUMMARY

Globalization is an important theme in a broad set of conversations, from everyday talks to political and academic debates, both in positive and also negative terms. But what are the positive implications of globalization for the economic development of the countries? Do the effects of globalization on innovation differ between developed and developing economies? This PhD dissertation aims to explore these questions by identifying under which conditions globalization – conceived as a process fostering knowledge flows at a global scale – has played an important role in the innovation process.

The contribution of this dissertation is to the field of geography of innovation. Despite recent research on the spatial dimension of sources of innovation, this field still remains focused on the impact of local and global linkages, for firms in the advanced economies. This thesis contributes to this matter, by extending the discussion also to the organizational learning of firms from emerging economies.

Theoretically, it builds on contributions from innovation studies, economic geography and international business. Empirically, the focus is on firm level data gathered from emerging economies (BRICS) as well as several European countries.

The thesis consists of an introductory chapter followed by a literature review on previous works related to spatial aspects of knowledge sourcing for learning and innovation, three essays at different stages of publication, and finally conclusions.

Contextualizing the searching behaviour and the engagement in global collaborations is at the core of all three papers. By using firm level data and conducting comparative studies between advanced (North) and emerging economies (South), the first two papers analyse the impact of global knowledge flows for novelty of innovation. The third paper explores the impact of high level of local embeddedness on firm's engagement in global sourcing of knowledge; this paper relies on data from Indian firms

The first paper investigates the effects of local and global innovation collaborations on the degree of novelty in innovations of small and medium enterprises (SMEs) in the information and communications technology (ICT) sector by considering the country in which these firms are located. The findings of this study show that global linkages do indeed impact on the degree

of novelty of innovation. However, this impact is highly positive on the innovativeness of Scandinavian firms, whereas for the Indian SMEs, the regional linkages matter most.

The second paper explores the role played by active collaboration with users on the degree of novelty of innovation by focusing on the location of both users and producers. The results indicate that collaborating with international users is positively related to higher degrees of novelty. Furthermore, firms in low- and middle-income countries benefit more from South-South user collaboration than from South-North collaboration.

The third paper addresses the relation between high level of local embeddedness and engagement in global linkages for innovations -as a pre-requisite for catching-up- by comparing the engagement of group-affiliated firms, that are expected to present higher degree of internal collaboration, with standalone firms. The results indicate that affiliation to a business group also increases the likelihood of engagement in global linkages for innovation.

DANSK OPSUMMERING

Globalisering er et vigtigt emne i en række af konversationer, fra dagligdags samtaler til politiske og akademiske debatter, på en både positiv og negativ måde. Men hvad er de positive implikationer af globalisering på den økonomiske udvikling af landene. Er der en forskel på indvirkningen af globalisering i udviklede økonomier og økonomier under udvikling? Målet med denne ph.d.-afhandling er at udforske disse spørgsmål ved at identificere de betingelser under hvilke, globalisering – betragtet som en proces, der frembringer videnstrøm på en global skala - har spillet en vigtig rolle i innovationsprocessen.

Denne afhandlings bidrag ligger indenfor feltet innovationsgeografi. Til trods for nylig forskning i de rumlige dimensioner af innovationskilder, så forbliver dette felt fokuseret på indvirkningen af lokale og globale forbindelser for firmaer i de avancerede økonomier. Denne afhandling bidrager til dette emne ved at udvide diskussionen til også at omhandle den organisatoriske læring for firmaer fra udviklingsøkonomier (BRIK).

Teoretisk bygger den på bidrag fra innovationsstudier, økonomisk geografi og internationale virksomheder. Empirisk ligger fokusset på data indsamlet på firmaniveau i udviklingsøkonomier såvel som i adskillige europæiske lande.

Afhandlingen består af et indledende kapitel fulgt af en litteraturgennemgang af tidligere arbejder relateret til rumlige aspekter af køb af viden til læring og innovation, tre essays på forskellige udgivelsesstadier og til sidst konklusioner.

Indsætning af søgningsadfærd og involvering i globale samarbejder i en kontekst er kernen i alle tre essays. Ved at bruge data fra virksomheder og udføre komparative studier mellem avancerede økonomier (nord) og udviklingsøkonomier (syd) analyseres i de to første essays indvirkningen af global videnstrøm på innovationsnyheder. I det tredje essay undersøges indvirkningen af et højt niveau af lokal forankring på en virksomheds involvering i globalt køb af viden; dette essay bygger på data fra indiske firmaer.

I den første artikel undersøges indvirkningen af lokale og globale samarbejder på graden af innovationsnyheder hos små og mellemstore virksomheder (SMVer) indenfor informations- og kommunikationsteknologisektoren (IKT) ved at tage det land i betragtning, hvor disse firmaer er placeret. Undersøgelsens resultat viser, at global forankring faktisk har en indvirkning på graden af innovationsnyheder. Dog er denne indvirkning meget positiv på skandinaviske

firmaers innovationsevner, hvorimod de regionale forbindelser har størst betydning for indiske SMVer.

I den anden artikel undersøges den rolle et aktivt samarbejde med brugere har på graden af innovationsnyheder ved at fokusere på placeringen af både bruger og producent. Resultatet indikerer, at der er en positiv sammenhæng mellem et samarbejde med internationale brugere og graden af nyheder. Derudover har firmaer i lav- og mellemindkomstlande større fordel af et syd-syd-brugersamarbejde end et syd-nord-samarbejde.

I den tredje artikel undersøges forholdet mellem et højt niveau af lokal forankring og involvering i globale forbindelser og innovationer – som en forudsætning for at indhente – ved at sammenligne involveringen af koncernforbundne virksomheder, som forventes at vise højere grad af internationalt samarbejde, med enkeltstående virksomheder. Resultatet indikerer, at forbindelse til en koncerngruppe også øger sandsynligheden for involvering i globalt samarbejde om innovation.

CONTENTS

CHAPTER 1

INTRODUCTION

Globalization is an important theme in a broad set of conversations, from everyday talks to political and academic debates, both in positive and in negative terms. In the general economic debates, on one hand it is praised for its positive impacts for economic development, particularly thanks to the inflow of Foreign Direct Investments (FDI), on the other hand it is debated for its adverse side and threats, such as crowding out of local firms and for broadening the technological gap between countries. But do the effects of globalization on innovation differ between developed and developing economies? This PhD dissertation explores this question by identifying under which conditions globalization – conceived as a process fostering knowledge flows at a global scale – plays an important role in the innovation process.

1.1. Introduction

Having roots in the growth theory of the firm (Penrose 1959/ 2009) the resource-based view of the firm (RBV) (Wernerfelt 1984; Barney 1991; Peteraf 1993) argues that possession of heterogeneous resources (Barney 1991) is a source of competitive advantage. In this view resources are defined both as tangible and intangible assets that are valuable, rare, inimitable and non-substitutable (Wernerfelt 1984; Barney 1991). The RBV framework was further on extended to the *knowledge-based* view of the firm (Kogut and Zander 1992; Grant 1996), an approach that puts forward that the creation and transfer of knowledge is the most important process within firms (Spender 1996). Access to heterogeneous resources as a source of competitive advantage is not limited to internal resources, but includes also those that lie outside the firms boundaries through inter-firm collaboration (Dyer and Singh 1998; Gulati 1999).

The important contribution by Kline and Rosenberg (1986) highlighted that, contrary to the then-mainstream "linear model" (Bush, 1945), the innovation process involves *interactive learning* within the internal R&D departments of firms, but also the sourcing of knowledge from outside the firm boundaries. Firms adopt searching strategies (March 1991) that include a wide range of actors such as users, supplies, competitors or universities (von Hippel 1976;

Chesbrough 2003). The evolutionary framework (Nelson and Winter 1982) has been a widely used framework in studies analyzing the impact of external source on the innovation performance (e.g. Ahuja and Katila 2004; Laursen and Salter 2006; Rosenkopf and Nerkar 2001). In fact, as highlighted by Kline and Rosenberg (1986, p.287), radical or revolutionary innovation is more likely stem from the recombination of *multiple sources of information* that serve as inputs in the process.

Due to the uneven distribution of knowledge across the geographical landscape, the search across spatial boundaries is also regarded as one mechanism for expanding variety in the resource base of firms (Almeida 1996; Ahuja and Katila 2004). The spatial dimension of external sourcing of knowledge has for long been the subject of interest both for economic geographers as well as international business (IB) scholars, thus contributing to an understanding of the geography of innovation (McCann and Mudambi 2004, 2005; Beugelsdijk, McCann, and Mudambi 2010; Iammarino and McCann 2013). In this regard, economic geographers' perspective is related to the benefits that firms can gain thanks to their embeddedness in regions, while the IB perspective is related to the advantages that firms achieve by accessing to resources that is not available in the local environment. The locational behavior of multinational companies (MNCs) has been one of the pillars in IB theories (Dunning 1980; Vernon 1966). The early conceptualizations mainly regarded the locational advantages in terms of *exploitation* strategies (see Castellani and Zanfei 2006; Kuemmerle 1997). This approach was not concerned with the knowledge embedded in the host location, as innovation was conceived as a phenomenon happening only in the home location of firms. Knowledge sourcing across the national boundaries, and in particular at the regional level, was investigated at a later stage (Almeida and Kogut 1999; Cantwell and Piscitello 2002; Cantwell and Santangelo 1999; Cantwell and Iammarino 2000). This new perspective meant that the internationalization strategy was no longer restricted to only adaptation of products, but also included production of new products as a result of accumulation of knowledge across the national borders (Cantwell and Piscitello 2000; Frost 2001; Chung and Alcácer 2002; Cantwell and Piscitello 2005; Chesnais 1988). This process was termed *home-base-augmentation* (Kuemmerle 1997), global generation of technology (Archibugi and Michie 1995; Archibugi and Iammarino 1999, 2002), or exploration activity (Castellani and Zanfei 2006; Cantwell and Mudambi 2005).

Departing from the important contribution of Alfred Marshall (1920) on the importance of local externalities – and by adopting different labels such as "industrial districts" (Piore and Sabel 1984), "clusters" (Porter 1998) "innovative milieus" (Camagni 1991) or "learning regions" (Asheim 1996) the region has been regarded as the main unit of analysis for understanding the spatial dimension of interactive learning for innovation, particularly for economic geographers. The works in this stream examine especially the benefits deriving from *geographical proximity* to external sources, in the form of tacit knowledge spillovers (Storper and Venables 2004; Maskell and Malmberg 1999; Asheim and Isaksen 2002). More recent contributions have acknowledged the complexity of the interactions that can impact the innovation process, particularly by highlighting also a role attributed to global channels for knowledge circulation (Doloreux and Shearmur 2012; Bathelt, Malmberg, and Maskell 2004; Fitjar and Rodríguez-Pose 2012; Amin and Cohendet 2005; Simmie 2004). This recognition has resulted into works that have analyzed the spatial dimension of interactive learning, by distinguishing between local and global sources of innovation (Trippl, Tödtling, and Lengauer 2009; Laursen 2011; Fitjar and Rodríguez-Pose 2012; Grillitsch, Tödtling, and Höglinger 2013; Herstad, Aslesen, and Ebersberger 2014; Fitjar and Rodríguez-Pose 2014; Grillitsch and Trippl 2014; Grillitsch and Nilsson Forthcoming). The outcome of these studies also highlights how the impact of *variety* of resources, mechanisms, and spatial level of interactions can contribute to innovations with higher level of novelty.

While the impact of interactive learning on firm innovation process is crucial, this cannot be understood without considering firms' abilities in recognizing the value of external knowledge, assimilating and apply, what has been termed absorptive capacity in the management studies (Cohen and Levinthal 1990; Criscuolo and Narula 2008; Grimpe and Sofka 2009) or technological capabilities in the economic development literature (Lall 1992; Dahlman, Ross-Larson, and Westphal 1987; Westphal, Kim, and Dahlman 1985; Kim 1997).

1.2. Aim and contribution

The aim of this Ph.D. dissertation is to advance our understanding of the impact of global collaboration for innovation, through an exploratory research. In particular, by contextualizing the searching behavior of firms, this dissertation provides evidence of the

impact of external knowledge sourcing at different spatial scales on firm innovation. In order to accomplish this aim, the following questions will be investigated:

1. What is the interplay between local and global linkages for novelty of firm innovation?
2. How do differences in technological capabilities impact the likelihood of engagement in interactive learning for innovation process at different spatial scales?
3. Does knowledge sourcing from developing (South) or advanced economies (North) has different impacts for firm's innovation?

In answering these questions, this dissertation takes a micro-level perspective by analyzing the firm level behavior. The first question examines the impact of *variety* of resources on the novelty of innovation. As highlighted in the introductory section, one way of accessing heterogeneous resources is by geographical expansion. On the other hand, firms are also engaged in collaborations with partners in their geographical proximity. This question examines the impact of local and global linkages on the innovation type measured through novelty of innovation.

The second question considers whether there exist a difference between firms' technological capabilities and their searching behavior. This has been analyzed in two ways: first, by comparing firms from emerging economies to those located in more advanced economies, in terms of engagement in local-global linkages and ability to realize the value of the knowledge; second, in the context of an emerging economy, by highlighting the differences between firms embedded in a network (i.e. belonging to a business group) with standalone firms, in their likelihood of engagement in global sourcing of knowledge for innovation activities.

The third question opens up the box of "global" by analyzing whether the location of the sources of knowledge in the North or South affects the innovation process at the firm level. This is considered in particular by distinguishing between both the location of the focal firm as well as the geographical location of external sources that are used for innovation.

By answering to these questions, this dissertation contributes to the field of geography of innovation in three ways:

First, despite the recent research on the impact of interactive learning and external sourcing of knowledge on the firm innovation process, this field still remains mostly focused on firms located in the advanced economies. However, we should expect that the global sourcing of

information differs between firms from emerging and advanced economies, given the differences in terms of absorptive capacity (Cohen and Levinthal 1990) and technological capabilities (Lall 1992; Dahlman, Ross-Larson, and Westphal 1987; Westphal, Kim, and Dahlman 1985; Kim 1997).

Second, the results of this exploratory research, contribute to the scholarly works on economic development, in particular by examining the impact of local and global sources of knowledge in terms of novelty of innovation.

Third, this study shows that while global linkages matter for novelty of innovation, there should also be a distinction between sourcing of knowledge from developing countries (South) and advanced economies (North). In other words, due to the differences in absorptive capacity of firms, those located in the developing countries perhaps can gain a higher benefit from sourcing of knowledge from other developing countries than from those in the advanced economies.

1.3. Overview of the papers

In answering to the raised questions, this dissertation is structured into six chapters. This introduction, aimed at illustrating the issues at stake and the research questions motivating the study, is followed by an in-depth literature review that highlights the overall theoretical background on which this dissertation builds. Three research papers addressing the research questions (Table 1.1) are presented in Chapters 3-5, while the conclusions summarize the work and highlight the findings of the studies.

Contextualizing the searching behavior of firms and their engagement in the global sourcing of knowledge in terms of embeddedness is at the core of all three essays. This idea accounts for the differences in terms of absorptive capabilities between firms. While in Chapters 3 and 4 the difference between capabilities is considered in terms of comparison between firms in advanced and emerging countries, in Chapter 5 this is related to the differences between standalone Indian firms and those embedded in a business group. Furthermore Chapters 3 and 4 analyze the impact of global and regional linkages on novelty of innovation. While Chapter 3 considers both market- and institution-related external sources, Chapter 4 is focused on interactive learning with users by distinguishing between those in the South and those in the

North. The impact of variety of resources for innovation is measured through the novelty of firm innovation.

Table1.1. Overview of the research papers

	Paper 1	Paper 2	Paper 3
Title	The effect of local and global linkages on the innovativeness among ICT SMEs: Does context impact the geography of linkages?	Exploring the relation between the degree of novelty of innovations and user-producer interaction across different income regions.	Global linkages for innovation: The impact of group affiliation.
Authors	Aslesen, H.W. Harirchi, G.	Harirchi, G. Chaminade, C.	Harirchi, G.
Database	INGINEUS database. A subset of the database has been used. It covers 379 SMEs in the ICT sector of India, Norway and Sweden.	INGINEUS database. The complete database has been used, including 880 firms in the ICT, Auto and agrofood sectors of Brazil, India, China, South Africa, Estonia, Sweden, Norway, Denmark, Germany	Emerging Trends database. It covers 491 firms from Pune, India in software and automotive industries.
Aim	To extend the discussion on the effects of local and global innovation collaborations on degree of novelty of innovations of SMEs in the ICT sector by considering the location context in which these firms are embedded.	To explore the role of the active collaboration with users on the degree of novelty by focusing on the location of both users and producers.	To examine the relation between high level of local embeddedness and engagement in global linkages for innovations, as a pre-requisite for catching-up.

More in detail, **Chapter Three** entitled "*The effect of local and global linkages on the innovativeness among ICT SMEs: Does context impact the geography of linkages?*" is co-authored with Heidi Wiig Aslesen. The objective of this paper is to extend the discussion on the role of local and non-local collaborations on the degree of novelty of innovations by considering the *context* in which the firms are embedded, in particular by distinguishing between firms from developed economies and emerging economies. The paper highlights the importance of engagement in local and global sourcing of information for SMEs, and analyses this impact on novelty of innovation. This paper employs data from the INGINEUS project drawn from SMEs operating in the ICT sector in Norway, Sweden and India. The paper finds that local linkages are of greater importance for the degree of novelty of innovation in the case of firms located in India, whereas interacting with global actors matters more for Norwegian and Swedish firms. This paper adopts a micro-level perspective by considering the limitations related to the lack of data at the meso-level (i.e., regional level). Undoubtedly the embeddedness of SMEs in core regions or periphery regions also has a different impact on their engagement with local or global linkages.

The objective of **Chapter Four**, entitled "*Exploring the relation between the degree of novelty of innovations and user-producer interaction across different income regions*" and co-authored with Cristina Chaminade, is to understand the relation that active collaboration with users has on the degree of novelty in innovation by focusing on the location of both users and producers. In other words, we want to investigate if firms located in high-income or low- and middle-income locations are more or less likely to introduce innovations if they collaborate with their customers in high-income or low- and middle-income countries. This paper employs data from all the firms that participated in the INGINEUS survey. The results indicate that having international customers increases the likelihood of introducing novel innovations. In particular, the results suggest that firms in low- and middle-income countries are more likely to benefit from South-South collaborations than South-North collaborations, at least in terms of innovation novelty.

Finally, in the single authored **Chapter Five**, "*Global linkages for innovation: The impact of group affiliation*", I examine the relation between high level of local embeddedness and engagement in global linkages for innovations, as a pre-requisite for catching-up. The previous literature has particularly highlighted the internal sharing of resources among the

members of a business group. The paper addresses the relation between high level of local embeddedness and engagement in global linkages for innovations by comparing the engagement of group-affiliated firms, with standalone firms. By using data from Indian firms in Pune region, the results indicate that affiliation to a business group increases the likelihood of engagement in global linkages for innovation.

1.4. Data description

As already mentioned, two of the three papers included in this dissertation use firm-level data collected through surveys in emerging economies – Brazil, Russia, India, China and South Africa (BRICS) – as well as from several European countries through the INGINEUS (Impact of networks, globalization, and their interaction with EU strategies) project. The third paper is based on firm-level data collected in India through the Emerging Trends Project. The choice of data from both emerging economies and European countries provides a sound basis for analyzing the role of the location-specific context.

1.4.1. INGINEUS Project

The INGINEUS project was funded by the European Union (EU) Seventh Framework Program. The goal of the project is to examine the evolution of global production networks (GPNs) into global innovation networks (GINs), and the impact this new process of global capitalism has on knowledge-intensive activities in the EU (INGINEUS 2013). The project focused on both developed and developing countries as the involvement of regions and firms from emerging economies has shaped the new geography of innovation.

The project was conducted in 2009–2010 and employed a survey conducted across nine countries under the auspices of an FP7 EU-funded project. Data on firms in Europe were gathered from leading economies with a per capita income above US$45,000 per year, namely Denmark, Germany, Norway and Sweden. Estonia, a transition economy, was also part of the survey, as were four prominent countries of emerging economies: Brazil, China, India and South Africa. The choice of countries allows a clear comparison of economies that are global leaders and those that are emerging in the global arena. The survey for each country focused on either ICT, the automotive or agro-processing industry, whichever sector was of economic importance

in that country. Table 1.2 contains information on the countries, sectors and number of firms that participated in the survey.

Table 1.2 Number of firms by country and industry

Country	ICT	Automotive	Agro-processing	TOTAL
Brazil		69 (25.9%)		
China	243 (2.7%)			
Estonia	17 (14%)			
India	324 (20.2%)			
South Africa			84 (16.9%)	
TOTAL middle-income countries	584 (5.34%)	69 (25.9%)	84 (16.9%)	737 (6.32%)
Denmark			49 (23.3%)	
Germany		53 (4.7%)		
Norway	181 (11.9%)			
Sweden	171 (10.3%)	24 (14.3%)		
TOTAL high-income countries	352 (11.05%)	77 (6.18%)	49 (23.2%)	478 (10.59%)
Total	936 (6.59%)	146 (10.64%)	133 (18.58%)	1215 (7.5%)

As with any other survey data, there can be doubts concerning reliability, particularly with regard to respondents' understanding of important concepts such as the degree of novelty of an innovation, the geographical location of collaborators, or more general information. However, in this case the reliability of the data was enhanced by the choice of respondents to the questionnaire: in the case of small firms, CEOs were responsible for completing the questionnaires; for larger firms, R&D managers did so. Furthermore the survey instruments had been tested through a pilot study conducted in each country.

The sample of firms was selected by using existing databases, including the following: Statistics Sweden; the German commercial database, Hoppenstedt; Proff Forvalt – Eniro, a commercial register of Norwegian firms; the Estonian Business Registry; Danish Statistics; the Shenzhen & Beijing database for China; the NASSCOM Directory of IT firms for India. In the case of Brazil and South Africa, due to a lack of up-to-date databases, the strategy comprised combining existing databases. In Brazil, the database of the automotive union SINDIPECAS, the official Annual Registry of Social Information (RAIS) and information from large automotive firms concerning their suppliers were used to compile a sample frame. The databases used in the case of South Africa were the Experian database, the Go Organic Online Directory (South Africa's premier organic website, directory and marketing company),

Tradepage Online Trade and Business Directory South Africa, Search ZA Directory, and The Food World.

The Swedish, South African, Norwegian, Danish and German surveys were national. Due to the size and geographical spread of the population in Brazil, China and India, these surveys were regional. This has been due to constrains derived from lack of comprehensive databases with information on the present firms. Specifically, in Brazil, the research focused on firms located in Minas Gerais, where the majority of auto firms are located; in India, on the IT clusters of Bangalore, Delhi, Mumbai, Pune, Trivandrum, Hyderabad and Kochi; in China, on the Beijing and Shenzen.

Data were generally collected through a web-based survey. However, in the cases of China, India, and Brazil due to very low levels of participation in surveys, different methods were applied: in India face-to-face interviews were conducted, and in China interviews were undertaken over the telephone. In Brazil both face-to-face interviews as well as interviews over the phone was carried out.

For each country, a t-test for firm size distribution and a non-response test were conducted by the partners. The results indicate that the sample is representative for all countries, with the exception of Germany. Furthermore, non-respondent firms were contacted for feedback on their reasons for not completing the survey; their responses indicate that the survey was not relevant to them. The low response rate in Germany is most likely due to the fact that the questionnaire was sent out during a period in which the German automotive industry was struggling with the aftermath of the economic crisis.

Despite the limitations faced in collecting *comparable* data from emerging economies, great care was taken to reduce the level of bias. However, as will be highlighted in each paper, the lack of a larger sample only permits exploratory analysis.

1.4.2. Emerging Trends Project

The project "Emerging trends in Asia: from cost-based producers to global suppliers of innovation" was financed by the Swedish Research Council (VR). The main objective of this project is to understand the extent and scope of the globalization of innovation activities and discuss the implications for developed and developing countries.

Firm-level data has been collected through a survey conducted in India (Pune) and China (Beijing) in 2008, and included the software, automotive and biotechnology sectors. Firms had been asked to answer the questions by referring to the previous year (2007). The survey was conducted through face-to-face interviews, followed up by phone calls if necessary. The survey included questions related particularly to different modes of globalization of innovation as specified in the taxonomy provided by Archibugi and Michie (1995).

For the purposes of the third paper, data collected from the Pune region in India in two sectors – the software and automobile industries – were employed. The main reason for this selection is related to the availability of data related to affiliation to a business group.

With regards to the sampling procedure, the project had difficulties due to the lack of a single and comprehensive database on firms present in the two regions. For India, the initial sample was selected from several databases purchased from the Indian industry associations which cover only formal sectors. Therefore, the initial sample did not include informal units, especially salient in the case of the automotive industry which is dominated by repairs shops.[1] In total, 494 firms responded to the questionnaire, yielding a response rate of 37% (221 firms) for the software industry and 54% (273 firms) for the automotive industry.

[1] According to the data from the Ministry of Science and Technology, the major suppliers are the main firms included in the estimations and formal databases.

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CHAPTER 2

LITERATURE REVIEW

Today, the *development of countries* is understood as *a process* involving **active learning, capability building** and **innovation** (Dutrénit et al. 2013, p.1). In this section I attempt to provide an understanding on how the three mentioned elements have impacted the catching-up and economic development. While the role of the three elements can be regarded separately, they are also interrelated as they have an impact on each other.

The literature review is organized in three sections. The first section provides a general understanding of catching-up, focusing in particular on the role of technological capabilities. The second and third sections provide an understanding of the impact of firm embeddedness in a *geographical location* for organizational learning, from the point of view of, respectively, economic geography (EG) and international business (IB). Both streams of studies adopt a spatial perspective on interactive learning for innovation, though presenting specific features (McCann and Mudambi 2004, 2005; Beugelsdijk, McCann, and Mudambi 2010; Iammarino and McCann 2013).

The EG perspective, as discussed in the second section, focuses on the advantages that firms achieve when they are embedded in a specific location by considering the interaction between different actors under specific institutional conditions at the regional level. This view regards organizational leaning as the consequence of various factors and goes beyond a micro-level perspective, as it considers the impact of environmental contextual factors such as institutions and various socio-economic factors (Figure 1). While the micro level perspective regards the firm at the center of interactions with one-way flows of knowledge, in the meso level there is a system of interconnected and interdependent components (Iammarino, Padilla-Pérez, and von Tunzelmann 2008).

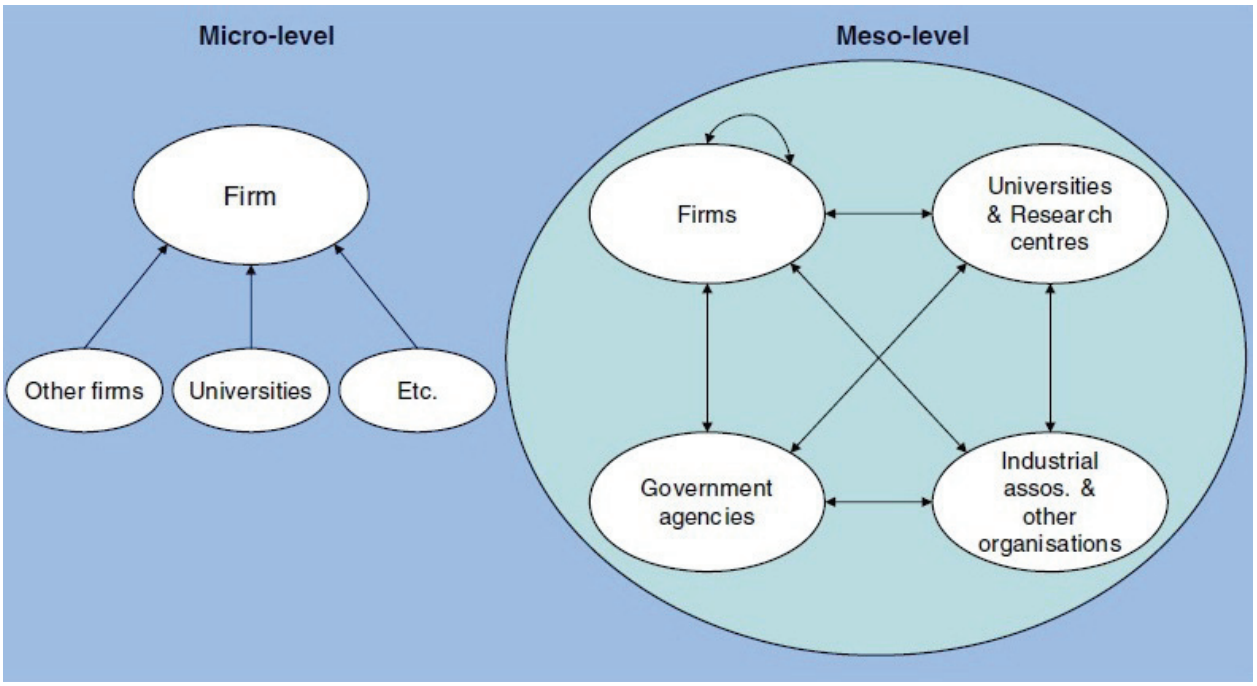

Figure 1. Micro versus meso level perspective to interactive learning (Iammarino, Padilla-Pérez, and von Tunzelmann 2008, p.1982).

On the other hand, the IB perspective, discussed in the third section, privileges the analysis of the linkages to resources that are not available in the local environment. Specifically, the latter view emphasizes the fact that by expanding outside their "home" context and embedding in other "host", firms can get access to the other "localized" resources and benefit from localized knowledge spillovers (Figure 2). The concept of "dual embeddedness" (Meyer, Mudambi, and Narula 2011) highlights the interaction of firms within a MNC network, and also with their immediate environment. As it will be highlighted in this chapter, while for long the perspective of IB scholars had been at a macro-level regarding the host location as in terms of country, the recent works have highlighted the need for analysis at the meso-level. In this perspective the interactions occurring externally within the "context" as highlighted in Figure 2 is equivalent to the meso-level perspective in Figure 1.

I believe that both perspectives are important in order to understand the concept of linkages and the local-global debate, central in this thesis.

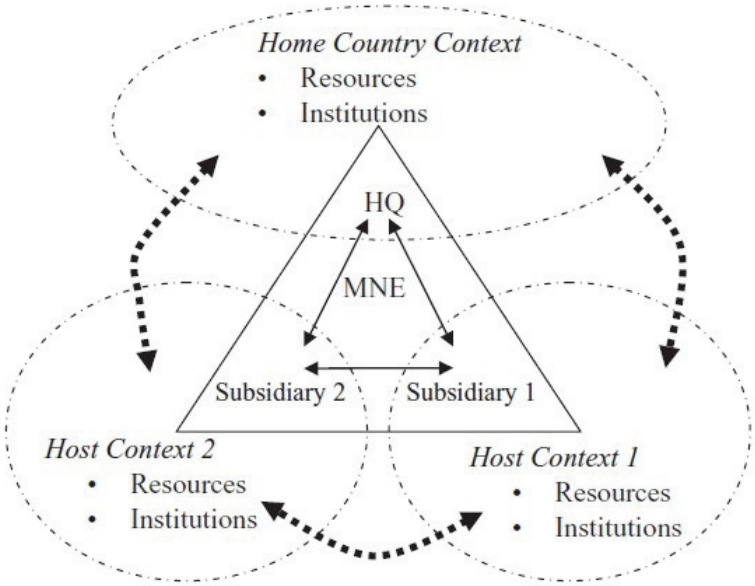

Figure 2. Multinational enterprises and local context (Meyer, Mudambi, and Narula 2011, p.240)

2.1. Innovation and Catching-up

Why countries differ with regard to economic growth and how the gap between developed and developing economies can be reduced, has been the subject of numerous studies which gained more attention after World War II (Abramovitz 1956). Today, there is no question that innovation plays an important role for economic growth. However, for long, technological change was not an obvious element for economic growth, as mainstream approaches provided only a partial view of this phenomenon (Freeman and Soete 1997; Nelson 1981). Therefore, economists tried to explain growth through traditional factors of labor and capital, while regarding the flow of new knowledge, inventions and innovations as "*exogenous variables*" (Fagerberg 1994; Freeman and Soete 1997; Nelson 1981; Justman and Teubal 1991). Based on the neo-classical assumptions, growth theory as proposed by Solow (1956) had acknowledged the role of *technological progress* in explaining the long-run growth in GDP per capita (Fagerberg 1994).

The growth theory was built on an assumption that technology and technological knowledge is a *public good* which is freely available to all nations (Verspagen 2007). While technological knowledge has some of the features of public goods such as the possibility of being acquired by more than one entity, the economic development in the developing countries

cannot be regarded as only the result of technological spillovers from the developed countries (Lall 1992; Verspagen 1991; Nelson 1981; Verspagen 2007). In this vein, the success of international diffusion of technology is dependent on the *capabilities* of the receiving firms in understanding the value of new knowledge (Verspagen 1991; Lall 1992). The lack of such understanding had led to concerns for the advanced economies on the penalties they may serve in the long-run as technological leaders, as less developed economies would freely benefit from the technological advances of developed economies by virtue of technological spillovers (Ames and Rosenberg 1963). In other wording, technological spillovers do not necessarily lead to the *adoption* of the technology unless there is a suitable ground in understanding and processing such technical knowledge (Verspagen 1991).

The concept of catching-up – which refers to the ability of technologically "backward" countries to narrow their gap vis-à-vis a technologically "leader" country by exploiting the already existing knowledge (Verspagen 1991; Fagerberg and Godinho 2004; Abramovitz 1986) – had gained momentum as the result of new understandings of the economic growth. This hypothesis implies that backward countries have a *potential* for a rapid advance (Abramovitz 1986). However, as highlight by Lall (1992, p.166): "*technological knowledge is not shared equally among firms, nor is it easily imitated by or transferred across firms*". Indeed as it will be highlighted in the next section, in order to benefit from the technological knowledge spillovers, there is a requirement for technological *capabilities* (Pack and Westphal 1986; Lall 1992; Kim 1997) or what Abramovitz (1986) would call as "social capital". As emphasized by Soete and Perez (1988, p.459) the real catching-up process can only be achieved by acquiring the *capacity* for participation in the generation and improvement of technologies.

2.1.1. Innovation Diffusion

Understanding the contribution of technological change in the economic development requires a study of their *diffusion* (Rosenberg 1972). As highlighted by Keller (2004, 2010) worldwide technical change is determined by international technology diffusion through foreign trade and Foreign Direct Investments (FDI). Therefore, making a distinction between the development of new knowledge in a country, and the diffusion of knowledge between countries is necessary (Fagerberg and Verspagen 2002). In fact, globalization of innovation refers to the increasing international scope of the generation and diffusion of technology (Archibugi and

Iammarino 2002). In the study of innovation, the term diffusion is used to refer to the *process* by which a technology is *adopted* or *replaces* an older technology (Hall 2004). The speed at which this diffusion takes is particularly crucial in order to understand the catching up process in developing regions and countries (Fagerberg and Godinho 2004; Hall 2004; Nelson, Peterhansl, and Sampat 2004).

It is important to have an understanding of the different steps within the learning orientation in the catching up process, as this can be from duplicative imitation, creative imitation to innovation (Kim 1998). The case studies on the industrialization pattern in Asia have indicated that in the earlier stages firms were merely importing foreign technologies and changes occurring in the technologies were very minor (Kim 1980). In fact, the industrialization that had taken place since 1960s in the Newly Industrialized Countries (NIC – Singapore, Taiwan, Hong Kong and Korea) is regarded as the result of imitation of foreign technologies coming from advanced countries (Kim and Nelson 2000). However imitation does not rule out innovation (Bell and Pavitt 1993). As highlighted by Rosenberg (1982), innovations can take place as the results of adaptation and by building on the technological knowledge that has been already diffused.

Kim (1980) regards industrialization of Korea as the result of a three stage process consisting of implementation, assimilation, and improvements. While the first stage relies mainly on the assembly of imported foreign technology, the experience accumulated in this stage will result into the indigenous efforts for assimilation of the foreign technology, which finally leads to the gradual improvements of the products. While the categorization of Kim considers innovation taking place at the last stage, the first and second stage also require minor changes in the products, primarily as the result of adaptation to the local market (Pack and Westphal 1986).

As discussed extensively in Bell and Pavitt (1993) a distinction between innovation and imitation is impossible. They emphasize that, due to adaptation of products for *both a different system of production* but also for the *new markets*, there is a need for continuous improvements of products which requires incremental innovation. Kim and Nelson (2000) emphasize the importance of the creative imitation, described as design copy, creative adaptation, technological leapfrogging, and adaptation to another industry. Kim (1997) also highlights that imitation does not require investments in R&D since firms are not required to produce new

knowledge and therefore the products are not the results of a learning process. Kim makes a distinction on the models of learning and innovation in advanced in comparison to developing countries. In his view, in the former innovation takes place as a result of "learning by researching", while in the latter innovation is the result of "learning by doing" that takes place as a result of imitative reverse engineering (Kim 1999, page ix).

There are different forms of imitation, that range from purely duplicative imitation to innovative new products; while the former does not yield any competitive advantages for the imitator, the latter is a source of sustainable competitive advantages (Kim and Nelson 2000). In this vein, Bell and Pavitt (1993) argue that there is always some degree of innovation involved in the diffusion process of innovation.

2.1.2. Degree of Novelty of Innovation: A Methodological Issue

The impact of the process of innovation on economic development has been highlighted since the works of Joseph Schumpeter in the early 20th century. Schumpeter defines innovation as "new combinations" of existing resources (Fagerberg 2004) therefore novelty is by definition the main elements in defining innovation. Innovation can be categorized in different ways (Fagerberg 2004; Garcia and Calantone 2002) both by their type[2] as well as by their level of innovativeness measured through degree of novelty (OECD 1997). Innovation as a process involves exploration and exploitation of opportunities for new or improved products, processes and services (Pavitt 2004).

The concept of novelty is particularly important in studies related to catching-up and gaining industrial leadership for the catching-up countries. For example, for long, innovations in the NIC were understood as new in the local context but not original in a global sense (Kim and Kim 1985). Although innovation by definition implies novelty (Smith 2004), there has long been ambiguity with regard to the terms "innovation" and "innovativeness" in the literature (Garcia and Calantone 2002; Hong, Oxley, and McCann 2012). The degree of novelty of innovations, or in other words the "newness" of innovation, is regarded as one of the identifiable *features* of innovation (Gordon and McCann 2005, page 525) and it has been used as a measure of "innovativeness", implying that highly innovative products would also be highly novel

[2] Schumpeter distinguished between five different types of innovation: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business (Fagerberg 2004).

(Garcia and Calantone 2002). But, the question at stake is how to define "newness". One common way of distinguishing between innovations, based on the classic work of Schumpeter, considers the marginality of the newness, i.e. whether it is radical (the incorporation of a radical idea) or incremental (Fagerberg 2004; Smith 2004).

The most common and widely accepted definition of "innovativeness" is the one given by the Oslo manual, and used in different innovation surveys (Smith 2004; Hong, Oxley, and McCann 2012). Specifically, the analysis of the impact of external knowledge sourcing on innovation, and in particular the degree of novelty of innovation, has a long-stand, such as using the Italian innovation survey (Evangelista et al. 1997; Sirilli and Evangelista 1998; Archibugi and Planta 1996) or the UK innovation survey (Laursen and Salter 2004; Laursen and Salter 2006).

The Oslo manual makes a specific distinction between "*a technologically new product"* and "*a technologically improved product*", where the former refers to a product with significantly different technological characteristics or intended usage compared to previous products and the latter is a product whose the performance has been enhanced (OECD 1997). Furthermore, the manual makes a clear distinction in relation to the degree of novelty: "new to the firm" refers to the minimum implementation requirement for an innovation, and is opposed to "new to the world", which requires that an innovation is introduced for the first time (OECD 1997).

It is commonly accepted that an improvement towards a "novel" product also implies the conferral of superior advantages, although this can only be determined by the existing markets (Hong, Oxley, and McCann 2012). Thus, determining the sources behind the degree of novelty is crucial in order to investigate the determinants of the upgrading of firms, particularly in emerging economies. Whereas previous works had focused on the imitation by firms from emerging economies that would imply either non-innovative activities or those of new-to-firm (Yeung 2007; Altenburg, Schmitz, and Stamm 2008), recent evidence indicates otherwise (Asakawa and Som 2008; Whang and Hobday 2011). As highlighted in the recent contributions of frugal innovations (Whang and Hobday 2011; Govindarajan and Ramamurti 2011b; Immelt, Govindarajan, and Trimble 2009), adapting and shaping products based on the local infrastructural and environmental conditions, requires more than only imitation and new-to-firm

innovation, but also innovation with higher novelty. Therefore understanding the critical factors behind more novel innovations is crucial to the competitiveness of firms.

2.1.3. Catching-up: Role of FDI

A static conceptualization on catching-up considers an initial stage in which innovation takes place in the developed economies, and a further stage in which technology is diffused and adopted in developing counties; the latter process is conceived as an effortless act that only benefits from the transferred technology (Dahlman and Westphal 1981). However, studies on the catching-up and industrial up-grading of the newly industrialized countries (NIC) and some Latin American countries, have provided a more advanced view on the dynamic process for catching-up (Chesnais 1992). In particular, the transition of NIC from imitators of technology in the 1960s to truly innovators in the electronics industry, initiated a more advanced understanding on the catching-up and the *learning process* behind it (Westphal, Kim, and Dahlman 1985; Dahlman, Ross-Larson, and Westphal 1987; Hobday 1995; Bell and Pavitt 1993; Lee and Lim 2001; Bell 2006; Chesnais 1992). Studying the *channels* for the transfer of foreign knowledge as well as the *capabilities* required for benefiting from this transferred knowledge, have been regarded as the main pillars in the catching-up process.

While the concept of catching-up would imply international flows of technological knowledge, spillovers from multinational enterprises (MNEs) is the main source for knowledge transfer required in the learning process (Chesnais 1988, 1992; Wang and Blomstrom 1992; Hobday 1994; Fosfuri, Motta, and Ronde 2001; Keller 2004). The main *channels* through which these spillovers can occur can be categorized into: demonstration/imitation (demonstration by MNE and imitation by local firms), labor mobility, and backward and forward linkages (Fosfuri, Motta, and Ronde 2001; Crespo and Fontoura 2007; Spencer 2008). The first mechanism relates to introduction of a new product in the local market that can motivate the imitation of the product by the local competitors (Wang and Blomstrom 1992). The second mechanism refers to the fact that employees who have already received training from MNEs are hired by local firms or start their own company (Fosfuri, Motta, and Ronde 2001; Rogers 1995). The third mechanism refers to the relationship between local firms and MNEs: backward linkages indicate the relationship between local firms as suppliers of global firms, while forward linkages relate to local firms as the users of the products of the MNEs (Kugler 2006; Ivarsson and Alvstam 2004,

2005; Jindra, Giroud, and Scott-Kennel 2009; Javorick 2004). In particular, the studies on global value chains have emphasized the *interactive learning* that can take place between the *global buyers* and *local suppliers* (Morrison, Pietrobelli, and Rabellotti 2008; Ivarsson and Alvstam 2011; Pietrobelli and Rabellotti 2011; Saliola and Zanfei 2009).

What is crucial is that not all firms benefit in the same terms from knowledge spillovers of MNCs (Wang and Blomstrom 1992), as the next section will highlight, capabilities, or absorptive capacity is the pre-requisite to benefit from interactive learning.

2.1.4. Capability Creation: Pre-requisite for Catching-up

Central in studies attempting at providing an understanding of the industrialization process of NIC and of the differences among industries in the catching-up process, is the concept of "technological capability" (Bell and Pavitt 1993; Lall 1993). Technological capability (Westphal, Kim, and Dahlman 1985; Enos 1991; Bell and Pavitt 1993; Kim 1997; Kokko, Tansini, and Zejan 1996; Justman and Teubal 1991) absorptive capacity (Criscuolo and Narula 2008; Lall 1992; Cohen and Levinthal 1990) or what Abramovitz (1986) calls social capital, are the pre-requisite for benefiting from knowledge spillovers from FDI. Following Katz (1984), while technological knowledge is indeed important for the economic growth, in order to benefit from this, there is a need for technological capabilities both at the firm and also country level.

Various scholars, particularly in the early 1980s, have attempted to define the concept of "technological capability" and to provide and understanding of the different levels of capabilities required at different stages of industrialization (Lall 1992; Dahlman, Ross-Larson, and Westphal 1987; Westphal, Kim, and Dahlman 1985; Kim 1997). In a simple definition, while technology is the practical application of technological knowledge, technological capability is the *ability* to make effective use of technological knowledge (Westphal, Kim, and Dahlman 1985).

In a widely used definition by Kim (1997), technological capability is regarded as synonymous with absorptive capacity:

"*The ability to make effective use of technological knowledge in efforts to assimilate, use, adopt and change existing technologies. It also enables one to create new technologies and to develop new products and processes in response to changing economic environment"* (Kim 1997, p.4).

Therefore while technological capabilities are necessary for benefitting from the technological knowledge, they also enable firms to create new technologies as well.

In his seminal work, Enos (1991), emphasizes the role of individuals' training and their technical skills; indeed capital accumulation, which can include also the human capital (Stiglitz 1996), was regarded as the engine of growth in the East Asian economies. Kim (1993) in analyzing the National Innovation System (NIS) of Korea, highlights the particular role of human capital as the most basic and crucial determinant of technological capability. The catching up process in Korea has been the result of both the acquisition of foreign technologies (Pack and Westphal 1986) and the *increased capability of local personnel* in improving those products both for the local market and later international market (Kim 1980). In his important contribution, Hobday (1995) highlights the learning process and capability creation that had occurred in the NICs through acquisition of foreign technology; in particular, he highlights how *original equipment manufacturers (OEMs),* have been used as a training in order to overcome entry barriers and furthermore enabling firms to assimilate manufacturing and design technology (Hobday 2001).

Dahlman and Westphal (1987) divide the components of technological capability into: production capability, investment capability and innovation capability[3]. As a country climbs up the development ladder it needs to generate more sophisticated technological capabilities, starting from simpler production capabilities and then moving to finance and innovation capabilities, in a process that can take decades. Recently, scholars have also distinguished between different levels of capabilities, from basic to advanced, arguing that while latter are required for *generating* new technologies the former are required for using what has been developed by others (Iammarino, Padilla-Pérez, and von Tunzelmann 2008).

Moving from an understanding of the capabilities required for up-grading at the *firm level*, to those required for gaining an *industrial leadership*[4] (Hobday 1995; Lee and Lim 2001; Hobday, Rush, and Bessant 2004; Dutrénit 2007; Iammarino, Padilla-Pérez, and von Tunzelmann 2008; Dantas and Bell 2009) have been the focus of more recent studies (For a review see Bell and Figueiredo 2012). By analyzing changes over a long period, the industry-

[3] Production capability refers to the capabilities required to operate and maintain production facilities; investment capability refers to the abilities required for expanding capacity and establishing new production facilities; innovation capability refers to: the capabilities required both for invention but also for innovations.

[4] As will be highlighted in the next section, analysing up-grading from a sectoral innovation system perspective, had been at the core of several of these studies.

focused case studies have contributed to understanding the diversity of the catching-up processes not only among countries but also among different *industries* (Lee and Lim 2001). Thus, developing countries were no longer regarded as only passive receivers of "technology" but also of the generators of technology (Gereffi 1999; Hobday 1995; Katz 1984).

While technological capabilities are a pre-requisite for learning, they are also accumulated as result of *interaction* between different actors in the environment. The literature on catching-up of the NIC had mainly regarded the building of technological capabilities and learning at the firm level (micro-level). However accounting for the factors emanating from environment resulted into works that had considered development as an interactive process, particularly by using an innovation system framework.

2.2. Interactive Learning and Innovation: Economic Geography Perspective

The framework of innovation systems has been widely used to understand barriers to economic development and catching-up, offering policy recommendations has been at the center of these types of contributions (Metcalfe and Ramlogan 2008; Lundvall et al. 2009; Chaminade and Vang 2008; Altenburg, Schmitz, and Stamm 2008). Therefore, understanding what is an innovation system and how it can contribute to learning is crucial.

The initial idea of the innovation system goes back to the work of Friedrich List (1841) on *The National System of Political Economy*. The national innovation system contributions (Freeman 1987; Lundvall 1992; Nelson 1993) can be regarded as the pioneering works that have emphasized the role of external sources of innovation, other than those related to R&D. In this framework, a system consists of elements with an active interaction between these elements (Lundvall 1992). In fact these interactions are regarded as a social process that involves feedbacks at different stages of the innovation process (Cooke, Uranga, and Etxebarria 1997).

An interactive view to the learning process can be regarded as the basis of frameworks such as innovation system. The chain-linked model or Kline model of innovation which was proposed by Kline and Rosenberg (1986) can be seen as the basis for these approaches. This framework was proposed as an opposition to the linear view model by Bush (1945) which had regarded the process of innovation as a linear and one-way process starting from research, then to development, production and finally marketing and not giving room to feedback processes (Kline and Rosenberg 1986). On the other hand Kline and Rosenberg (1986) have argued that

the process of innovation is complex and it must be regarded as a series of changes in the whole *system*, therefore changes should also be embedded in the marketing environment, production facilities and the social context of the organization. In fact, in the innovation system, "activities" that take place are regarded as the determinants of the development and diffusion of innovations (Edquist 2011) and in this system, learning is the central activity which is also involves interaction such as with users (Lundvall 1992). Searching is another main activity within the innovation system that can start from a local search defined as those sources already known to the organization and be expanded to more distant alternatives (ibid).

But what is the definition of an innovation system? Edquist (2004) defines system of innovation as *all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovations.* While this definition is rather broad, the main pillars of the innovation system can be divided to actors and institutions. This framework regards innovations as the outcome of interactions between actors at the micro-level while these interactions are ruled by institutions (Edquist 1997; Lundvall 1992). Therefore, innovation is no longer regarded as the outcome of a linear process from basic research to the final product, but as the outcome of an interactive process involving feedbacks at the different stages (Edquist 1997). Innovation systems can be defined both from a narrow and broad perspective, while the narrow definition includes organizations and institutions such as R&D departments or universities that are involved in searching and exploring, the broader definition includes all parts and aspects of the economic structure that can impact learning and searching (Lundvall 1992, page12). As also emphasized by Lundvall (1992, page 13) innovation system is an open definition that relies on the sub-systems that it can include, he also relates the same openness to the NSI approach and emphasizes that different theoretical perspective can bring forward different aspects of the system.

The systematic view on the interactive learning can be delimited with different boundaries: regional (Cooke 1992; Asheim and Isaksen 2002; Asheim and Gertler 2004), technological (Carlsson and Stankiewicz 1991) and sectoral (Malerba 2002) systems of innovation are the different frameworks that have been used.

2.2.1. Regional Innovation System

Proceeding from the ground of national innovation system, economic geographers have been arguing that globalization has made the importance of nations obsolete and therefore an increase of importance for sub-nations has been recognized. They have argued that indeed the basic characteristics that can distinguish nations, can also be evident in some sub-nations as compared to the others (Cooke, Uranga, and Etxebarria 1997, p.479), this logic is the basic starting point for the arguments on the importance of analyzing innovations system at a regional level.

Departing from the work of Marshall (1920), since the early 1980s social scientists started to considered the significant role of *regions* for the economic life[5]. Although adopting different labels, such as "industrial districts" (Piore and Sabel 1984), "clusters" (Porter 1998) "innovative milieu" (Camagni 1991) or "learning region" (Asheim 1996), the region has been regarded as the main unit of analysis for understanding the spatial dimension of interactive learning for innovation, particularly for economic geographers. Therefore, the impact of geographical proximity to other external actors was regarded as highly valuable. The benefits of proximity are mainly related to the externalities and *localized* knowledge spillovers (Asheim 1996; Maskell and Malmberg 1999; Breschi and Lissoni 2001; Asheim and Isaksen 2002; Gertler 2003; Storper and Venables 2004; Asheim and Gertler 2004). Arguing for the differences on the transferability of tacit and codified knowledge, (Polanyi 1983 (1966)) had highlighted the importance for the spillovers of tacit knowledge (Maskell and Malmberg 1999; Asheim and Gertler 2004; Storper and Venables 2004). Economists have also contributed to provide an understanding of role of knowledge spillovers (Jaffe, Trajtenberg, and Henderson 1993; Acs 1994; Audretsch and Feldman 1996) by analyzing the impact of externalities[6] within a geographic unit.

However, the great emphasis on tacit knowledge spillovers also raised criticism (Breschi and Lissoni 2001; Doloreux and Parto 2005) by highlighting the importance of knowledge exchange as the result of embeddedness in a similar context and institutional setting (Gertler 2003; Doloreux and Parto 2005). Deriving from the basics of social network analysis, other scholars have emphasized the knowledge exchange as the result of embeddedness in a localized

[5] Storper (1995) has an extensive literature review on the earlier works and the schools they had belonged too
[6] Relying on the principles of the growth theory is the main point of departure in these studies

network (Boschma and ter Wal 2007; Owen-Smith and Powell 2004). Furthermore, more recent contributions from economic geographers have added to the view of proximity by extending it to other types such as cognitive, organizational, social and institutional, that are not necessarily geographically bounded (Boschma 2005).

Although not rejecting the idea of localized knowledge, there has been a shift from a sole emphasis on intra-regional exchange of knowledge to a complementary non-local inter-regional linkages (Bathelt, Malmberg, and Maskell 2004; Simmie 2004; Amin and Cohendet 2005; Gertler and Levitte 2005; Tödtling, Lehner, and Trippl 2006). The argument is based on rejecting the tacit/local vs. codified/global distinction by highlighting the knowledge flows among network members (Amin and Cohendet 2005). In this view, openness to the external environment through global linkages, is regarded crucial for preventing over-embeddedness (Giuliani, Pietrobelli, and Rabellotti 2005).

Other works have also emphasized that benefiting from local or non-local linkages also depends highly on the knowledge bases (Asheim and Coenen 2005; Asheim, Coenen, and Vang 2007; Moodysson, Coenen, and Asheim 2008). Relying on data gathered at firm level through surveys or interviews, these works have tried to illustrate under which conditions the global or regional sphere matters most for the exchange of knowledge between firms and other organizations. Geographical proximity has higher importance for industries in symbolic or synthetic knowledge bases while global sourcing of knowledge can matter more for analytical knowledge that relies more on scientific and codified knowledge (Martin and Moodysson 2013; Moodysson 2008; Owen-Smith and Powell 2004). Departing from this framework, various recent works have illustrated the engagement of firms, according to their sector, in variety of channels both in terms of type and also their spatial expansion (Trippl, Tödtling, and Lengauer 2009; Grillitsch, Tödtling, and Höglinger 2013; Grillitsch and Trippl 2014; Aslesen and Freel 2012; Plum and Hassink 2011; Tödtling, Lehner, and Trippl 2006; Herstad and Ebersberger Forthcoming).

By arguing on the variety of regional innovation systems (Evangelista et al. 2002), others have concluded that firms embedded in weaker regional innovation systems tend to collaborate with firms outside their region (Grillitsch and Nilsson Forthcoming; Chaminade and Plechero 2015). In a similar vein, there is a strong argument that collaboration of firms with

universities is primarily determined by the quality of university rather than geographical proximity (Laursen, Reichstein, and Salter 2011).

2.2.2. Sectoral Innovation System

Delimiting the systematic analysis to specific sectors has been at the core of sectoral innovation system (Malerba and Orsenigo 1997; Malerba 2002). Malerba (2004) categorizes the dimension of a sectoral innovation system into: knowledge and technological domains, actors and networks, and institutions. This framework has received increased attention as a result of industrial upgrading of firms from NICs and later on emerging economies (Malerba and Nelson 2011). In particular, this framework had been helpful for analyzing different rates of catching-up among sectors (Lee and Kim 2008; Malerba and Mani 2009; Cusmano, Morrison, and Rabellotti 2010; Malerba and Nelson 2011; Giuliani, Pietrobelli, and Rabellotti 2005).

The role of demand and interactions with sophisticated customers has been at the core of recent studies using the sectoral innovation system framework (Malerba et al. 2007; Fontana and Malerba 2010; Lee and Malerba 2014; Adams, Fontana, and Malerba 2012). This has also been highlighted as one of the important aspects that has shaped the transition of countries into an industrial leadership both in high tech sector such as ICT (Whang and Hobday 2011) or in a low-tech sector as wine industry (Cusmano, Morrison, and Rabellotti 2010).

The concept of "windows of opportunity" has been critical in recent contributions, highlighting the transition of firms in some sectors to industrial leadership (Cusmano, Morrison, and Rabellotti 2010; Niosi and Reid 2007; Lee and Malerba 2014). The concept of windows of opportunity as proposed by Soete and Perez (Perez and Soete 1988), refers to the advantages gained by the later-comers as the result of diffusion of technology, as new products are built upon the existing knowledge of the old products. As highlighted by Niosi and Reid (2007), the developing countries have good chances of long-run success if they enter at an early stages of a given emergent technology. In a recent contribution, Malerba and Lee (2014) propose that upgrading of firms would depend on a combination of capabilities alongside the windows of opportunity (Perez and Soete 1988) that consists of technological, demand or institutions.

2.2.3. Global Value Chain: Learning and Innovation for Catching-up

The Global Value Chain (GVC) analysis had emerged with the aim of providing an understanding of the globalization of economic activities and how it can impact the economic development of the developing countries (Gereffi 1999; Kaplinsky 2000; Bair and Gereffi 2001; Gereffi, Humphrey, and Kaplinsky 2001; Humphrey and Schmitz 2002). This is a widely used framework in studying learning and innovation in particular for the catching-up (Morrison, Pietrobelli, and Rabellotti 2008; Humphrey and Schmitz 2002; Giuliani, Pietrobelli, and Rabellotti 2005). This framework can be regarded as complementary to the innovation system frameworks, as it considers also the *international* channels of knowledge exchange and collaboration (Gereffi, Humphrey, and Kaplinsky 2001; Humphrey and Schmitz 2002; Pietrobelli and Rabellotti 2011). In other words while the regional innovation system framework is more concerned with the localized learning, in the GVC analysis, cross-border linkages between firms in the value chain system is the focus of analysis.

In a simple definition, value-chain embraces the range of activities which are required to bring a product or service from the starting phase to the final end (Kaplinsky 2000). The global value chain can be regarded as the integration of *internationally dispersed activities* (Gereffi, Humphrey, and Kaplinsky 2001). In particular, as an outcome of globalization, the production processes have become increasingly dislocated across *various* developed and developing countries (Pietrobelli and Rabellotti 2011). The integration of firms from the emerging economies in the GVC has even increased in the last years; this has been the result of increasing capability of emerging economies on one side and the facilitated communication channels on the other (Sturgeon 2008).

Value chain activities (Porter 1985) can be categorized into the upstream (input) end, the downstream (output or market) end and the middle[7]; in this categorization *value creation* is related to the activities at the upstream or downstream end (Mudambi 2008). Therefore the *location* of activities with higher "value" is of importance: in fact, gaining access to activities with higher value is an indication of industrial upgrading (Gereffi 1999). The term "up-grading", central in understanding the catching-up process of firms, would indeed refer to the

[7] On the activities related to each category Mudambi (2008, p.701) explains "*activities at the upstream end generally comprise design, basic and applied research and the commercialization of creative endeavours. Activities at the downstream end typically comprise marketing, advertising and brand management and after-sales services. Activities in the middle comprise manufacturing, standardized service delivery and other repetitious processes in which commercialized prototypes are implemented on a mass scale*."

move of firms along the value chain, from lower value added activities to those of higher value (Humphrey and Schmitz 2002). Therefore, how to gain access to skills and competences required for participation in GVC, and what are the potential for "upgrading" are the main pillars within this framework (Gereffi, Humphrey, and Kaplinsky 2001).

This framework has also been used in understanding the up-grading that can take place in clusters. The main argument lies on the notion that upgrading of firms embedded in clusters can take place as the result of not only localized learning but also global linkages (Humphrey and Schmitz 2002; Pietrobelli and Rabellotti 2006; Giuliani, Pietrobelli, and Rabellotti 2005). In particular, learning can occur as a result of interaction between local producers (suppliers) and global buyers (Humphrey and Schmitz 2002; Giuliani, Pietrobelli, and Rabellotti 2005; Ivarsson and Alvstam 2011, 2004).

Inevitably, a sectoral analysis has also been central in the analysis of the industrial upgrading. Highlighting the sectorial up-grading from the low-tech sectors to high-tech industries, has been the focus of some of the case studied, such as those related to the case of the Sinos Valley shoe cluster in Brazil (Humphrey and Schmitz 2002); blue jeans industry in Torreon, Mexico (Bair and Gereffi 2001); the Czech automotive industry (Pavlínek and Žížalová 2014); or on the Indian auto-industry (Kumaraswamy et al. 2012). As already discussed in the previous section, the main argument of these studies lies on illustrating how up-grading can differ *across* sectors. As upgrading embraces a range of activities, they can be categorized based on the "type" of activities such as product, process and functional upgrading[8] (Humphrey and Schmitz 2002). The GVC analysis has mainly been concerned with the up-grading at industrial level, the analysis of up-grading at the firm level is of more recent works (Hansen, Fold, and Hansen Forthcoming).

The main building blocks of the GVC studies can be categorized into: governance and location. Governance is a central concept in the GVC analysis (Gereffi, Humphrey, and Sturgeon 2005; Altenburg 2006; Nadvi 2008; Humphrey and Schmitz 2002). It is a system that links firms together in a variety of ways and therefore important in the generation, transfer and diffusion of knowledge that can lead into innovation (Gereffi, Humphrey, and Kaplinsky 2001; Gereffi, Humphrey, and Sturgeon 2005; Humphrey and Schmitz 2002). The reason for their

[8] Product upgrading would refer to introducing more sophisticated products; process upgrading refers to transforming inputs to outputs more efficiently; functional upgrading refers to acquiring new functions to increase the overall skill and content of the activity (Humphrey and Schmitz 2002)

central role is related to the need for taking decisions any stage of the value chain "*not only on "what" or "how" a good/service should be produced, but also sometimes "when", "how much" and even "at what price"* (Morrison, Pietrobelli, and Rabellotti 2008, p.40), although, this co-ordination at the global scale does not imply a direct ownership (Gereffi, Humphrey, and Sturgeon 2005, p.81).

As a result of variety of relations between the global buyers and local supplier, Gerreffi and colleagues (2005) recognize five types of global value chain governance: market, modular, relational, hierarchy and captive[9], that goes from low to high levels of explicit *coordination* and *power* asymmetry. Departing from these works, scholars have also recognized different learning path that reflects the complexity of relation between the global and local players (Pietrobelli and Rabellotti 2011; Saliola and Zanfei 2009; Ivarsson and Alvstam 2011; Hansen, Fold, and Hansen Forthcoming), highlighting the different levels of up-grading that can take place as the result of the type of governance. Pietrobelli and Rabellotti (2011) argue that due to the different levels of complexity of transactions, codification of competences, and supplier competence, the learning channels involved in each stage also differ. Saliola and Zanfei (2009) argue that the value chain relationships is a *multi-facet process* of interaction between buyers and suppliers and therefore it involves different modes of knowledge transmission and development. The criticism made to GVC analysis is their overemphasize on the governance typologies (Yeung and Coe 2015).

Parallel to the GVC literature, also global production network (GPN) framework was developed (Ernst and Kim 2002; Coe et al. 2004; Coe, Dicken, and Hess 2008; Coe 2012; Henderson et al. 2002). The aim of this framework is "*to reveal the multi-actor and multi-scalar characteristics of transnational production systems through intersecting notions of power, value and embeddedness. In particular, attempts are made to connect with understandings of sub-*

[9] *Market linkages* do not have to be completely transitory, as is typical of spot markets; they can persist over time, with repeat transactions. The essential point is that the costs of switching to new partners are low for both parties. *Modular value chains.* Typically, suppliers in modular value chains make products to a customer's specifications, which may be more or less detailed. *Relational value chains.* In these networks we see complex interactions between buyers and sellers, which often creates mutual dependence and high levels of asset specificity. *Captive value chains.* In these networks, small suppliers are transactionally dependent on much larger buyers. Suppliers face significant switching costs and are, therefore, 'captive'. Such networks are frequently characterized by a high degree of monitoring and control by lead firms. *Hierarchy.* This governance form is characterized by vertical integration. The dominant form of governance is managerial control, flowing from managers to subordinates, or from headquarters to subsidiaries and affiliates (Gereffi, Humphrey, and Sturgeon 2005, pp.83-84)

national regional development and clustering dynamics" (Coe, Dicken, and Hess 2008, p.267). The emphasis on the "network economies" (Parrilli, Nadvi, and Yeung 2013) is the main principle that also distinguishes these works from those related to GVC. Furthermore the GPN researchers are more explicit in their incorporation of state institutions in shaping the constitution of global production networks (Neilson, Pritchard, and Yeung 2014).

2.3. Localized Learning for Globalized Enterprises: International Business Perspective

The impact of foreign direct investments on the economic development of the host location has been a widely studied subject since post-world World War II (Dunning 1985). Understanding the motivations for firms to expand globally and the choice of location for that expansion has been one of the widely studied topics within the international business.

Scholarly works of international business have been concerned with different aspects of MNEs and in particular with: why firms become MNE, where do they locate their subsidiaries, and how they organize their production and transaction (Iammarino and McCann 2013, p.1)[10]. The product life cycle (PLC) model developed by Vernon (1966) and the eclectic paradigm of Dunning (1976; 1980) have been the main applied frameworks in the international business studies that have also explained the spatial dimensions of MNEs (McCann and Mudambi 2004, 2005; Iammarino and McCann 2013).

Innovation is at the core of PLC model, and the location of activities varies based on the product life cycle (introduction, maturity and standardization) (Vernon 1966) .While at the initial stages innovation takes place at the home market, a MNE expands in the later stages in order to exploit foreign markets (Frost 2001), therefore it is recognized as a demand-driven model (Iammarino and McCann 2013). This model has informed corporate policies during 1955-1975, implying that only after extensive imitation at the home market, firms release the technology to the foreign firms (Chesnais 1992). In fact, as already highlighted in the previous section, Perez and Soete (1988) have raised the criticism that PLC framework regards products as independent from each other, and therefore each product is regarded as a "radical innovation" and its improvements would lead to incremental innovations, whereas each product in reality is

[10] For the purpose of this thesis, this section is concerned with giving an overview on how the locational behaviour of MNEs has impacted the theories of international business and scholarly works that have followed. Therefore OLI and PLC as the two highly used theories, have been selected and explained briefly.

built upon the existing knowledge. Therefore they propose the concept of life cycle of technology (ibid.).

The eclectic theory of international production also known as the OLI (ownership, locational, internalization) framework was proposed by Dunning (Dunning 1976), and has been further developed during the years as a response to the critics and shortcomings (Dunning 1998; Dunning 1988). The model offers a framework for identifying and evaluating the factors that initiate foreign production (Dunning 1988), thus has been used vastly in order to explain the *competitive advantages* that firms can gain from internationalization. These advantages are related to three pillars: ownership (why), location (where) and internalization (how). In explanation of why the model is called eclectic paradigm, Dunning (1988, p.1) clarifies:
"*to convey the idea that a full explanation of the transnational activities of enterprises needs to draw upon several strands of economic theory; and that foreign direct investment is just one of a number of possible channels of international economic involvement, and of which is determined by a number of common factors*"

As highlighted in the previous section, analyzing the locational advantages for the economic activities of the firms at the regional level has been at the core of the economic geography works; International Business (IB) scholars had analyzed the locational advantages at the country level. Therefore, the major shortcoming of the OLI framework has been related to treating the region as a black box, while this is important in order to understand the advantages derived from location for the innovation and technological processes within the MNEs (Iammarino and McCann 2013; McCann and Mudambi 2005). Departing from this limitation led to a series of papers that aimed at going beyond the observation of "location" dimension at the country level and capture the advantages at the regional level (Cantwell and Piscitello 1999; Cantwell and Santangelo 1999; Cantwell and Piscitello 2005).

2.3.1. From Exploitation to Exploration

The classical theories on multinational firms include those of the international trade developed in the period 1955-1975, when foreign trade grow faster than foreign direct investments. In these theories the locational advantages of the host countries were regarded as those related to easing the access to specific natural resources, availability of labor with at an attractive cost or desirable product market (Chesnais 1992). This approach was not concerned

with the knowledge embedded in the host location as innovation was conceived as a phenomenon happening only in the home location. Understanding the knowledge-seeking behavior of MNEs became the subject of IB studies from the 1990s onwards. In these analyses, the location dimension is particularly important for understanding the "knowledge-seeking" motives behind the FDI. Globalization has transformed the aspects of multinationality and multinational activities since the late 1980s (Iammarino and McCann 2013) leading to an impact on globalization of innovation or global generation of innovation (Archibugi and Michie 1995; Archibugi and Iammarino 2002).

Traditionally MNEs expanded geographically, driven mainly by the adaptation of products already developed in their home country to the needs of the market in the host country. The aim of these R&D sites was exploitation activity or in the words of Kuemmerle: *home-base-exploiting* (Patel and Pavitt 1991; Archibugi and Michie 1995; Kuemmerle 1997; Archibugi and Iammarino 2002; Cantwell and Mudambi 2005; Castellani and Zanfei 2006). The location choice of these subsidiaries was based on proximity to an already existing manufacturing and marketing location (Kuemmerle 1997). However the increasing recognition of the importance of the scientific excellence embedded in the geographical location (Cantwell and Janne 1999) lead to the engagement of subsidiaries in their local environment with the aim of gaining *access to the localized knowledge* that can be shared between the network of subsidiaries and the parent company (Blanc and Sierra 1999; Cantwell and Piscitello 2005; Meyer, Mudambi, and Narula 2011).

This new perspective meant that the internationalization strategy was no longer restricted to only adaptation of products but also included production of new products as a result of gaining and accumulation of knowledge across the national borders (Cantwell and Piscitello 2000; Frost 2001; Chung and Alcácer 2002; Cantwell and Piscitello 2005; Chesnais 1988) – what has been termed *home-base-augmentation* (Kuemmerle 1997), global generation of technology (Archibugi and Michie 1995; Archibugi and Iammarino 1999, 2002), or exploration activity (Cantwell and Mudambi 2005; Castellani and Zanfei 2006)[11].

Clearly, this shifting of the role for the subsidiaries of MNCs was seen more than anything else as the result of facilitated communications between the headquarter and

[11] The distinctions between exploitation and exploration used in the international business literature are indeed analogues to that of organizational learning theory (Cantwell and Mudambi 2005; Mudambi and Swift 2014).

subsidiaries brought by advancements in the transportation system and ICT (Chesnais 1992; Cantwell and Santangelo 1999; McCann and Mudambi 2004). These changes also meant a new interpretation of the OLI framework, as moving from exploitation to exploration had also meant that firms were no longer only the consequence of *ownership* advantages that can be exploited in foreign markets, but also as means of expanding the competitive advantage of the firm (Cantwell and Piscitello 2005).

2.3.2. Locational Determinants of FDI: Extraction of Local Knowledge

Interest in analyzing the locational determinants of FDI, was brought as the result of increasing exploration activities (Dunning 1994; Almeida 1996; Dunning 1998; Frost 2001; Chung and Alcácer 2002). *Where* and *how* MNEs decide to locate their investment became the core of the analysis that have been contributing to a new understanding of locational behavior of MNEs (McCann and Mudambi 2004). This understanding has been important on one hand from a theoretical stand and in shaping a new understanding of *locational behavior* of MNEs, and on the other hand these findings have been an important input for regional and national policies aimed at attracting FDI as a source of regional economic development (McCann and Mudambi 2004; Iammarino and McCann 2013; Basile, Castellani, and Zanfei 2009; Dimitratos, Liouka, and Young 2009). Indeed, this understanding is the main challenge for regional economists that need to predict the decision of MNEs with regards to their spatial configuration of activities (McCann and Mudambi 2004, p.492).

Departing from works on the role of geographical proximity and knowledge spillovers (Kogut and Zander 1992; Jaffe, Trajtenberg, and Henderson 1993; Audretsch and Feldman 1996), the IB scholars have also highlighted that the major locational advantages and motives for FDI are associated with the benefits in terms of tacit knowledge spillovers and ease of interaction with the external *host* environment (Almeida 1996)[12]. On the other hand, some have also casted doubts concerning the negative motivations for preventing knowledge spillovers to the competitors for the location determinants of firm (Alcacer and Chung 2007).

In fact, based on the results of previous studies on industrial districts and innovation milieus, the *internal* differences within the regions based on their *sectoral pattern of specialization* have been analyzed in a series of papers (Cantwell and Iammarino 1998;

[12] For a review of the literature refer to: (Iammarino and McCann 2006)

Cantwell and Iammarino 2000; Cantwell and Iammarino 2001) concluding that firms are more likely to be attracted to regions with "higher order" that can result into higher spillovers. The authors clarify that the high spillovers effects in high-order regions are related to the high dynamism in those regions in terms of technological and productive activities, general infrastructure, financial facilities, openness to the external environment and business network (Cantwell and Iammarino 2001, p.1011).

The embeddedness perspective and the benefits deriving from access to the *innovation system* of the home and host country as a result of a dual network, have been the subject of analysis of various works (Criscuolo, Narula, and Verspagen 2005; Almeida and Phene 2004; Frost 2001). The result of the analysis by Frost (2001) highlights that indeed subsidiaries benefit from interaction with the local sources, however this is dependent also on the characteristics of the parent home, emphasizing that the issue at quest is in fact the *condition* under which firms can benefit from the local knowledge. By making advancements on this perspective and concerned with the "conditions", the result of the study by Almeida and Phene (2004) highlight that linkages to the other firms in the host country have a positive impact on the innovativeness of MNCs.

The studies on dual network advantages led to more recently accepted concept of "dual embeddedness" (Meyer, Mudambi, and Narula 2011). The term "dual embeddedness" refers to the benefits gained by having both an internal embeddedness within a MNE and by interacting with other subsidiaries and the parent company, but at the same time the local embeddedness of firms and the localized knowledge of the host country can have positive impacts (ibid). In fact, the dual embeddedness can lead to positive impact at the home location in the form of reverse knowledge transfer (Criscuolo 2009; Mudambi, Piscitello, and Rabbiosi 2014; Castellani and Pieri 2013). This does not only include the benefits received by the MNC's group (intra-firm) but also includes benefits gained by firms at the home location and through inter-firm knowledge-spillovers (Criscuolo 2009).

2.3.3 "Branch Plant" Syndrome

Despite the emphasis on the positive impact of MNCs on the economic development of regions, some scholars have been concerned also with their negative impacts; in particular by raising doubts on whether FDI would generate substantial technological externalities that can

impact the economic development of the host locations (Keller 2004; Irsova and Havranek 2012; Javorick 2004). Among the negative impacts are crowding-out of local firms (Spencer 2008), increased foreign dependency, and loss of control (Narula and Guimon 2010). However the negative factors cannot be studied without a deeper analysis on the firm behaviors, both in terms of the mode of entry and exploitation or exploration strategies as motivations behind the R&D activity (Kuemmerle 1997; Narula and Guimon 2010; Castellani and Zanfei 2006).

On the other hand, the impact of MNCs toward the development of the host economies has also been subject of negative concerns, in particular, "branch plant" syndrome (Laxer 1986) has been regarded as one of the reasons for casting doubts on their contribution to local development (Phelps 1992; Young, Hood, and Dunlop 1988; Phelps et al. 2003). The concept of "branch plant economies" had initially refereed to economies that had been hosting the manufacturing plants of foreign companies as in the case of American companies in Canada (Laxer 1986). This concept was also applied by Phelps (1992) in order to explain the reasons behind the failure of manufacturing industries in the older industrial districts in the UK during the 1960s and 1970s. The core of his analysis has been focused on the formation and changing spatial patterns of industrial linkages.

The embeddedness of a MNC in the region is an indicator of its positive impact on regional growth through indirect employment and increased output, that can be measured through the depth and quality of the interactions between the foreign affiliated firms and the local actors, either firms or other organizations (Brand, Hill, and Munday 2000; Phelps et al. 2003; Phelps 1992; Young, Hood, and Dunlop 1988). Knowledge spillovers are regarded as one of the main advantages derived from hosting foreign firm, which can occur through the direct interaction. Therefore the lack of this embeddedness or the isolation of the subsidiary from interaction with other local actors would result in the "branch plant" syndrome. The concept of "enclave economy" (Lovering 1999), on the other hand, refers to the fact that while MNCs can be beneficial for the host economy in terms of higher employment, their mere presence does not imply closer interactions with local actors (Phelps and Fuller 2000).

2.4. Summary

The aim of this dissertation is to provide an understanding on the impact of global linkages on innovation activities particularly for the economic development. *Active learning,*

capability building and innovation are the three dimensions that lie behind economic development and catching-up. However, while the three elements cannot be separated, they have also attracted contributions from different fields, each bringing an original perspective to the phenomenon. Therefore the theoretical background behind this dissertation lies at the intersection between: innovation studies, development studies, economic geography and international business.

In this dissertation, understanding how innovation would matter for the catching-up is highlighted through an evolutionary perspective with its emphasize on searching for various resources. Interactive learning at different spatial levels and sourcing of knowledge from different places highlights the search for variety. This requires combining theoretical contributions from economic geography and its emphasize on systematic view to learning and particularly localized learning, and international business that highlights the impact of having access also to knowledge across geographical boundaries. This literature review has provided an overview of the contributions from both fields.

Furthermore, what is central in this thesis, as also reflected in the literature review, is the attempt to account for the differences on technological capabilities of firms that can impact on their involvement and on the benefits they can gain from local or global linkages. Therefore, providing and understanding of technological capabilities or absorptive capacity has been regarded necessary.

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CHAPTER 3

The effect of local and global linkages on the innovativeness in ICT SMEs: Does location-specific context matter[13]?

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Abstract: Countries differ significantly with regard to the location-specific contexts in which they are embedded. The aim of this paper is to extend the discussion on the effects of local and global innovation collaborations on the degree of novelty of innovation by considering this context. Our main question is: Does embeddedness in the developed or emerging country context affect the likelihood of benefiting from local or global linkages for innovations with higher novelty? The paper is based on data gathered through a survey of firms in the ICT sector in an emerging economy (India) context and from two Scandinavian countries (Sweden and Norway). The findings of this study show that global linkages do indeed impact the degree of novelty of innovation. However, country context does have a moderating effect. While the effect of global linkages is highly positive on the innovativeness of Scandinavian firms, for the Indian SMEs, the innovation linkages that give positive innovativeness results are the regional ones.

Keywords: External sources, regional linkages, global linkages, SME, ICT, degree of novelty, Scandinavia, India.

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1. Introduction

The role of small and medium sized enterprises (SMEs) as dynamic actors contributing to job creation and economic growth in nations has long been studied by researchers (Lucas 1978; Acs and Audretsch 1990; Acs et al. 1997; Johansson 2004) and by policy actors (European Commission 2007). Research suggests that SMEs' ability to learn and to innovate are pivotal for the dynamics of regions and nations (Kemeny 2011). However, the *liability of smallness* (Freeman, Carroll, and Hannan 1983) or constraints emanating from lack of resources has hindered the abilities of SMEs to innovate (Hewitt-Dundas 2006). In particular their competitive advantages can be raised by introducing *novel* innovation or enhancing their "innovativeness" (Garcia and Calantone 2002; Hong, Oxley, and McCann 2012). In this regard, understanding the factors that enrich the learning capabilities of SMEs is important, both from a firm level perspective and also from a policy angle.

The resource-based view regards firms' resource *heterogeneity* as the source of differences for firms' performance (Wernerfelt 1984; Barney 1991; Peteraf 1993). In this regard, as the sources for innovation and determinants of product innovations can be manifold (de Jong and Vermeulen 2006; Acs and Audretsch 1988), firms are necessitated to search for various channels in order to increase their learning capabilities (Chesbrough 2003; Laursen and Salter 2006; Ahuja and Katila 2004; Nieto and Santamaría 2010). Previous research particularly in economic geography (Asheim 1996; Giuliani, Rabellotti, and Dijk 2005; Ceci and Lubatti 2012) has highlighted that SMEs benefit most by networking and by using geographical proximate (local) external resources (Rogers 2004; Hewitt-Dundas 2006; Colombo et al. 2012; Nieto and Santamaría 2010; Freel and Harrison 2006; Håkansson and Snehota 1989; Rothwell 1991; Rosenfeld 1996; Davenport 2005).

Research has shown that countries both with advanced economies (Asheim and Gertler 2004; Fitjar, Gjelsvik, and Rodríguez-Pose 2013) as well as with emerging economies (Chaminade and Vang 2008b; Padilla-Perez, Vang, and Chaminade 2009) have invested in regional innovation policies. In this vein, recent discussions have highlighted the importance of having access to other innovation systems through global linkages (Bunnell and Coe 2001; Bathelt, Malmberg, and Maskell 2004; Gertler and Levitte 2005; Romero and Javier Santos 2007; Pietrobelli and Rabellotti 2011; Fitjar and Rodríguez-Pose 2012; Doloreux and Shearmur

2012; Morrison, Rabellotti, and Zirulia 2013; Meyer, Mudambi, and Narula 2011). This signifies that today's debate has a nuanced view of the impact of local and global resources on firm level innovation (Romero and Javier Santos 2007; Moodysson 2008). This paper is particularly interested in contributing to this debate by incorporating a new dimension, that is to investigate whether embeddedness in different contexts (Meyer, Mudambi, and Narula 2011) can impact the likelihood of benefiting from the local or global linkages in terms of enhancing the degree of innovativeness.

Recent work has emphasized the role played by location-specific factors while analysing the likelihood of engagement in an innovation network (Crescenzi, Rodríguez-Pose, and Storper 2012; Fernández-Serrano and Romero 2012; Doloreux and Shearmur 2012; Herstad and Ebersberger Forthcoming). Differences between embeddedness in emerging economies as compared to developed countries can be regarded as one of the contextual factors impacting the benefits gained from engagement in local and global linkages for SMEs. In other words, just as countries differ significantly with regard to a variety of socio-economic factors (Fagerberg, Srholec, and Knell 2007; Crescenzi, Rodríguez-Pose, and Storper 2012; Ghemawat 2001; Oliver 1997) their ability to benefit from local or global actors can also differ.

Access to external resources can be regarded as one of the determinants of the differences in technological capabilities between countries (Crespi and Zuniga 2012; Pietrobelli and Rabellotti 2011) and as a means for *overcoming limitations* for growth and innovation in the home-country context (Giuliani, Pietrobelli, and Rabellotti 2005; Stal and Cuervo-Cazurra 2011; Mair and Marti 2009; Chakravarthy and Coughlan 2011). Differences in these technological capabilities indicate that countries also differ in their abilities to recognise the value of external knowledge (Crespi and Zuniga 2012; Pietrobelli and Rabellotti 2011) or their absorptive capacity (Cohen and Levinthal 1990). Therefore, questions related to firms' (in our case SMEs') usage of external resources cannot be addressed without taking into consideration the context that these external linkages have emerged from (Fitjar, Gjelsvik, and Rodríguez-Pose 2013; Fitjar and Rodríguez-Pose 2012; Crescenzi and Rodríguez-Pose 2013; Fernández-Serrano and Romero 2012). The contextual factors can be regarded as a virtuous cycle that can affect the general ability of firms to link up to external resources and thus affect the technological capabilities of countries.

The objective of this paper is to extend the discussion on the effects of local and global innovation collaborations on the degree of novelty of innovations by considering the context that the ICT SMEs are embedded in. The following research questions will be explored:

1) What is the effect of local and global linkages on the degree of novelty of innovation among SMEs in the ICT sector?
2) Does embeddedness in the developed or emerging country context affect the likelihood of benefiting from local or global linkages for innovations with higher novelty?

Our study compares SMEs in the ICT sector in two small open economies and an emerging economy and examines if the context that firms are embedded in (emerging or developed) moderates the effect of local and global linkages on the innovation outcome of these linkages. The paper focuses explicitly on innovation outcome in the form of new to the industry or new to the world innovation, particularly as the novelty of products can have a positive impact on the competitiveness of SMEs.

In order to respond to the above question, we use results from a survey of ICT firms from Norway and Sweden (developed economy context) and India (an emerging economy context). The Norwegian and Swedish ICT industry (Johansson, 2004) is known to be innovative and dynamic; however, changes are happening fast and firms must be in the forefront in order to survive, particularly with the emergence of new global actors from India. The ICT industry has seen emerging economies like India and China entering and swiftly moving up the value chain (Crescenzi, Rodríguez-Pose, and Storper 2012).

The paper is structured as follows: In the next section we review the literature on SMEs and external sources for innovation and country context. In Section 3 we present the data on which the analysis is based. Section 4 contains the main results followed by conclusions.

2. Theoretical framework and literature review

With its roots in the growth theory of the firm (Penrose 1959/ 2009) the resource-based view of the firm (Wernerfelt 1984; Barney 1991; Peteraf 1993) argues that as firms possess different resources, their economic performance will also differ. In other words, firms' resource heterogeneity is regarded as a source of competitive advantage. From this perspective, firms can gain a competitive advantage by *owning* resources that are valuable, rare, inimitable and non-

substitutable (Barney 1991). While the original idea focused on the role of in-house resource, this view has been extended to also embrace external sources by going beyond the firm's boundaries (Lavie 2006). In other words, a firm does not only need to own the required resources but can gain access to them through the external network that firms are embedded in (Dyer and Singh 1998; Gulati 1999).

It is well researched that firms benefit from having access to *external* knowledge and from collaborating with sources outside their firm's boundaries (Dyer and Singh 1998), either through formal agreements such as R&D joint ventures or through informal collaborations (Tether 2002; Ahuja and Katila 2004; Laursen and Salter 2006; Freitas et al. 2010; Hagedoorn 2002). The notion of *firm network resources* really refers not to resources within the firm but to resources embedded in the inter-firm networks (Gulati 1999).

While the resource based view would help us understand why firms need access to differentiated resources, understanding the factors that can lead to resource heterogeneity requires an evolutionary perspective (Ahuja and Katila 2004; Laursen and Salter 2006; Rosenkopf and Nerkar 2001). Research in evolutionary economics (Nelson and Winter 1982) has argued that technological change and advancement is achieved through an evolutionary process. Economic development comes about through additions to the economic system that differ from the previous ones (Saviotti 1996). In the evolutionary framework, variety is a central concept (Nelson and Winter 1982; Saviotti 1991). While in a biological system mutations are the source of variety, in the economic system the equivalent is found in *innovations* (Johnson 1992). According to this framework, innovations and in particular radical innovations, will lead to new products, processes, markets etc. which implies an increased variety in the economic system and a source of competitive advantage for individual firms (Saviotti 1996; Johnson 1992).

In the evolutionary perspective, the variety generating mechanisms act alongside the selection mechanisms (Nelson and Winter 1982; Saviotti 1996). In order to survive, firms take deliberate action by introducing novel innovations to differentiate themselves from their competitors (Johnson 1992; Nelson and Winter 1982; Saviotti 1991, 1996). The notions of searching and openness to the external environment, central elements in organizational learning (March 1991), are also key concepts in understanding the selection mechanisms in evolutionary theory (Nelson and Winter 1982). Innovations are conceived as the result of search activities,

therefore openness to a variety of external channels of knowledge can improve the firm's innovation by bringing access to a wide variety of resources (Laursen and Salter 2006; Ahuja and Katila 2004).

Using an evolutionary theory, Ahuja and Katila (2004) argue that resource heterogeneity is created as a response to idiosyncratic problems and opportunities and this is reached by embarking on new search paths outside the firms' boundaries. However, setting off on new search paths may include also explorations outside the *geographical boundaries* (Phene, Fladmoe-Lindquist, and Marsh 2006; Peng 2001; Ahuja and Katila 2004). In this regard, having access to other "localized contexts" and the innovation systems, through a dual embeddedness, has been regarded as a crucial factor for the success of firms that expand beyond their home locations (Meyer et al, 2011). Therefore, the learning opportunities can become available not only by interaction among local firms but also by searching beyond.

2.1. SMEs and external sources for innovation

SMEs often have to compensate for internal resource deficiencies (Hewitt-Dundas 2006) emanating from their liability of smallness by seeking external resources (Muscio 2007; Lasagni 2012; Colombo et al. 2012). Thus network relationships are often seen to be vital for the survival (Bougrain and Haudeville 2002) and innovation (Rogers 2004; Nieto and Santamaría 2010; Forsman 2011; Lasagni 2012; Ceci and Lubatti 2012) of SMEs, although their ability to establish exactly these relationships might be less developed than in larger firms (Narula 2004; Segarra-Blasco and Arauzo-Carod 2008).

Recent evidence suggests that the use of open innovation strategies (Chesbrough 2003) is both widespread and increasing in small firms (van de Vrande et al. 2009; Lee et al. 2010). There are different ways in which SMEs can link up to external knowledge sources (Colombo et al. 2012), and the type of external collaborators for SMEs has also been the topic of several studies (Audretsch and Vivarelli 1994; Bougrain and Haudeville 2002; Lasagni 2012; Ceci and Lubatti 2012). An in-depth study of SMEs in Northern Italy indicates that both formal as well as informal and personal relations matter for the innovativeness of SMEs (Ceci and Lubatti 2012). The overall results of these studies indicate that SMEs, like large firms, are engaged in various types of collaborations for their innovations.

Several recent studies have analysed the impact of external collaborations in particular for SMEs' innovativeness (Nieto and Santamaría 2010; Forsman 2011; Huggins and Johnston 2010) and found that technological collaboration is a critical element for product innovations in SMEs (Nieto and Santamaría 2010). Finding who to collaborate with can be difficult for SMEs, so when a network is organised SMEs are likely to build deep and lasting ties (Simard and West 2006); thus, long-lasting collaboration can be regarded as an important factor for the benefits derived by SMEs through external collaborations. The result of the study based on firms in Northern England indicates that SMEs would benefit more from a dynamic network and therefore should change their partners more frequently (Huggins and Johnston 2010).

It must be emphasized that as absorptive capacity is necessary for all firms in order to be able to acknowledge useful knowledge, assimilate it and use it for commercial purposes (Cohen and Levinthal 1990; Grimpe and Sofka 2009), this is even more crucial in the case of SMEs that can suffer from a shortage of human skills or insufficient R&D activities; and a lack of absorptive capacity can hinder the use of external knowledge (Muscio 2007; Forsman 2011).

It is often argued that SMEs, especially in developing countries, lack the internal capability for participation in global networks therefore making their internationalisation distinct from internationalisation of western multinational companies (MNCs) (Johnson, Arya, and Mirchandani 2013). The result of several in-depth case studies in Latin America shows that SMEs are actively engaged both in clusters and gain from local interactions but also from global leaders in the value chain (Pietrobelli and Rabellotti 2006). A comparative study between SMEs in less developed and developed regions shows SMEs in low-income regions are more likely to purchase from external suppliers and therefore more likely to be in collaboration with sources external to the region (Fernández-Serrano and Romero 2012). The study by Ebersberger and Herstad (2013) indicates that SMEs that are strong in overall innovation performance would gain a competitive advantage from being embedded in global innovation collaboration. However, this study only focuses on SMEs from a developed country context.

Firms can gain access to different types of information based on *the type of linkages* they engage in (Jensen et al. 2007; Di Stefano, Gambardella, and Verona 2012) either as market related sources from users and customers (von Hippel 1976; Lundvall 1988) or more research related sources from universities and research units (Laursen and Salter 2004; Fukugawa 2006;

Segarra-Blasco and Arauzo-Carod 2008). The classic debate on technology push and demand pull has made a distinction between science and technology inputs as opposed to market related factors. Results of a study by Lasagni (2012) on European SMEs confirm that external collaboration specifically with suppliers, users and customers matter most for innovations. Although the results of a study by Audretsch and Vivarelli (1994) indicate that spillovers from universities are more important for smaller firms compared to larger firms.

2.2. The role of the geography of external linkages for SMEs

The cluster literature has stressed the advantages SMEs can gain by being in geographical proximity to other firms and organisations to compensate for their lack of resources and capabilities. The collective localised learning capacity of SMEs for radical innovations has been the basis of the discussion on industrial districts (Asheim 1996; Giuliani, Rabellotti, and Dijk 2005). In fact, the success of family-owned SMEs in Northern Italy has been one of the pioneering examples of benefits derived from industrial clustering specifically for SMEs (Rosenfeld 1996; Ottati 2003). The concept of industrial districts and geographical proximity is important in order to understand the innovation performance of SMEs (Ottati 2003; Ceci and Lubatti 2012). The theoretical arguments can be found in access to tacit and complex knowledge and the possibility of frequent face-to-face interaction which can offer opportunities for trial and error at a lower cost (Lane and Lubatkin 1998; Laursen, Reichstein, and Salter 2011; Storper and Venables 2004). Proximity between actors can help overcome the constraints of knowledge exchange. Others have linked the advantages gained by firms in geographical proximity to embeddedness in epistemic communities (Håkanson 2005).

Recent debates have indicated that global linkages are also necessary in order to prevent lock-in at the firm or regional level (Bathelt, Malmberg, and Maskell 2004; Boschma 2005; Giuliani and Bell 2005; Gertler and Levitte 2005); firms cannot solely be based on localised learning but access to global codified knowledge is also necessary (Asheim and Isaksen 2002; Bathelt, Malmberg, and Maskell 2004). In a globalised knowledge economy firms are part of global value chains and knowledge networks, and the complexity of products pushes firms to look outside the regional or national context for innovation sources (Fitjar and Rodríguez-Pose 2012; Pietrobelli and Rabellotti 2011). Firms are expanding their knowledge sources beyond

national boundaries (Dunning 1994) to gain advantages of dual embeddedness (Meyer, Mudambi, and Narula 2011), exposing firms to more diverse information and knowledge than what is domestically available, improving both innovation and financial performance (Cotic-Svetina, Jaklic, and Prodan 2008; Trippl, Tödtling, and Lengauer 2009; Narula and Zanfei 2006). In this vein, global collaboration for innovation refers to the ability to generate innovations through activities conducted together with other firms and other organisations like universities and government research agencies located in other countries, suggesting an "active" role played by the firms in the exploration process and an exchange of knowledge with other organisations (Archibugi and Michie 1995).

2.3. Location-specific context and external linkages

Recent studies have emphasized the role of *localised contextual factors* while analysing the engagement in external linkages for innovations (Fitjar, Gjelsvik, and Rodríguez-Pose 2013; Fitjar and Rodríguez-Pose 2012; Crescenzi and Rodríguez-Pose 2013; Fernández-Serrano and Romero 2012). Localized context varies in particular on two dimensions: institutional framework and resource endowment; while the former refers to legal frameworks and regulatory systems impacting both local and foreign enterprises the latter indicates the resource endowment of local firms, individuals, and the economy as a whole (Meyer, Mudambi, and Narula 2011). The impact of localized contextual factors can be studied from two interdependent dimensions. On the one hand it is related to the *local conditions* in which firms are embedded, on the other hand it can be regarded as a reason for expansion of firms beyond their geographical boarders. In this regard, research supports the argument that the composition of the larger industrial and institutional structures that surrounds firms in their home countries, the position of these countries in the global landscape of technology, and trade and the level of domestic economy development (Ebersberger and Herstad 2011; Ebersberger, Herstad, and Koller 2014) will affects firms' ability to take an active part in global linkages for innovation. The localised contextual factors impacting the differences of innovation performance among emerging and developed economies can be attributed to a diverse set of socio-economic factors (Fagerberg, Srholec, and Knell 2007; Iammarino, Padilla-Pérez, and von Tunzelmann 2008; Crescenzi, Rodríguez-Pose, and Storper 2012; Gertler 2003; Crescenzi and Rodríguez-Pose 2012) and

innovation systems (Padilla-Perez, Vang, and Chaminade 2009; Chaminade and Vang 2008b; Crescenzi and Rodríguez-Pose 2013, 2012).

The potential advantages firms can gain from global linkages for innovations requires an understanding of diversity in terms of cultural, administrative, geographical and economic distance (Ghemawat 2001; Beugelsdijk, McCann, and Mudambi 2010; Gertler 2003). While an understanding of distance is particularly important to grasp the benefits of global linkages, these linkages can also be attributed to differences observed *inside* countries with a high level of internal diversity (Crescenzi and Rodríguez-Pose 2013). In other words, while some countries are more homogenous with regard to income level or cultural diversity, others may be embedded in a more heterogeneous context. Scandinavian countries are an example of the former (Fitjar and Rodríguez-Pose 2012) and India a very good example of the latter (Crescenzi, Rodríguez-Pose, and Storper 2012). In fact, the recent evidence indicates that markets in emerging economies can no longer be satisfied solely through exploitation strategies (Castellani and Zanfei 2006) and competition based on price; but rather the huge population from emerging economies with sophisticated demands require customized products (Ernst 2005; Altenburg, Schmitz, and Stamm 2008; Whang and Hobday 2011). In this regard the role of "local demand" particularly in the emerging economies for novelty of products cannot be dismissed.

2.4. Localized context: Scandinavia versus India

While differences exist among the Scandinavian countries, these differences are more subtle and visible between the Nordics and emerging economies. The Scandinavian countries represent a context with well-developed innovation systems, while institutions and intermediaries are still 'emerging in emerging economies' (Khanna and Palepu 2010; Chaminade and Vang 2008a; Lorenz and Lundvall 2010). The global innovation index (2013) also indicates that while Sweden and Norway rank on an equal footing with regard to different institutional indicators, large differences exist between India and these two economies.

Norway and Sweden besides being small open economies represent the same cultural block and share political and institutional characteristics (Ronen and Shenkar 1985). Firms from small, open economies tend to demonstrate a higher propensity to be globally oriented than those from larger home economies (Bellak and Cantwell 1997). In their effort to measure

country distance (from the context of Spain), Martín Martín and Drogendijk (2014) show that Norway and Sweden come out with relatively similar measures (20,8 and 25,28) compared to India (78,32) when investigating the relative importance of socioeconomic development and physical, cultural and historical distance. According to these measures the country difference between our two contexts can be seen as large.

The Nordic welfare state ensures a fairly equal distribution of goods and services. These countries are also characterised by the fact that higher education is free, and higher education and the knowledge infrastructure is regulated by national laws. The Nordic countries are defined as coordinated market economies (Soskice 1999) where non-market coordination and cooperation exists in the business sphere. The financial systems in these countries are also able to provide long-term financing, securing economic activity and growth. India on the other hand has the lowest expenditure on higher education per student in Asia, only 17.5% of graduated engineers were employable in the IT support service sector (Narula 2015; Minds 2011). Limited interaction between the knowledge infrastructure and firms, due to inefficiencies and few resources directed towards industrial R&D (NISTADS 2008), is not helping domestic innovation activity, even pushing innovation activity out of India. This discouragement of domestic engagement in R&D and innovation can also be explained by weak protection mechanisms through the formal institutions in India.

Prior to the 1990s, developing and many emerging economies, including India, were closed systems largely dependent on domestic suppliers and customers and with non-national links being typically 'shallow' (Narula 2014). However, in recent years, the economic structure of these economies has moved towards internationally interdependent systems. In this vein, actors have tended to change patterns of interaction rather slowly *"...you may have all the 'building blocks' of a 'globalized' economic system, but they may still not work together efficiently*" (Narula 2014, page 96) due to structural and institutional inertia or resource constraints.

The technological gap has driven developing countries to catch up (Abramovitz 1986), in particular the emerging economies are increasingly investing in the development of their *regional innovation systems* (Chaminade and Vang 2008b; Lundvall et al. 2009; Padilla-Perez, Vang, and Chaminade 2009). Specifically, the innovation system approach in the context of a

developing country emphasizes the role of institutional factors which can both create opportunities for innovations as well as hamper them (Chaminade and Vang 2008b; Barnard 2008; Chaminade, Intarakumnerd, and Sapprasert 2012). As emerging economies are increasingly de-localising important knowledge-production units and moving up the learning ladder of the industry life cycle (Malerba and Nelson 2011) they are becoming active players in the set up of global collaborations for innovations (Ernst 2005; Altenburg, Schmitz, and Stamm 2008).

3. Data, method and measures

3.1. ICT sector

ICT is an appropriate case to study SMEs from two different contexts, Scandinavia and India, for two main reasons. First, the ICT sector is often defined as a high-tech industry where the drivers of change can be attributed to science (Castellacci 2008). Second, ICT is an industry in which India has been moving up the value chain (Altenburg, Schmitz, and Stamm 2008; Crescenzi, Rodríguez-Pose, and Storper 2012; Lorenzen and Mudambi 2012) and excelling in innovation, thus potentially increasing the country's role in global collaborations for innovation. Known ICT clusters such as Bangalore, for example, began at the bottom of the "smile of value creation" (Lorenzen and Mudambi 2012), and have from the start been outward looking and part of global linkages through pipelines constructed by MNE subsidiaries.

3.2. Data

The empirical analysis relies on a survey conducted in 2009 with partners from several countries studying global innovation networks. The project aimed at determining the extent of and/or how innovation takes place in globally dispersed networks. This data allows the comparison of two small but specialized Northern economies in the ICT sector, Sweden and Norway, with a leading emerging economy, India. An initial pilot survey was carried out before finalizing the survey. The survey was conducted electronically in Norway and Sweden and through face-to-face interviews in India.

In Norway and Sweden, the ICT sector was delineated from other industries in accordance with the broadly accepted definition based on the international ISIC rev. 1.1 industry

classification standard[14]. Firms were identified using a commercial database based on official business registers. Firms in Norway and Sweden where surveyed electronically with several reminders. For India, a different procedure was applied due to the lack of business register data for applying these standard industry classifications. Nevertheless "NASSCOM Directory of IT firms: 2009-10" was used for initial identification of firms in the country. The NASSCOM Directory is released every year and covers all areas of software production and related industries such as IT Enabled Services.

Table 1 offers a summary of the response rate received from each country, the number of responses and response rates. However, for the purpose of the current study non-innovative firms were dropped, as these firms could not answer the relevant question on collaboration for innovation. We have also focused on only small and medium sized firms using the OECD (2011) definition with an upper limit of 250, *reducing* our sample size to 379.

Table 1. Survey response rate by country (total sample including larger firms)

Countries	ICT
India	324 (24%)
Norway	181 (11.9%)
Sweden	171 (10.3%)
Total	676

For each country, we conducted a t-test for firm size distribution. The results indicate that the sample in terms of size is representative for the three countries. As with any other survey data, doubts can arise on the reliability of data collected, particularly with regard to understanding important concepts such as degree of novelty, geographical location of collaborators, or more general information. In order to increase the reliability of the answers in most cases the CEOs were responsible for answering the questions.

3.3. Measures

3.3.1. Dependent variable

In order to obtain a measure of novelty of innovation, the authors drew on the response to a question that asked firms what their most important innovation in the past three years

[14] 26.30 Manufacture of communication equipment, 62.01 Computer programming activities, 62.02 Computer consultancy activities, 62.03 Computer facilities management activities and 62.09 Other information technology and computer service activities.

(2006-2008) had been. The option given was first, to choose between product or process innovations; for the purpose of this paper we are only considering product innovations, including new services. On the second level, the survey asked firms to indicate the degree of novelty of the introduced products and the options given were 1. new to the firm 2. new to the industry 3. new to the world". As this paper is interested in novelty of innovations, a dummy variable was constructed taking value 1 for *new to the industry* or *new to the world* innovations. By combining the two categories we also tried to limit the possibilities of firms that are not sure whether the innovation is new to the world or new to the industry. Although firms could have chosen more than one category, we only considered the highest degree of product innovations. Therefore, a firm with both *new to the firm* innovation and *new to the world* innovations is counted for its *new to the world* innovations.

3.3.2. Explanatory variables

In order to explore factors related to the type of linkages on degree of novelty of innovation, several variables were included that characterise various structural features of linkages and may influence the likelihood of firms introducing novel innovations. Table 2 shows a summary of the explanatory variables used.

Firms were asked to indicate their most important innovation sources, *with whom* they had actively collaborated in the past three years (2006-2008), and their geographical locations. The survey listed 6 different sources (customers, suppliers, competitors, consultancy companies, government and universities) and respondents were asked to specify the *geographical locations* of the sources. The geographical locations given as options were region, country, and global[15].

Resources located in the region are labelled as *regional* resource, in the country as *country resources,* and on the global scale as *global resources*.

A distinction was also made between the type of resources in order to control for technology push or demand pull as they can have a different effect on the novelty of innovations especially in the case of SMEs (Audretsch and Vivarelli 1996). Linkages can be divided into those related to market and those related to institutions (OECD 2011). Thus, sources of innovation are divided into:

[15] The sub-categories of global includes: South America, Central & Eastern Europe, Africa, rest of Asia, North America, Japan & Australasia, and Western Europe.

- *global resources market*: dummy variable takes value 1 if firms indicated collaboration with clients, suppliers, competitors or consultancy companies on a global scale
- *global resources institutes*: dummy variable takes value 1 if firms indicated collaboration with government or universities/ research institutes on a global scale

It must be noted that these variables are *not mutually exclusive,* both in terms of geographical location of resources as well as the type of resources. Therefore, a firm could have indicated collaborations with different actors at the different geographical levels.

In order to examine the influence of the focal firm's context on the likelihood of benefiting from local and global linkages in interactions with customers, we constructed two categorical variables:

- *Focal firm context - regional resources*: This variable includes collaboration between producers in Scandinavia (Norway and Sweden) or India and resources at the regional level. Focal firm context refers to the location of the firm, and is either Scandinavia or India.
- *Focal firm context - global resources:* This variable includes collaboration between producers in Scandinavia (Norway and Sweden) or India and resources at the global level. Focal firm context refers to the location of the firm, and is either Scandinavia or India.

Table 2. Description of variables

Explanatory Variables	Definition	Type
Regional Resources Country Resources Global Resources	1: yes 0: no	3 separate dummy variables
Global Resources Market	1: yes collaborated globally with either clients, suppliers, competitors or consultancy companies 0: did not collaborate globally with clients, suppliers, competitors or consultancy companies	1 dummy variable
Global Resources Institutions	1: yes collaborated globally with either government or universities/ research institutes 0: did not collaborate globally with government or universities/ research institutes	1 dummy variable
Focal firm context-regional resources	0: Scandinavia - used regional resources 1: Scandinavia – did not use regional resources 2: India - used regional resources 3: India – did not use regional resources	
Focal firm context-global resources	0: Scandinavia - used global resources 1: Scandinavia – did not use global resources 2: India - used global resources 3: India – did not use global resources	

3.3.3. Control variables

R&D: The ability to use external knowledge is influenced by the absorptive capacity of the firm (Grimpe and Sofka 2009) and is controlled for by looking at the technological input from R&D activities within the firm. Therefore, a dummy variable R&D was constructed.

The role played by SMEs in international markets was controlled for by two dummy variables: export market & FDI (Lu and Beamish 2001)

Export market: dummy variable that takes the value 1 if the main market is based on export, to control for the effects derived from being internationally market driven. Previous studies on internationalisation of SMEs have emphasized that firms with an exporting orientation are also more likely to learn from global resources (Cassiman and Golovko 2010).

FDI: dummy variable that takes value 1 if the firm has indicated offshoring of production or any R&D activities.

The firm's characteristics can also influence the ability to introduce radical innovations, therefore we controlled for size and organisational form.

Size: categorical variable, based on the answer to a question about full-time equivalent (FTE) employees in the enterprise. A distinction was made between micro, small and medium firms. Medium takes value 0 if 50 to 249 employees, small takes value 1 if 10-49 employees, micro takes value 2 if fewer than 10 FTE employees.

*Organisational form***:** categorical variable takes value 0 if "the headquarters of an MNC"; value 1 if "a subsidiary of an MNC" and value 2 if "a standalone company".

3.4. Econometric method

This research aimed at exploring the relation between global collaboration and novelty of introducing innovations[16] in SMEs by considering the context they are embedded in. A logit model was used to analyse the effects of external linkages both in terms of type of and geographical location on the likelihood of introducing novel innovations.

4. Results

4.1. Descriptive results

Appendix A gives the descriptive statistics as well as the correlation of all variables. It must be noted that there is a high correlation between the variables global resources and global resources market as the latter is a subset of the former variable. However, these variables are not used in the same regression models. The variance inflation factor (VIF) and indictor of multi-collinearity were checked and all found to be below 3. The descriptive results indicate that around 60% of firms have introduced a novel innovation either as new to the world or new to the industry. With regard to the size of the firm, more than half of the firms are small firms,

[16] This research aimed at exploring factors affecting the novelty of innovation and not merely introducing innovations or not. Therefore firms with novel innovations (new to the world or new to the industry) are compared with firms that have introduced only new to the firm innovations. Furthermore, this is also related to the lack of survey data on non-innovative firms.

whereas micro and medium firms have a rather equal proportion. Furthermore, as would be expected, these firms are standalone, meaning they are not related to any group of firms.

Table 3 illustrates the distribution of firms based on the sub-sector corresponding to their firm's location. This table shows that while the number of firms from India in our sample is 34%, this proportion is also similar within the sub-groups and particularly for the sub-group, *computer programming activities*, which constitute the main population of the sample firms.

Table 3 Sub-sector and firm's location

Sub sector	Scandinavia	India	Total
Manufacture of communication equipment	10 66.67%	5 33.33%	15 100.00%
Computer programming activities	103 68.67%	47 31.33%	150 100.00%
Computer consultancy activities	63 79.75%	16 20.25%	79 100.00%
Computer facilities management activities	24 77.42%	7 22.58%	31 100.00%
Other information technology and computer service activities	44 44.44%	55 55.56%	99 100.00%
Total	244 65.24%	130 34.76%	374* 100.00%

* missing values=5

4.2. Results

Table 4 presents the regression results. Model 1 is the baseline model with the results of only control variables. Model 2 contains only variables related to geographical location of the collaborators, irrespective of the type of the collaborator or the location of the focal firm. Model 3 expands the analysis to include collaboration with market resources and institutions at the global level. Models 4 and 5 are the interaction between the focal firms' location and collaborations with global or regional resources.

Model 1 (control variables only) suggests that as expected engagement in R&D activities is positively associated with introducing novel innovations, and this result also holds in the full

model. However, the organisational characteristics of a firm both in terms of size and organisational form do not affect the likelihood of introducing novel innovations. Perhaps this can also be related to the fact that by considering only SMEs the number of multinational companies was also reduced; therefore, we cannot observe any effect with relation to large multinational companies. As previous research (at least in the case of Norway) has indicated, larger firms have a larger pool of skilled labour and are therefore more likely to introduce novel innovations (Fitjar and Rodríguez-Pose 2012), which is not observable in our sample. Although previous literature has indicated that firms from emerging economies are less capable of introducing novel innovation (Pietrobelli and Rabellotti 2011), the result of our base model does not confirm this idea, as we cannot observe any significant differences between the developed economies compared to India in the likelihood of introducing novel innovations. This is particularly interesting especially when interpreting Models 4 and 5. These models also show that firms engaged in exporting activities are more likely to introduce novel innovations; this effect is diminished once explanatory variable of global collaboration is introduced, which can confirm the organisational learning that can take place through exporting (Cassiman and Golovko 2010; Golovko and Valentini 2011).

Model 2 suggests that in general a network limited to *regional* or *country* level collaborations does not have a significant impact on firms' likelihood of introducing novel innovations. In other words, firms that have limited their collaboration to only regional or domestic resources will not see any significant impact on introducing novel innovations. On the contrary, engagement in global collaborations will have a relatively strong and significant impact on novel innovations. This result can also be related to the discussion on internationalisation of SMEs and benefits gained by firms for innovations through global expansion (Golovko and Valentini 2011). Nevertheless, as will be explored in Model 4, these results can also be related to the local contexts of these firms, as our sample consists of both an emerging economy as well as two Scandinavian countries.

In order to explore the type of global resources that matter for novel innovations a distinction was made on the type of linkages, whether these are market related or a result of collaborations with institutions (OECD 2011). Model 3 shows that while firms collaborating with market related factors on a global scale are more likely to introduce novel innovations with a relatively high significant impact no meaningful impact can be attributed to those that have

collaborated with universities or governments on a global scale. This is in line with previous research indicating that interaction with institutions with a geographical proximity would matter for innovations (D'Este, Guy, and Iammarino 2013).

Although the results of Model 2 do not indicate a significant impact from collaboration with regional resources for firms' innovations, this result can yield a different interpretation once interacted with the type of country (focal firm's context) and in relation to the contextual factors. Indeed, once interacted with a firm's location, we observe different results in Model 4 as compared to Model 2. The results of Model 4 show that Indian SMEs that have collaborated with local resources are also *more* likely to introduce novel innovations as compared to firms in Scandinavia that have collaborated with local resources, yet we cannot make any significant interpretation for Scandinavian SMEs. However, once the baseline has been changed to Indian SMEs that have used local resources[17], we see that Scandinavian firms that have not used any local resources fall below the baseline. In other words, Indian SMEs that have used local resources are more likely to introduce innovations with a higher degree of novelty as compared to Scandinavian firms that have or have not used local resources. Based on Model 1 we cannot deduce that Indian firms are more likely to introduce novel innovations, but we can conclude there is a strong relation to using *local resources* for Indian SMEs as compared to Scandinavian firms.

Model 5 explores the relation between embeddedness in emerging or developed economies and the likelihood of benefiting from global resources. The baseline in this model is SMEs in Scandinavia that have used global resources for innovation. The model shows a clear and strong relation between using global resources and the likelihood of introducing innovations with high novelty. However, the change of baseline to Indian SMEs with global collaborations shows that only Scandinavian SMEs that have not used global resources are worse off. In other words, Scandinavian firms that are not using global resources are always worse off than other firms and this includes Indian firms that do or do not use global resources[18].

[17] The models are not presented but can be provided upon request.

[18] As our "global" variable includes both market as well as institutions related collaborators there might be concerns whether there also exists a different pattern in terms of local or global collaborators. While we have taken this into account in our 3rd Model, Models 4 & 5 include global collaborators in general. However, by distinguishing

Table 4. Results of the logit model

	Model 1	Model 2	Model 3	Model 4	Model 5
	new to the world/industry	new to the world/industry	new to the world/industry	new to the world/industry	new to the world/industry
Global resources		0.705***		0.772***	
		(0.269)		(0.268)	
Global_market			0.687**		
			(0.292)		
global_inst			0.527		
			(0.366)		
regional_sources		-0.038	-0.067		-0.061
		(0.257)	(0.257)		(0.258)
Country_sources		-0.261	-0.262	-0.271	-0.202
		(0.284)	(0.286)	(0.286)	(0.281)
Scan. regional resources not used				0.414	
				(0.287)	
Indian regional resources used				1.054**	
				(0.448)	
Indian regional resources not used				0.026	
				(0.493)	
Baseline= scan. regional resources used					
Scan. global resources not used					-0.94***
					(0.300)
Indian global resources used					-0.046
					(0.444)
Indian global resources not used					0.279
					(0.605)
Baseline= scan. global resources used					
India	0.437	0.450	0.442		
	(0.367)	(0.392)	(0.394)		
R&D	1.148***	1.169***	1.153***	1.134***	1.150***
	(0.249)	(0.254)	(0.253)	(0.255)	(0.254)
Subs	-0.745	-0.777	-0.745	-0.772	-0.750
	(0.580)	(0.589)	(0.602)	(0.624)	(0.584)
Standalone	-0.398	-0.392	-0.354	-0.339	-0.461
	(0.554)	(0.568)	(0.576)	(0.604)	(0.568)
baseline headquarter of MNC					
Export market	0.574*	0.253	0.154	0.217	0.447
	(0.319)	(0.340)	(0.350)	(0.345)	(0.353)
R&D internationalization	0.297	0.135	0.058	0.157	0.189
	(0.317)	(0.333)	(0.339)	(0.337)	(0.330)
Micro	-0.315	-0.301	-0.296	-0.255	-0.224
	(0.386)	(0.405)	(0.411)	(0.403)	(0.413)
Small	0.141	0.193	0.218	0.238	0.245
	(0.351)	(0.374)	(0.374)	(0.375)	(0.383)
baseline medium					
Constant	-0.067	-0.155	-0.199	0.574	-0.315
	(0.619)	(0.689)	(0.695)	(0.671)	(0.704)
N	355	355	355	355	355
chi2	49.261***	55.283***	59.392***	57.072***	57.725***
ll	-207.27	-203.83	-202.11	-200.56	-201.74
pseudo R2	0.1227	0.1373	0.1446	0.1512	0.1461

Key: * p<.1; ** p<.05; *** p<.01

between market and institutions our results stay the same for market related factors and we cannot observe any significant differences in the institution variables.

4.3 Robustness checks

Global sources can include sources both in the north as well as sources in the south. It can be argued that firms in Europe are more likely to benefit from collaboration with sources in Europe. Indeed, running our models on the sub-categories of global (north and south) indicates that firms in Norway/Sweden would benefit more from collaboration inside Europe. However we do not observe any differing effects for the Indian firms as those already obtained in the main models.

5. Discussion and conclusion

The aim of this paper has been to expand the current debate on the effect of local and global innovation linkages by considering how context related factors play a role with regard to the innovation outcome of such linkages (Crescenzi, Rodríguez-Pose, and Storper 2012; Fernández-Serrano and Romero 2012; Doloreux and Shearmur 2012; Herstad and Ebersberger Forthcoming). The role of benefits gained through geographical proximity (Asheim and Gertler 2004; Storper and Venables 2004) in particular for SMEs, which has long been prominent, is challenged by the current debate discussing the benefits gained through global linkages for innovation (Bathelt, Malmberg, and Maskell 2004; Morrison, Rabellotti, and Zirulia 2013).

This paper aims to understand this subtle view by incorporating a new dimension while analysing the innovation impact of regional and global collaborative linkages. Our first finding shows that limiting innovation collaboration to domestic partners does not affect the likelihood of introducing novel innovation, however, global collaboration has a strong and significant impact showing that SMEs, in spite of the liability of smallness, benefit from global sources in their search for innovation-relevant knowledge.

Including focal firm's context into our analysis changes our results with regard to whether regional or global innovation linkages have the strongest effect on the likelihood of novel innovation. Looking especially at the country context representing India, the results indicate that regional interactions are indeed important for novel innovations among SMEs. For SMEs in the Scandinavian countries (Norway and Sweden) the use of global partners for innovation receives a positive effect in the form of novel innovations. Our main conclusion is then that different country context gives a nuanced picture of the effect of regional and global

linkages of introducing innovations with a higher degree of novelty and, as such, contributes to the discussion on the interplay between the role of regional and global sources of innovation for SMEs. Although not limited to SMEs, Morrison and colleagues (2013) also conclude that the "settings" that firms are embedded in can impact the likelihood of benefiting from global linkages.

But how can country context impact the way SMEs benefit from local or global linkages? According to Ebersberger and colleagues (2014) the technological specializations of a context relative to the world, constrain global collaboration. The ICT sector in India is highly specialised in software services (Kapoor 2013), especially computer related services and telecommunication. Seeing Norway and Sweden together, the diversity of ICT activity will be greater, with regard to both services and manufacturing activity within the ICT sector. An explanation can also be linked to the *diversity* of market related factors in different countries and particularly the sophisticated demands from customers (Yeung, Liu, and Dicken 2006). India, both representing a huge market and a dual economy with varied demands can itself provide the variety of technological opportunities that can foster novel innovation. However, ICT service specialization and narrow geographical ties can in the long-term lead to lock-in.

Our findings show that firms in the Scandinavian context are more likely to benefit from global linkages. In the Scandinavian context the challenges for engagement in such linkages are moderated by both resource support and strong regional innovation systems (Ebersberger and Herstad 2013). In these countries the focus of innovation policy has been to strengthen regional networks, clusters and innovation systems. Today they represent well-functioning innovation systems, creating contexts in which to build strong SMEs able to connect and use global knowledge for the purpose of innovation. These contexts are dependent on global linkages in order to develop further, since being too strongly oriented towards local or national actors in small economies with fewer potential new contacts and a less diverse economy (Fitjar and Rodríguez-Pose 2012) can lead to lock-in and over embeddedness. Further, enduring competitive advantages, in the form of novel innovations, can be gained through idiosyncratic relations in global pipelines that can be harder for competitors to imitate (Fitjar, Gjelsvik, and Rodríguez-Pose 2013), suggesting the competitive advantage of having global linkages. Thus, for SMEs in the ICT sector in Scandinavia, if the aim is to raise the share of firms able to introduce to the market novel innovations that will give a more lasting competitive edge,

innovation policy should continuously build strong innovation systems. At the same time policy should be directed towards identifying global partners and helping to strengthen and co-ordinate innovation efforts on a global level. This will be important in order for SMEs to overcome their general liability of smallness.

Following this reasoning, the policy implications of our findings for India would possibly be to strengthen the actors and linkages in the innovation system, as institutions and intermediaries are still "emerging in emerging economies" and their workings are thus imperfect (Chaminade and Vang 2008b). The Indian ICT industry has been outward looking through linkages constructed by foreign MNE subsidiaries in India in a drive to attract foreign firms and thereby embed the national system into the global knowledge flows. Many Indian firms have global linkages; however, our findings suggest that regardless of SME affiliation, there are no direct linkages between global collaboration and novel innovation output. Innovation systems in the emerging country context are underdeveloped and indicative of 'institutional thinness' (Tödtling, Lengauer, and Höglinger 2011; Chaminade and Plechero 2015). Both the knowledge component of the systems and the types of linkages in these systems must be strengthened so that SMEs can build on these in order to upgrade and to connect up to global innovation linkages that will produce the desired results in the form of novel innovations. The overall technological capabilities and lower absorptive capacity (Grimpe and Sofka 2009) of SMEs in India as compared to the Scandinavian ones can also be an explanatory factor. As found by (Ebersberger and Herstad 2012), firms showing low R&D capacity will not gain from global innovation collaboration. These firms gain more from strengthening their internal knowledge base (R&D activity) and by raising their absorptive capacity.

A further contribution of this paper is that it shows that collaboration with global market actors is more important for the firms in our sample in terms of novelty of innovation, whereas collaboration with universities and government have no significant impact. In fact, the descriptive statistics from CIS data also demonstrate a large gap between SMEs and large firms, specifically from Scandinavia countries when it comes to institutional collaboration, while this is not the case for a country like the UK (OECD 2011).

As with any exploratory analysis using survey data, ours is characterized by important limitations. First and foremost this limitation is related to the use of different methods for data

collection in the case of India as compared to Norway and Sweden. As in any other research using survey data we may face limitations on the reliability of answers provided by the respondents. We have tried to minimize our bias at least in the case of our dependent variable by creating a combined variable that does not differentiate between new to the industry and new to the world as the response. Our analysis is only based on innovative firms, therefore we cannot make claims with regards to non-innovative firms. The cross-sectional type of dataset did not allow the researchers to make concrete conclusions based on the *impact* of local-global linkages on the degree of novelty of innovations. However, the value of this study can be regarded in its exploratory analysis that provides some initial evidence on differences between SMEs embedded in different context for using linkages at different geographical levels.

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Appendix A: Correlation between main variables (n=379)

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(1) Novel Innovation	0.617	0.487	1.00																
(2) Globalresources	0.567	0.496	0.24	1.00															
(3) Regional_Resources	0.546	0.499	0.06	0.11	1.00														
(4) Country_Resources	0.697	0.460	-0.05	0.08	-0.13	1.00													
(5) Globalresources_Market	0.551	0.498	0.25	0.97	0.09	0.07	1.00												
(6) Globalresources_Institutes	0.222	0.416	0.22	0.47	0.15	-0.01	0.40	1.00											
(7) India	0.343	0.475	0.25	0.25	0.23	-0.15	0.23	0.34	1.00										
(8) Developed	0.657	0.475	-0.25	-0.25	-0.23	0.15	-0.23	-0.34	-1.00	1.00									
(9) Export Market	0.314	0.465	0.25	0.46	0.11	-0.10	0.46	0.39	0.51	-0.51	1.00								
(10)R&D	0.580	0.494	0.34	0.18	-0.01	-0.01	0.17	0.22	0.26	-0.26	0.29	1.00							
(11) Fdi	0.280	0.450	0.18	0.35	0.04	0.04	0.32	0.38	0.31	-0.31	0.31	0.22	1.00						
(12) Micro	0.232	0.423	-0.20	-0.13	-0.09	0.08	-0.12	-0.14	-0.32	0.32	-0.25	-0.18	-0.23	1.00					
(13) Small	0.433	0.496	-0.01	-0.11	-0.09	-0.06	-0.10	-0.13	-0.34	0.34	-0.10	-0.03	-0.04	-0.48	1.00				
(14) Medium	0.309	0.463	0.15	0.24	0.16	-0.01	0.22	0.25	0.58	-0.58	0.32	0.15	0.23	-0.37	-0.58	1.00			
(15) Headq	0.074	0.262	0.12	0.08	0.10	-0.08	0.09	0.19	0.22	-0.22	0.18	0.14	0.14	-0.13	-0.14	0.29	1.00		
(16) Subsid	0.156	0.363	0.08	0.17	0.13	-0.06	0.17	0.16	0.33	-0.33	0.27	0.17	0.12	-0.13	-0.14	0.20	-0.12	1.00	
(17) Standalone	0.770	0.421	-0.15	-0.20	-0.17	0.10	-0.20	-0.25	-0.43	0.43	-0.35	-0.24	-0.19	0.20	0.21	-0.36	-0.52	-0.79	1.00

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CHAPTER 4

Exploring the relation between the degree of novelty of innovations and user-producer interaction across different income regions[19]

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Abstract: User-producer interactions have been recognized as important for innovation. With the rapid growth of emerging economies' markets, and an increasing degree of technological sophistication of both users and producers in those markets, user-producer interaction is becoming global. Using original firm-level data, this paper explores how collaboration with users in different income regions affects the degree of innovations' novelty. We find that collaborating with international users is positively related to higher degrees of novelty. Furthermore, firms in low- and middle income countries will benefit more from south-south user collaboration than a south-north one.

Keywords: Users; international demand; innovation; absorptive capacity; Europe; BRICS

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1. Introduction

User-producer interactions have been traditionally recognized as important factors in the innovation process (Lundvall, 1988). Hitherto most of the literature on user-producer interactions and its impact on the degree of novelty is based almost exclusively on the evidence of users and producers located in high-income countries (Laursen 2011; Fitjar and Rodríguez-Pose 2012). With the rapid growth of emerging economies' markets, and an increasing degree of technological sophistication of both users and producers in those markets (Ernst 2005; Altenburg, Schmitz, and Stamm 2008; Whang and Hobday 2011), user-producer interaction is becoming global. However, the existing literature is quite limited in explaining how collaborations with users in different income regions affect the degree of innovations' novelty for producers located in high-income countries, as well as middle- and lower-income countries, which have different degrees of technological capabilities (Castellacci and Archibugi 2008). This is due to three main shortcomings in the literature.

On the one hand, although many studies (Christensen and Bower 1996; Atuahene-Gima 1996; Asheim and Isaksen 2002) discuss the impact user-producer interaction has on innovation, they do not specify how the interaction relates to different degrees of novelty in that innovation, from new to the firm to new to the world.

On the other hand, most of the literature focuses on the user as a source of information for innovation (Atuahene-Gima 1996; Augusto and Coelho 2009; Fitjar and Rodríguez-Pose 2012; Kohli and Jaworski 1990; Rothwell 1986; Lettl, Herstatt, and Gemuenden 2006) and not as an active partner in the development of the innovation. This view is particularly predominant in the discussion of how multinational enterprises (MNEs) exploit their innovations in international markets by adapting their already developed innovation to particular market needs (learning from exporting), as well as the extensive literature on market orientation. We argue in this paper that with the increased technological sophistication of international users, this "plug & play" vision is quite limited, and that more active collaboration with the user is needed in order to develop innovations.

Finally, the specific location of both users and producers is almost completely absent from the literature. Most of the authors tend to treat the international user as one single category (e.g.Fitjar and Rodríguez-Pose 2012; Laursen 2011), not considering the location of the user,

and consequently the differences between users in high-, middle- and low-income countries. Similarly, most of the literature is based on evidence of producers located in high-income countries, thus ignoring differences in the degree of producers' competencies in different income regions.

The aim of this paper is to explore the relation that active collaboration with users for innovation has on the degree of novelty by focusing on the location of both users and producers.

In dealing with the above issue, this paper draws on a unique set of firm-level data collected in 2010 in a variety of European countries, as well as Brazil, China, India and South Africa. The questionnaire collected data on innovation collaboration with customers – as one type of users – in the development of innovations, taking into account their geographical location. The data allows the researcher to distinguish the international locations of customers in high-, middle- and low-income countries.

More specifically, this paper aims to answer two main research questions:

1. For firms located in high-income countries, how does collaboration with customers in high-income countries (north) and low- and middle-income countries (south) relate to the degree of novelty of their product innovations?
2. For firms located in low- and middle-income countries, how does collaboration with customers in high-income, or middle- and low-income countries, relate to the degree of novelty of their product innovations?

By doing so, the paper contributes to the literature on user-producer interaction by including the location of both users and producers as active partners in the development of product innovations, and their relationship to the degree of innovations' novelty on a global scale. Furthermore, by providing empirical evidence on the role of *users from the south* as important partners in innovation collaboration, this paper contributes to discussions on the role of demand for innovation for firms located in high-income countries, as well as those in low- and middle-income countries.

The paper is structured as follows. In the next section we review the literature on user-producer interaction, as well as the geography of the user and producer, and the impact on innovation. In section 3 we present the data on which the analysis is based. Section 4 contains the main results, and we conclude the paper with a discussion and suggestions for further research.

2. Literature review

Users, either as individuals or organizations, have long been regarded as key actors in the innovation process (Lundvall 1988). Producers are highly interested in commercializing their products, and often engage in different activities (market intelligence, customer relations, etc.) to access their users' knowledge and understand their needs (for an overview see Bogers, Afuah, and Bastian 2010). Users, on the other hand, are motivated to share knowledge conducive to innovation so that products and services fit better with their needs and preferences.

Users in general, and customers in particular, have long been considered as a key source of information for innovation and there is an extensive amount of literature that has analyzed empirically the impact of sourcing as a form of user-producer interaction on innovation. However, the results are not conclusive. While most authors find a positive relationship (Atuahene-Gima 1996; Augusto and Coelho 2009; Fitjar and Rodríguez-Pose 2012; Kohli and Jaworski 1990; Rothwell 1986; Lettl, Herstatt, and Gemuenden 2006), some studies have argued that paying attention to customers has led to the "death" of innovation (Bennett and Cooper 1979; Christensen and Bower 1996). What this literature often lacks is a clear definition of what innovation means and a more nuanced discussion on how user-producer interaction affects the degree of novelty (Garcia and Calantone 2002).

2.1. Forms of user-producer interaction and the degree of novelty of innovations

Regarding the degree of novelty, one of the most widely used definitions is the OECD's (OECD 1997). The OECD distinguishes between technologically new and significantly technologically improved innovations[20] on the one hand, as well as new-to-the-firm, new-to-the-industry and new-to-the-world innovations on the other. 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. New to the world and technologically new are often used in the literature as synonyms for radical or breakthrough innovations, while improved innovations and new to the firm are often used as proxies to incremental innovations.

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

Among the exceptions in the literature that make specific reference to the degree of novelty, Lukas and Ferrell (2000), argue that market orientation, as a simple form of user-producer interaction, seems to be positively related to breakthrough innovation. In a similar vein, Augusto and Coelho (2009) concluded that sourcing for information from the customer was positively related to breakthrough innovations. Zhou, Yim and Tse (2005) analyzed the effects of market orientation on breakthrough innovations, and concluded that market orientation has a positive effect on tech-based innovation and a negative impact on market-based innovation. Govindarajan, Koppalle and Danneels (2011a), highlight that the impact on innovation depends on the type of customer. Relating market orientation and innovations with the types of customers, the authors show that focusing on emerging customers is unrelated to radical innovations, while a strategy oriented to mainstream customers may have a positive impact on the degree of innovation.

One of the limitations of this literature is that reduces user-producer interaction to users as sources of information that may be relevant to innovation. It assumes that information from the markets is easily transferable to the innovation processes. However, this "plug & play" vision is disputable. The negative implications of customer orientation are attributable to too narrow an understanding of market orientation strategies (Augusto and Coelho 2009). As some authors argue (Alam 2002; Magnusson 2009) with the increased technological complexity of products, the diversity of markets and the tacit nature of the customer knowledge, customers should be actively involved in different stages of product development needs.

Indeed, when interaction takes the form of *active collaboration* with the users or, in other words, when users are partners in the development of innovation the impact of user-producer interaction on the degree of novelty is much clearer. Scholars in the so-called user-centered innovation literature or lead-user literature (Baldwin, Hienerth, and von Hippel 2006; von Hippel 2005) regard users not only as consumers of products, but also as agents who know exactly what they require, thereby allowing them to become innovators of products that are adapted by manufacturers for commercial use later on; Users can also be used for understanding highly advanced needs or as external problem-solvers (Franke and Hippel 2003; Lettl 2007; Poetz and Prugl 2010). Users may become involved in the development of innovations with the producers, or even become innovators themselves (otherwise known as *lead-users*) (von Hippel

1986). In this respect, interaction with users is often associated with breakthrough innovations (Enos 1962; Oliveira and von Hippel 2011; Poetz and Prugl 2010; von Hippel 2005).

However, as economic geographers have long discussed, the impact on the degree of novelty is not only related to the form of interaction with the user, but also to the specific location of the user. Asheim and Isaksen (2002) have illustrated the role of local users in *incremental* innovations in the Norwegian ship industry. Their results are in line with Weterings and Boschma (2009), who use firm-level data on user-producer interactions of Dutch software firms, and show that although spatial proximity facilitates interaction, it does not impact firms' innovation output in terms of *radical* innovations. Radical innovations seem to be more related to interactions with international users, while incremental innovations are associated with local users (Fitjar and Rodríguez-Pose 2012; Laursen 2011). So, while local users are important for incremental innovation, international users matter more for more radical innovation, as discussed next.

2.2. Location of users and producers and the degree of novelty of innovations

Interaction with international users may take a variety of forms from exports to active collaboration with users in distant locations. Exports can be considered as a *passive form* of acquiring relevant knowledge for innovation, and are more related to asset exploitation strategies (Castellani and Zanfei 2006) and the sourcing of specific market knowledge than to the development of innovation. Incremental innovation is triggered by a need to adapt products to the local market and the specific demands of local users in the foreign market. Interactions with the customer are thus a source of information that will allow the firm to adapt the already developed innovation to the specific tastes and preferences of the markets. In this respect, international markets can facilitate access to valuable knowledge that can be used for innovation (Salomon and Jin 2007; Castellani 2002; Blalock and Gertler 2004). Castellani and Zanfei (2006) argue that exporters often benefit from accessing the diverse knowledge available in the local export market, which has a positive impact on innovations. Socioeconomic, institutional and environmental factors influence the shaping of the demand context (Ray and Ray 2011), implying differences between consumers' tastes in different geographical locations (Salomon

2006).[21] The analysis of Slovenian microdata indicates a positive relationship between exporting and process innovations specifically (Damijan, Kostevc, and Polanec 2010). In fact, both innovation and exports are complementary activities that can reinforce each other (Golovko and Valentini 2011). Prior product innovation has been analyzed as a moderating factor which, through its effects on firms' productivity, allows firms to enter the exporting market (Cassiman and Golovko 2010). Therefore, exporting can improve firms' learning, and result in innovations at the same time as more innovations will increase the likelihood of entering into new markets. This stream of literature is particularly predominant in the discussion of how MNEs exploit their innovations in international markets by adapting their already developed innovation to particular market needs, and is based on evidence of multinationals from developed countries who adapt their innovation in international markets, both in the developed and developing world.

A second stream of literature on engagement with international customers thus revolves around *active collaboration* with users to access specific knowledge that can be used for innovation. Collaboration with local users in the foreign market is a more active form of engagement by comparison, and more linked to asset seeking strategies. Firms actively seek to collaborate with specific customers to gain strategic innovation knowledge. This form of engagement is motivated by the geographically bounded nature of knowledge sources, which drives firms to cross geographical borders and gain competitive advantages through access to local knowledge sources (Almeida 1996; Castellani and Zanfei 2006; Meyer, Mudambi, and Narula 2011). With the increased technological sophistication of some products and services, and a growing diversity of markets, firms need to actively engage customers in their innovation process (Whang and Hobday 2011; Fabrizio and Thomas 2012).

What these two streams of literature have in common is that they do not consider the specific location of the international customer in their analysis. Collaboration with customers in the development of innovations has traditionally taken place in a north-north context. Therefore, both the theoretical frameworks, as well as the empirical evidence of the impact of user-producer interactions on innovation, are based on the implicit assumption that both the users and producers are located in high-income countries and have high technological competences.

[21] In this vein, "per capita income of average consumers" and "infrastructural variability" are the important contextual dimensions making a distinction between demand from emerging economies and advanced economies ((Govindarajan and Ramamurti 2011b)

However, the rapid growth of emerging economies has triggered a change of strategy for many multinational firms, who have started to preempt local competitors in emerging economies by developing innovations that can be expanded later on in high-income countries (Immelt, Govindarajan, and Trimble 2009; Wooldridge 2010). This requires a change of strategy from exploiting what has been developed in the home nation to exploring local markets and local needs for new product developments (Kuemmerle 1997); that is, from sourcing information on the customer to actively collaborating with the customer for the development of innovations.

Important innovations occurring in emerging economies usually do not involve breakthrough innovations, but novel and innovative combinations of knowledge and technologies (Govindarajan and Ramamurti 2011b). What MNCs can gain (in terms of innovation) from engaging with users located in developing countries remains to be systematically studied, but there is anecdotal evidence on the importance of reverse innovations as well as on the increasing technological sophistication of some users in developing countries. Reverse innovation – still a nascent phenomenon – refers to innovation developed initially for low- and middle-income countries, which then spreads to high-income countries (Govindarajan and Ramamurti 2011b; Immelt, Govindarajan, and Trimble 2009; Ray and Ray 2011).[22] One such example is the so-called "innovations for the poor" or "frugal innovations" (Prahalad 2005).

However important, the role of users from the south cannot be limited to the poor, as some studies have shown the role of sophisticated users in emerging economies (Mudambi 2008; Whang and Hobday 2011; Yeung 2007). The case of development in the Brazilian software industry in the early 2000s demonstrates how locals' idiosyncratic needs have led to the huge development of this industry (Botelho, Stefanuto, and Veloso 2005); while Asian users are considered technologically very advanced in various sub-industries, particularly with regard to electronics (Yeung 2007; Whang and Hobday 2011). Ernst (2005), for example, argues that "global firms relocate design activities to be close to the rapidly growing and increasingly sophisticated Asian markets for communications, computing and digital consumer equipment, to be able to interact with Asia's lead users of novel or enhanced products or services". (55)

[22] General Electrics' low-cost electrocardiogram, that initially was developed for rural areas in India (Immelt, Govindarajan, and Trimble 2009) or the Nano car – the cheapest car in the world – developed by Tata Motors of India (Ray and Ray 2011) are examples of reverse innovations.

Producers of innovation can also be located in low- and middle-income countries, and this may have implications for the nature and impact of user-producer interactions on innovation. It is uncontestable that firms located in high-income countries always rank higher than firms in other countries in terms of investment in R&D and innovation, number of researchers and innovation output (Srholec and Verspagen 2012; UNCTAD 2006), and that national and regional conditions affect the capacity of firms to innovate (Arora and Badge 2006; Chaminade and Vang 2008; Fagerberg, Srholec, and Knell 2007; Srholec and Verspagen 2012). But while it is true that the technology clubs in the world have remained stable in the last five decades (Castellacci and Archibugi 2008), this may be rapidly changing. China joined the more advanced cluster (Castellacci and Archibugi, 2008) between 1990 and 2000, and in 2010 its share of total global R&D spending was 12.2 % – the same level as Japan, but still below the US and Europe (Battelle 2011) – which suggests that these countries may also be home to technologically sophisticated users and producers (Plechero 2010).

In sum, the existing literature on user-producer interactions has focused almost exclusively on producers located in high-income countries, and on the interaction with local or domestic users. The existing evidence suggests that while local users are important for incremental innovation, international users are important for radical innovation. However, the research conducted hitherto does not allow us to make a distinction between users from high-income countries and users from low- and middle-income countries. Anecdotal evidence suggests that interacting with users in the south may be useful mainly for incremental innovation, but the rapid accumulation of capabilities in some emerging economies suggests otherwise.

Extending the current discussion on user-producer interactions to include middle- and low-income countries is one of the purposes of this paper. More specifically, we want to investigate the impact of collaborating with users on innovation, taking into account the geographical location of both users and producers on a global scale.

3. Methodology and empirical analysis

3.1. Sample

This research project relies on a survey conducted across nine countries under the auspices of the EU-funded INGINEUS project.[23] The detailed description of the project's data collection and challenges faced, particularly in emerging economics, is available in the methodology document of the project (EU 2009). The survey aims to collect data similar to community innovation surveys (CIS) for countries that lack an innovation survey. While the novelty of the data set has enabled a comparison between high-income and middle-income countries, it has also resulted in challenges for data collection; therefore, precautions should be taken when generalizing the results. This research should be regarded as an *exploratory research* that should be followed by further quantitative and qualitative studies.

Data on firms in Europe were gathered from leading economies with a per capita income above US$ 45,000 per year, namely Denmark, Germany, Norway and Sweden. Estonia, a transition economy, was also part of the survey,[24] as were four prominent middle-income countries: Brazil, China, India and South Africa. The choice of countries allows a clear comparison of economies that are global leaders and ones that are emerging economies in the global arena in line with the overall aim of the project. The survey for each country focused on either ICT, automotive or agro-processing[25], i.e. whichever sector was of economic importance in that country.

Because one of the goals of the INGINEUS project was to extend insights about the globalization of innovation beyond large multinationals from high-income countries, the choice of the data sets was complicated. The sample of firms were selected by using existing databases, including: Statistics Sweden; the German commercial database Hoppenstedt; Proff Forvalt – Eniro, a commercial register for Norwegian firms; the Estonian Business Registry; Danish Statistics; Shenzhen & Beijing database for China; and the NASSCOM Directory of IT firms for India. In the case of Brazil and South Africa, due to lack of up-to-date databases, the strategy

[23] The INGINEUS project focuses on the developed and developing world to determine the extent to which innovation is taking place in globally dispersed networks.

[24] Estonia is an unusual case; although it is based in Europe, it has a similar level of development to middle-income countries.

[25] Sweden had both auto and ICT surveys. However, the selection of these two industries does not affect our final results, as the auto industry is a small share of our total sample.

comprised combining existing databases. In Brazil, the database of the automotive union SINDIPECAS, the official Annual Registry of Social Information (RAIS) and information from large automotive firms about their suppliers were used to compile a sample frame. The databases used in the case of South Africa were the Experian database; Go Organic Online Directory, South Africa's premier organic website, directory and marketing company; Tradepage Online Trade and Business Directory South Africa; Search ZA Directory; and The Food World.

The gathering of information also took place in a variety of different ways. In countries with a culture of participating in surveys, e.g. the Scandinavian countries, firms were sent a link to an online tool. In the middle-income countries, data gathering was best done telephonically or in face-to-face interviews. In all sectors and across all countries, 1215 responses were collected. However, for the purpose of this study, non-innovative firms were left out, as they did not answer the relevant question on collaboration for innovation. Table 1 offers a summary of the results for each sector and country, the number of responses and response rates. The combined sample is dominated by ICT responses. Although China has the second-highest number of responses, it also has the lowest estimated response rate (2.7%). This is because the number of ICT firms in China is extremely high as compared with the other countries participating in the survey, particularly when small firms are considered in the sample. For each country, a t-test for firm size distribution and a non-response test has been conducted. The results indicate that the sample is representative for all countries, with the exception of Germany. This is due to the fact that the research team in Germany had initially targeted firms with more than 50 employees and only at a later stage tried to include smaller firms. As a consequence, the final sample is biased towards large firms and did not pass the t-test by firm size. Despite this, the most relevant automotive firms in Germany are included in the sample. Furthermore, non-respondent firms were contacted for feedback on reasons for not answering the survey; their responses indicate that the survey had not been relevant to them. The low German response rate is most likely due to the fact that the questionnaire was sent out during a period when the German automotive industry was struggling with the aftermath of the economic crisis.

Table 1. Survey results by country and industry

Countries	ICT	Auto	Agro	TOTAL
Brazil		69 (25.9%)		
China	243 (2.7%)			
Estonia	17 (14%)			
India	324 (20.2%)			
South Africa			84 (16.9%)	
TOTAL middle-income	584 (5.34%)	69 (25.9%)	84 (16.9%)	737 (6.32%)
Denmark			49 (23.3%)	
Germany		53 (4.7%)		
Norway	181 (11.9%)			
Sweden	171 (10.3%)	24 (14.3%)		
TOTAL high-income countries	352 (11.05%)	77 (6.18%)	49 (23.2%)	478 (10.59%)
Total	936 (6.59%)	146 (10.64%)	133 (18.58%)	1215 (7.5%)

3.2. Variables

3.2.1. Dependent variable

The *dependent variable* is based on a question that asks firms about their most important innovation in the past three years (2006–2008), with the option of choosing among product or process innovations (for the purpose of this paper we are only considering product innovations, including new services). In terms of product innovation, the survey asked firms to indicate whether "they had been able to introduce any products and/or services that were new to the firm, new to the industry or new to the world". We have excluded non-innovative firms, as they did not answer the questions on collaboration for the development of the most important innovation.[26] As we are interested in the degree of novelty, the variable is categorical, taking the value 1 for new-to-the-firm innovations, 2 for new-to-the-industry innovations and 3 for new-to-the-world innovations. Although firms could have chosen more than one category, we only consider the highest degree of product innovation. Thus, a firm with both new-to-the-firm and new-to-the-world innovations is counted for its new-to-the-world innovations. In this way, we avoid biased results due to different interpretations of the question, as a firm with a new-to-the-world innovation can also select new-to-the-industry and new-to-the-firm for the *same innovation*. Consequently, we have tried a more elaborate estimation by only considering the

[26] While not talking about non-innovative firms can be a source of bias due to shortcomings of the data set, it must also be emphasized that this paper is seeking to understand the role of collaboration with users for the novelty of the most important innovation; therefore firms without innovation cannot also answer whether collaboration with users has had any impact on their innovations or not.

most novel innovation. It must also be noted that, in later paragraphs, we consider radical innovation as new to the world.

3.2.2. Explanatory variables

Firms were asked to indicate their most important innovation partners, with whom they had *actively collaborated* in the past three years (2006–2008), and their geographical locations. The survey listed six different partners (customers, suppliers, competitors, consultancy companies, government and universities), and respondents were asked to specify the geographical locations of the partners. The geographical locations given as options were region;[27] country; South America; Central & Eastern Europe; Africa; rest of Asia; high-income America; Japan & Australasia; and Western Europe.

Customers located in the same region or country in which the firm is located are defined as *local customers*; otherwise, as *international customers*. For the purpose of this paper, we have constructed a variable based on whether the international customers are located in middle- or low-income countries or high-income countries. As firms can have customers in more than one location, this variable is not mutually exclusive (multiple choice answers).

- *Customers in middle-/low-income regions*: South America, Central & Eastern Europe, Africa, and rest of Asia;
- *Customers in high-income regions*: North America, Japan & Australasia, and Western Europe.

In order to examine the influence of geographical location of producer on interactions with customers, we have constructed three categorical variables:

- *Region- international Customer*: This variable captures collaboration between producers in middle-income or high-income countries and international customers in general. Region refers to the location of the firm, and is either middle-income or high-income.
- *Region- middle-income customers*: This variable captures collaboration between producers in middle-income or high-income countries and customers from middle-income countries. Region refers to the location of the firm and is either middle-income or high-income.

[27] The survey defines a region as a sub-national area.

- *Region- high-income customers:* captures collaboration between producers in middle-income or high-income countries and customers from high-income countries. Region refers to the location of the firm, and is either middle-income or high-income.

Table 2 shows the matrix of *divisions between location* of customers and the location of firms. Based on the location of the focal firm, there can be four possible combinations corresponding to the location of the producer and the user.

Table 2. User-producer interaction attending to location

		Producers	
		High Income	**Middle income**
Users	**High Income**	Firms located in high income countries that collaborated with customers in high-income countries in the development of their most important innovation	Firms located in middle income countries that collaborated with customers in high-income countries in the development of their most important innovation
	Middle/low income	Firms located in high income countries that collaborated with customers in low and middle-income countries in the development of their most important innovation	Firms located in middle income countries that collaborated with customers in low and middle-income countries in the development of their most important innovation

Table 3 shows all possible combinations for each variable. For the simplicity of reading and comparison in Models 5 and 6, the categories of variables have been replaced with their actual meanings.

Table 3. Description of variables

Explanatory Variables	Definition	type
Region	1: producers is in high income 0: producers in low/middle income countries.	dummy
Customer collaboration Local Customer International Customer Customers in middle-income region Customers in high income- region	1: yes 0: no	5 separate dummy variables
Region-international customers	0: producers in middle-income without international customers (baseline) 1: producers in middle-income countries that collaborate with international customers 2: producers in high-income countries without international customers 3: producers in high-income countries that collaborate with international customers	Categorical variable
Region-middle/low income customers	0: producers in high-income countries that have not collaborated with customers in middle-income countries (baseline) 1: producers in high-income countries that collaborated with customers in middle-income 2: producers in middle-income countries that collaborated with customers in middle-income 3: producers in middle-income countries that did that have not collaborated with customers in middle-income countries	Categorical variable
Region- high income customers	0: producers in middle-income countries that did not collaborate with customers in high-income (baseline) 1: producers in high income countries that collaborated with customers in high-income 2: producers in high-income countries that did not collaborated with customers in high-income countries 3: producers in middle-income countries that collaborated with customers in high-income countries	Categorical variable

3.2.3. Control variables

Although this study examines the impact of collaboration with customers on firms' ability to introduce radical innovations, we also control for the absorptive capacity of the firm by looking at the technological input from universities or R&D activities inside the firm. We have created two dummy variables:

- *University as a source of collaboration*: Dummy variable that takes the value 1 if the firm had indicated collaboration with university for their main innovation.
- *R&D*: Dummy variable that takes the value 1 if the firm had significant R&D activity.

The firms' characteristics may also influence their ability to introduce radical innovations. Accordingly, we control for size, organizational form, and industry:

- *Size*: Categorical variable based on the answer to the question on FTE employees in the enterprise. Small takes the value 0 if fewer than ten FTE employees or 10–49 employees; medium takes the value 1 if there are 50–249 employees; large takes the value 2 if 250–999 employees or 1000+ employees. We expect the firm size to be positively related to the propensity to introduce innovations.
- *Organizational form*: Categorical variable that takes the value 0 if "a standalone company"; the value 1 if "a subsidiary of an MNC"; and the value 2 if "the headquarters of an MNC".
- *Industry*: Categorical variable that takes the value 0 if "ICT"; the value 1 if "automobiles"; and the value 2 if "agro-food".
- *Export market:* Dummy variable that takes the value 1 if the main market is based on export, to control for the effects derived from being internationally market-driven.

3.3. Estimation

In order to analyze the effects of customers from middle- and low-income countries on the degree of novelty – a categorical variable – we have chosen to run a multinomial logit model with new to the firm as the baseline. Post-estimation tests of independent irrelevant alternatives (IIA) show support for the model.

As the large number of empirical studies on innovation and internationalization using CIS data have shown, innovation and internationalization are inherently endogenous.

International collaboration is probably carried out by already highly innovative firms. A naïve regression of international collaboration on innovation measures may therefore result in biased estimates of reverse causality. This is also a long-existing issue in empirical studies that measure learning through exports (Cassiman and Golovko 2010; Ito and Lechevalier 2010). In an ideal situation, this can be captured – as a source of external knowledge – by longitudinal data on the innovation performance of firms prior to engagement in international collaborations. However, in the absence of such data, we have tried to achieve less biased results by adding appropriate control variables, such as organizational form and size; this is because headquarters of large MNCs can be examples of innovative firms that are also engaged in more international collaborations. As will be discussed under the robustness checks, compiling a sample based on propensity score matching (PSM) is also regarded as another way of controlling for the endogeneity concerns. This method has particularly been used by learning-by-exporting literature (Cassiman and Golovko 2010; Ito and Lechevalier 2010).

4. Results

4.1. Descriptive results

We begin by exploring the information on types of innovations and their degree of novelty in the two high-income and middle-income regions. Interestingly, Table 4 shows that firms with new-to-the-industry innovations have a higher number of observations (44%) in comparison to firms with a lower degree of innovations, i.e. new-to-the-firm innovations (34%).

Table 4. Degree of novelty of product innovations

Product innovation	Frequency	Percent	Cumulated
New to the Firm	300	34.09	34.09
New to the Industry	391	44.43	78.52
New to the World	189	21.48	100.00
Total		880	100.00

In order to further explore the location of the firm, Table 5 shows the percentage of firms located in high-income or middle-income countries compared with the degree of innovations' novelty. The descriptive result shows that no matter the type of region, the percentages of firms with new-to-the-world innovations are almost the same; with 24% of firms in high-income countries and 20% of firms in middle-income countries have indicated introducing new-to-the-world innovations in the last three years. This shows no significant difference with regard to "region type" and introducing new-to-the-world innovations. However, firms in high-income countries have more new-to-the-firm innovations (44%), whereas firms in middle-income economies have more new-to-the-industry innovations (52%). This is also confirmed in the multinomial logit models, as Model 2 shows; compared to firms located in middle-income countries, firms in high-income countries are less likely to have new-to-the-industry innovations (the negative and highly significant indicator).

Table 5. Region type and degree of novelty of innovations

	Degree of novelty			
Region type	New to firm	New to industry	New to world	Total
Middle income	28%	52%	20%	100%
High income	44%	32%	24%	100%
Total	34%	44%	22%	100%

Table 6 lists the responses to the question about the main collaborators for the most important innovations. In line with previous research, the descriptive results of our data also confirm that customers have indeed been used as the main source of innovation.

Table 6. Use of external sources of innovation

Used sources	Frequency	Percentage of total
Customers	798	72%
Suppliers	669	60%
Competitors	410	37%
Consultancy Group	440	40%
Government	380	34%
Universities	413	37%

Appendix A[28] shows the correlation between all variables. It should be noted that the high correlation between variables customers in middle- income region or customers in high income- region with variable international customer are due to interactions.

4.2. Results

Tables 7 and 8 contain the results of the estimations. Results from our baseline model (Model 1) indicate that, in line with previous research on sources of innovation, firms with R&D and collaboration with universities are more likely to possess innovations which are both new to the industry and new to the world. Headquarters of MNCs are also more likely to have new-to-the-industry or new-to-the-world innovations.

Model 2 contains only variables related to customer collaboration, no matter the location of customers or the firm. Model 3 has been expanded to include collaboration with international and/or local customers. Model 4 is the interaction between the focal firms' location and international customers in general. Models 5 and 6 are the results of interplay between the matrix of producers' locations and customers' locations.

The results of Model 2 are in line with previous research, indicating that *collaboration with customers* will have a significant and positive impact on the degree of novelty; but this only matters for *new-to-the-industry* innovations, as we do not observe any significant impact on

[28] This table shows that, in the overall database, local customers are the main source of innovation (71%) and that customers from high-income countries (33%) are more used that those in middle-income economies (25%).

new-to-the-world innovations. For purely radical innovations, collaboration with customers (independent of location) does not have a meaningful impact. Moreover, as already discussed in the descriptive section, being located in high-income countries (region 1) will have a significant negative impact on the likelihood of introducing new-to-the-industry innovations in comparison to firms in middle-income countries.[29]

In order to explore the role of *international customers*, we must first make a distinction between international customers and local customers (Model 3). The results suggest that collaboration with *international customers* has a highly positive impact on new-to-the-world innovations and new-to-the-industry innovations. On the other hand, local customers do not have a significant impact on the degree of innovations' novelty, which is also in line with previous studies showing that local resources do not have an impact on the likelihood of firms introducing radical innovations (Laursen 2011; Weterings and Boschma 2009).

Since regions and countries differ with regard to their technological capabilities (Fagerberg, Srholec, and Knell 2007), we also make a distinction between the locations of the focal firms (producers). Therefore, Models 4–6 also include the location of the focal firm. Model 4 shows the likelihood of *using international customers* for firms in high-income countries and middle-income countries. The baseline is set at producers in middle-income countries that do not collaborate with international customers. This model confirms the role of international customers for firms in high-income countries. The results show that international customers in general have no significant impact on the likelihood of introducing new-to-the-industry or new-to-the-world innovations in firms located in middle-income countries. However, in this model we cannot interpret a positive or negative impact of customers from middle-income countries.

Model 5 shows that although firms in middle-income countries are more likely to introduce new-to-the-industry innovations, those that have collaborated with customers in middle-income regions are highly and significantly more likely to introduce new-to-the-industry innovations. However, firms in high-income countries that have customers in middle-income countries are more likely to introduce new-to-the-world innovations. In order to further investigate the role of customers in middle-income countries, we have changed the baseline to firms in middle-income countries that have not collaborated with customers in middle-income

[29] This result is also consistent with Model 3.

regions[30]. We found that collaboration with customers in middle-income regions have a positive and significant effect on the likelihood of firms from middle-income economies introducing new-to-the-industry innovations.

Table 7. Results of the multinomial logit models 1-4 (baseline=new to firm)

Variable	Model 1		Model2		Model3		Model4	
Independent/dependent	Industry	World	Industry	World	Industry	World	Industry	World
Customer Collaboration			0.48**	0.34				
			(0.237)	(0.289)				
Firm region			-0.70***	0.17	-0.68***	0.21		
baseline=middle income			(0.201)	(0.240)	(0.201)	(0.243)		
Intl Customer					0.45**	0.75***		
					(0.214)	(0.249)		
Local Customer					0.16	-0.17	0.17	-0.11
					(0.200)	(0.231)	(0.201)	(0.234)
Middle income firm-Intl Customer							0.26	0.09
							(0.258)	(0.314)
High income firm-No Intl Customer							-0.77***	-0.37
							(0.231)	(0.296)
High income firm-Intl Customer							-0.12	1.20***
baseline=middle income firm with no international Customer							(0.334)	(0.356)
University collaboration	0.43**	0.46**	0.36**	0.41*	0.37**	0.41*	0.38**	0.46**
	(0.174)	(0.21)	(0.179)		(0.179)		(0.180)	
Export Market	0.061	0.353	-0.02	0.32	-0.19	-0.07	-0.18	-0.02
	(0.193)	(0.223)	(0.196)		(0.228)		(0.230)	
R&D	1.19***	1.23***	1.15***	1.22***	1.14***	1.18***	1.12***	1.09***
	(0.177)	(0.220)	(0.180)	(0.221)	(0.180)	(0.222)	(0.181)	(0.225)
Medium	0.04	0.023	-0.23	0.08	-0.21	0.10	-0.21	0.11
	(0.212)	(0.252)	(0.226)	(0.269)	(0.226)	(0.271)	(0.227)	(0.273)
Large	-0.03	-0.2	-0.30	-0.14	-0.32	-0.12	-0.29	-0.06
	(0.238)	(0.25)	(0.253)	-0.137	(0.254)	-0.121	(0.254)	-0.058
Subsidiary	0.23	0.27	0.16	0.36	0.07	0.21	0.10	0.31
	(0.22)	(0.26)	(0.227)	0.364	(0.230)	0.208	(0.231)	0.310
Headquarter	0.79**	0.755**	0.70**	0.83**	0.67**	0.82**	0.67**	0.81**
	(0.29)	(0.337)	(0.300)	(0.346)	(0.299)	(0.346)	(0.299)	(0.347)
Industry dummies (3)	YES	YES	YES	YES	YES	YES	YES	YES
_cons	-0.78	-1.68	-0.68**	-2.05***	-0.48*	-1.78***	-0.42	-1.52***
	0.165	0.213	(0.277)	(0.352)	(0.255)	(0.320)	(0.261)	(0.327)
N	840	840	840		840		840	
chi2	109.36		131.69		139.47		151.93	
ll	-834.38		-823.22		-819.33		-813.10	
pseudo R2	0.061		0.0741		0.0784		0.0854	
legend: * p<.1; ** p<.05; *** p<.01								

[30] The model is not presented here.

Model 6 indicates that firms from technologically advanced countries are more likely to have new-to-the-world innovations if they collaborate with customers from advanced countries. This model shows that collaborating with customers in high-income countries is not related to the degree of innovations' novelty in firms from middle-income economies.

Table 8. Results of the multinomial logit models 5 & 6 (baseline=new to firm)

Variable	Model5		Model6	
Independent/dependent	Industry	World	Industry	World
Local Customer	0.13	-0.17	0.16	-0.12
	(0.201)	(0.233)	(0.202)	(0.236)
High income firm with middle income customers	0.035	0.795*		
	(0.481)	(0.454)		
Middle income firm with middle income customers	1.07***	0.119		
	(0.309)	(0.367)		
Middle income firm with no middle income customers	0.593**	-0.057		
	(0.215)	(0.264)		
baseline= High income firm with no middle income customers				
High income customers	0.25	0.49*		
	(0.230)	(0.263)		
High income firm with high income customer			-0.138	1.11**
			(0.345)	(0.363)
High income firm with no high income customer			-0.821***	-0.321
			(0.226)	(0.284)
Middle income firm with high income customer			-0.117	-0.359
			(0.281)	(0.34)
baseline= Low income firm with no high income customers				
Low-income customers			0.47*	0.55*
			(0.256)	(0.294)
University collaboration	0.34*	0.44**	0.36**	0.44**
	(0.180)		(0.180)	
Export Market	-0.22	-0.06	-0.20	-0.01
	(0.233)		(0.235)	
R&D	1.15***	1.17***	1.11***	1.10***
	(0.180)	(0.223)	(0.181)	(0.225)
Medium	-0.19	0.08	-0.20	0.11
	(0.227)	(0.271)	(0.228)	(0.273)
Large	-0.35	-0.14	-0.31	-0.09
	(0.255)	-0.138	(0.256)	-0.093
Subsidiary	0.04	0.24	0.10	0.30
	(0.231)	0.243	(0.232)	0.304
Headquarter	0.67**	0.78**	0.68**	0.83**
	(0.299)	(0.347)	(0.299)	(0.347)
Industry dummies (3)	YES	YES	YES	YES
_cons	-1.04**	-0.81	-1.20***	-1.83***
	(0.523)	(0.518)	(0.248)	(0.303)
N	840		840	
chi2	143.54		154.62	
ll	-817.29		-811.75	
pseudo R2	0.0807		0.0870	

Legend: * p<.1; ** p<.05; *** p<.01

Table 9 summarizes the main results. In line with previous research, new-to-the-world innovation is related to collaboration between international customers and firms located in high-income countries. This holds when collaborating with users in high-income countries, and with users in middle- and low-income countries. This means that rather than only adapting to the local market in developing countries, firms may use collaboration with customers located in those countries for the development of radical innovations.

For firms located in low- and middle-income countries, the results are also very interesting, since they show that collaboration with really advanced customers, such as those located in high-income countries, is not related to the degree of novelty. Rather, it is the collaboration with customers in other middle-income countries which is associated with new-to-the-industry innovations.

Table 9. Summary of results

		Producers	
		High Income	**Middle income**
Users	**High Income**	New to the world	No effect of the degree of novelty
	Middle/low income	New to the world	New to the industry

4.3. Robustness Checks

As discussed earlier, the results can suffer from a reverse causality; while this cannot be controlled without longitudinal data, we have tried to validate our results by conducting the same regressions on a sample compiled through propensity score matching (Heckman, Ichimura, and Todd 1997; Becker and Ichino 2002). The learning-by-exporting literature has also used this method extensively for the same problem (Cassiman and Golovko 2010; Ito and Lechevalier 2010). Propensity score matching involves "pairing treatment and comparison units that are similar in terms of their observable characteristics" (Dehejia and Wahba 2002) p. 151). The instrumental variables are used to measure the invention activities of firms prior to collaboration with customers. In simple words, the sample will consist of firms that have collaborated with international customers (treated) matched with those that have not had

collaboration with international customers (control), but are comparable based on instrumental variables.

We have used logistic regression specification to estimate the conditional probabilities of using international customers, and we have also chosen several conditioning (instrumental) variables: firm size, organizational form, industry, region, large share of export market, and R&D activities. After creating a new subsample, we ran Model 2; the results are similar to the original model, indicating that collaboration with international customers is not related to being a productive firm, but collaboration with international customers increases the likelihood of introducing more novel innovations.

5. Concluding remarks

We began this paper by noting that user-producer interactions have been traditionally recognized as important for innovation. Thus far, the discussion on user-producer interaction and its impact on degree of novelty has been based exclusively on the evidence of *producers* and *users* located in advanced, high-income countries (Laursen 2011; Fitjar and Rodríguez-Pose 2012). However, with the growth of emerging economies' markets and an increasing degree of technological sophistication of both users and producers in these markets (Whang and Hobday 2011; Ernst 2005), user-producer interaction is becoming global. The aim of this paper had been to understand the impact that active collaboration with users for innovation has on the degree of novelty by focusing on the location of both users and producers.

In line with existing literature, our results show that geographical proximity to local customers is not related with new-to-the-world or new-to-the-industry innovation, but collaborating with international clients is associated to new-to-the-world innovation. However bringing the specific international locations of the user and the producer into the discussion provides very interesting insights.

Existing theory indicates that collaboration with international customers is positively related to radical innovations. But that assumes that users and producers are in the north – with high-technological capabilities and absorptive capacity. Our findings suggest that this is not always the case as the specific location of both the international users and producers may affect the capacity of firms to benefit from their interaction. For firms located in high-income countries, markets in low-income countries have traditionally been seen as a way to diffuse

innovations developed in high-income countries. Thus, user-producer interaction is regarded more as sourcing information for product adaptation. However, the results of this study indicate that firms from advanced economies have also started to collaborate more closely with customers located in low- and middle-income countries to develop new-to-the-world innovation. In accordance with recent empirical studies, this can be related to technologically sophisticated customers, especially ones in Asian countries (Whang and Hobday 2011; Yeung 2007), which can be attributed to the countries' expanding middle class. It should be emphasized that our data refers explicitly to collaborations with customers on the development of the most important innovations, and not market adaptation (sourcing). Thus, active collaboration with customers located in low- and middle-income countries is related to new-to-the-world innovations.

On the other hand, firms located in middle-income countries may have fewer technological resources, and consequently a less absorptive capacity. Collaborating with advanced customers located in high-income countries may be too difficult. However, collaborating with users located in other low- or middle-income countries may have a higher impact on degree of novelty.

What our results suggest is that firms in low- and middle-income countries will benefit more from South-South collaborations than from South-North ones, at least in terms of innovation, as the technological distance to the customer may be too large to actually facilitate learning and innovation in the firm. This corresponds with more recent studies (Whang and Hobday 2011) that shed light on the fact that catch-up cannot only be limited to the supply side, as demand and user-producer interactions can also play a pivotal role in the advancement of nations.

As with any exploratory analysis using novel, dedicated survey data, ours is characterized by important limitations. The most important ones relate to the sampling procedure and low response rate attained in some of the countries and sectors. A second limitation is the cross-sectional nature of the data, which does not allow us to capture causality between the collaboration with customers and degree of novelty unless a significant relationship exists. Unfortunately, there is little reason to expect that quantitative innovation data of sufficient quality and geographical coverage will be available in the near future. The value of our study is therefore linked to the exploratory purpose that it serves in providing some initial

evidence of the role of users and producers in low- and middle-income countries in the degree of novelty of innovations.

Our findings suggest several avenues for future research. Although we have been able to proxy for the absorptive capacity of firms, our data has not allowed us to say much about the type of customer, apart from the location. Data on the degree of technological sophistication of the customer, as well as the technological distance between customer and producer, would provide a much more nuanced analysis of the implications of the geography of user and producer for innovation on a global scale.

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Appendix A: Correlation between main variables (n=880)

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) New to firm	0.610	0.488	1.00																					
(2) New to industry	1.116	0.994	-0.40	1.00																				
(3) New to world	0.644	1.233	-0.23	-0.03	1.00																			
(4) Customer collaboration	0.840	0.367	0.01	0.10	0.05	1.00																		
(5) International Customer	0.397	0.489	-0.08	0.13	0.14	0.35	1.00																	
(6) Local Customer	0.717	0.451	0.06	0.07	-0.03	0.70	-0.05	1.00																
(7) Customers in middle- income region	0.248	0.432	-0.09	0.12	0.09	0.25	0.71	0.004	1.00															
(8) Customers in high income- region	0.334	0.472	-0.08	0.11	0.13	0.31	0.87	-0.04	0.50	1.00														
(9) Emerging economies	0.613	0.487	-0.28	0.18	-0.04	-0.07	0.14	-0.12	0.23	0.09	1.00													
(10) High-income	0.388	0.487	0.28	-0.18	0.04	0.07	-0.14	0.12	-0.23	-0.09	-1.00	1.00												
(11) Univ. collaboration	0.442	0.497	-0.07	0.11	0.07	0.22	0.23	0.14	0.25	0.21	0.11	-0.11	1.00											
(12) Export market	0.319	0.466	-0.13	0.06	0.09	0.10	0.55	-0.16	0.48	0.52	0.20	-0.20	0.21	1.00										
(13) R&D	0.631	0.483	-0.24	0.26	0.12	0.05	0.19	-0.02	0.16	0.19	0.22	-0.22	0.15	0.19	1.00									
(14) Small	0.442	0.497	0.13	-0.11	-0.05	-0.06	-0.20	-0.01	-0.22	-0.20	-0.45	0.45	-0.19	-0.23	-0.23	1.00								
(15) Medium	0.280	0.449	-0.01	0.02	0.03	0.06	0.06	0.01	0.03	0.04	0.19	-0.19	0.08	0.08	0.06	-0.55	1.00							
(16) Large	0.267	0.443	-0.11	0.09	0.01	-0.00	0.16	0.002	0.22	0.18	0.29	-0.29	0.13	0.17	0.18	-0.54	-0.38	1.00						
(17) Stand-alone	0.611	0.488	0.19	-0.16	-0.05	0.10	-0.20	0.11	-0.22	-0.19	-0.39	0.39	-0.05	-0.17	-0.24	0.40	-0.08	-0.35	1.00					
(18) Subsidiary	0.227	0.419	-0.08	0.05	0.05	-0.08	0.22	-0.16	0.23	0.20	0.23	-0.23	0.01	0.16	0.10	-0.23	0.00	0.24	-0.68	1.00				
(19) Headquarter	0.138	0.345	-0.17	0.13	0.04	-0.04	0.03	0.02	0.06	0.05	0.22	-0.22	0.09	0.09	0.18	-0.23	0.10	0.17	-0.50	-0.22	1.00			
(20) ICT	0.793	0.405	-0.15	0.03	-0.01	0.04	0.02	0.03	0.05	0.03	0.08	-0.08	0.05	0.08	0.16	0.14	-0.01	-0.15	-0.07	-0.04	0.15	1.00		
(21) Auto	0.111	0.315	0.11	0.02	0.04	0.06	0.03	0.09	-0.04	0.04	-0.13	0.13	-0.02	-0.10	-0.06	-0.16	0.05	0.14	0.00	0.05	-0.08	-0.69	1.00	
(22) Agrofood	0.093	0.291	0.10	-0.06	-0.02	-0.12	-0.06	-0.13	-0.03	-0.09	0.02	-0.02	-0.03	-0.001	-0.15	-0.03	-0.03	0.07	0.10	0.003	-0.12	-0.63	-0.11	1.00

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CHAPTER 5

Global linkages for innovation: The impact of group affiliation

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Abstract: The impact of network-embeddedness through business group affiliation for catching-up of firms in the developing countries is a highly recognized. The previous literature has particularly highlighted the internal sharing of resources among the group members. Therefore, the objective of this paper is to examine the relation between high level of local embeddedness and engagement in global linkages for innovations, as a pre-requisite for catching-up by comparing the engagement of group-affiliated firms, with standalone firms. The paper relies on data from Indian ICT firms in Pune region, the results indicate that affiliation to a business group also increases the likelihood of engagement in global linkages for innovation.

Keywords: Catching-up, Global linkages, Business group, Pune.

1. Introduction

Nowadays there is no doubt that innovation fosters the catching-up process (Abramovitz 1986; Fagerberg 1994) and that inflows of *foreign technological knowledge* in developing countries offer a valuable contribution to innovation activities (Lee and Lim 2001; Fu 2008). Firms may have access to such knowledge through various the channels (Crespo and Fontoura 2007; Spencer 2008), including the *linkages* with foreign actors, which is regarded as one of the main mechanisms for this purpose (Kugler 2006; Ivarsson and Alvstam 2004, 2005; Jindra, Giroud, and Scott-Kennel 2009; Javorick 2004; Giuliani, Pietrobelli, and Rabellotti 2005). Global value chain studies have investigated the *interactive learning* that can take place between the *global buyers* and *local suppliers* (Morrison, Pietrobelli, and Rabellotti 2008; Ivarsson and Alvstam 2011; Pietrobelli and Rabellotti 2011; Saliola and Zanfei 2009).

While not limited only to catching-up, the positive impact of external sourcing of knowledge for firm innovation has been extensively ascertained by the literature (Laursen and Salter 2006; Laursen 2011; Santamaría, Nieto, and Barge-Gil 2009; Fitjar and Rodríguez-Pose 2012). Recent works have particularly analyzed spatial diversity of such collaborative linkages (Trippl, Tödtling, and Lengauer 2009; Grillitsch, Tödtling, and Höglinger 2013; Grillitsch and Trippl 2014; Aslesen and Freel 2012; Plum and Hassink 2011; Tödtling, Lehner, and Trippl 2006; Herstad and Ebersberger Forthcoming). However, benefiting from knowledge spillovers through external linkages is not an automatic and costless act, as it requires the capability to understand the value of external knowledge, assimilate and apply it – what has been termed absorptive capacity (Cohen and Levinthal 1990) or technological capability (Westphal, Kim, and Dahlman 1985; Enos 1991; Bell and Pavitt 1993; Kim 1997; Kokko, Tansini, and Zejan 1996; Justman and Teubal 1991).

Departing from economic sociology, the impact of network embeddedness on catching-up has been highlighted (Amsden and Hikino 1994; Fisman and Khanna 2004; Chang, Chung, and Mahmood 2006). In particular, these works have analyzed the knowledge sharing among the members of a specific form of network organization – the business group – with regard to their ability to overcome the poor availability of resources (Fisman and Khanna 2004; Yiu, Bruton, and Lu 2005) and the lack of institutions that support businesses (Khanna and Palepu 1997; Khanna and Rivkin 2001). However, to our knowledge, (with the exception of Vissa, Greve, and Chen 2010), the role of business groups for the catching-up is mainly examined with regard to

the advantages brought by the network relationships *within* the business group, whereas the impact of network embeddedness for searching outside their group boundaries is still to be studied. A key issue within this topic concerns search processes aimed at global sourcing of knowledge. Therefore, the objective of this paper is to examine the relation between high level of local embeddedness and engagement in global linkages for innovations, as a pre-requisite for catching-up.

In this paper, this issue is addressed and it is argued that the impact of group embeddedness for creation of linkages to global sources of innovation is not only related to the endowment of internal resources, but also to firm's external search capabilities. The mechanisms for creation of such linkages relates to the sharing of information within the groups in identifying other external resources. Furthermore the experience of searching locally within the group perhaps enables also the higher likelihood of searching externally (Vissa, Greve, and Chen 2010) and at a global scale. In dealing with the research questions, this paper draws upon unique firm level survey data collected in the Pune region of India in 2008. Regions in emerging economies like India are a particularly interesting case as firms in these contexts are becoming important players in the global arena for their innovation activities (Crescenzi, Rodríguez-Pose, and Storper 2012; Chaminade and Vang 2008). Pune is an interesting case as it represents one of the major clusters in a fast growing emerging economy both in the software industry and the automotive industry (Basant and Chandra 2007; Kumaraswamy et al. 2012). Therefore, the study focused on firms belonging to these industries. The questionnaire collected data on different forms of globalization of innovation (Archibugi and Michie 1995).

The paper is structured as follows. In the next section, we provide the background and literature review on the impact of capabilities for catching-up and discuss the network advantages for firms in developing countries. In section 3, we present the data on which the analysis is based. Section 4 contains the main results, and we conclude the paper with a discussion and suggestions for further research.

2. Background and literature review

2.1. Catching-up: capability creation and FDI

The concept of catching-up refers to the ability of technologically "backward" countries to narrow their gap vis-à-vis a technologically "leader" country by acquiring an already existing

knowledge (Abramovitz 1986; Verspagen 1991; Fagerberg and Godinho 2004). Understanding the factors behind catching-up became at the forefront of research in economic development, particularly after World War II (Abramovitz 1956; Lall 1992; Fagerberg 1994). Today, there is no question that innovation plays an important role for economic growth. However, for long, technological change was not an obvious element for economic growth, as economists were suffering from commitments to the already accepted systems of thoughts (Freeman and Soete 1997; Nelson 1981). Therefore they had tried to explain growth through traditional factors of labor and capital and regarding flow of new knowledge, inventions and innovations as "*exogenous variables*" (Fagerberg 1994; Freeman and Soete 1997; Nelson 1981; Justman and Teubal 1991). Suffering from these shortcomings, for long catching-up was regarded as a *non-creative* act of imitation (Bell and Pavitt 1993).

The rapid industrialization process of the East Asian countries surged a series of scholarly works studying the learning process that had resulted into industrial leadership of those countries (Amsden 1989; Kim 1980; Dahlman 1982; Bell and Pavitt 1993; Lall 1992). The results of these studies highlighted the role of foreign knowledge flow in the catching-up process. As highlighted by Keller (2004, 2010) worldwide technical change is determined by international technology diffusion through foreign trade and FDI.

Knowledge spillovers from MNCs has been conceptualized as the main mechanism through which domestic firms could access to foreign knowledge (Chesnais 1988, 1992; Wang and Blomstrom 1992; Hobday 1994; Fosfuri, Motta, and Ronde 2001; Keller 2004). In general, the channels for the transfer of knowledge from MNCs have been categorized into demonstration/imitation (i.e., demonstration by MNE and imitation by local firms), labor mobility and backward and forward linkages (Fosfuri, Motta, and Ronde 2001; Crespo and Fontoura 2007; Spencer 2008). The concept of "linkages" refers to the relationship between local firms and MNEs, and specifically backward linkages characterize the relationship between local firms as suppliers of global firms, while forward linkages refer to firms are the users of the products of the MNEs (Kugler 2006; Ivarsson and Alvstam 2004, 2005; Jindra, Giroud, and Scott-Kennel 2009; Javorick 2004).

The Global Value Chains (GVC) literature has also emphasized the *interactive learning* that can take place between the *global buyers* and *local suppliers* through different governance modes (Morrison, Pietrobelli, and Rabellotti 2008; Ivarsson and Alvstam 2011; Pietrobelli and

Rabellotti 2011; Saliola and Zanfei 2009; Gereffi, Humphrey, and Sturgeon 2005). In fact, this framework had emerged with the aim of providing an understanding of the globalization of economic activities and how it can impact the economic development and industrial up-grading of the developing countries (Gereffi 1999; Kaplinsky 2000; Bair and Gereffi 2001; Gereffi, Humphrey, and Kaplinsky 2001; Humphrey and Schmitz 2002).

While having access to foreign knowledge is regarded crucial in the catching-up process, there is also a requirement for technological capability (Lall 1992; Dahlman, Ross-Larson, and Westphal 1987; Westphal, Kim, and Dahlman 1985; Kim 1997). In a simple definition, technological capability is the *ability* to make effective use of technological knowledge (Westphal, Kim, and Dahlman 1985). This ability can be related to knowledge and skills to assimilate, use, adopt and change existing technologies, which also enables the creation of new technologies and to develop new products and processes (Kim 1997, p.4).

Industrialization is also seen as the result of building capabilities at higher levels (Lall 1992; Bell and Pavitt 1993; Dahlman 1982; Dahlman, Ross-Larson, and Westphal 1987). Thus, understanding the industrial leadership gained by the late-comers requires an understanding of innovation capabilities (Hobday 1995; Lee and Lim 2001; Hobday, Rush, and Bessant 2004; Dutrénit 2007; Iammarino, Padilla-Pérez, and von Tunzelmann 2008; Dantas and Bell 2009). Innovation capability refers to the abilities required both for invention and innovations (Dahlman, Ross-Larson, and Westphal 1987).

2.2. *The geography of interactive learning*

Innovation capability building is regarded as the outcome of an interactive learning process (Kline and Rosenberg 1986) in particular between firms and external actors such as clients, suppliers, universities and other institutions (Lundvall 1992; Malerba 2002; Chesbrough 2003). In this regard, the impact of external sources of knowledge on innovation performance of firms has been widely recognized (e.g. Laursen and Salter 2004; Frenz and Ietto-Gillies 2009; Katila and Ahuja 2002; Laursen 2011; Santamaría, Nieto, and Barge-Gil 2009). Arguing for the uneven distribution of knowledge across the geographical landscape, the search across geographical boundaries is also regarded as one dimension of expanding variety in the firm's resource base (Almeida 1996; Ahuja and Katila 2004).

Departing from the work of Marshall (1920), there is an extensive literature that has particularly been highlighting the role of *local interaction* and regional resources in creation of innovation capability. Although adopting different labels, such as "industrial districts" (Piore and Sabel 1984), "clusters" (Porter 1998) "innovative milieu" (Camagni 1991) or "learning region" (Asheim 1996), region has been regarded as the main unit of analysis for understanding the spatial dimension of interactive learning for innovation. Benefiting from localized knowledge spillovers has been regarded as the main factor behind localized learning (Jaffe, Trajtenberg, and Henderson 1993; Almeida and Kogut 1999). The localized knowledge spillovers has been related to face-to-face interactions (Asheim 1996; Maskell and Malmberg 1999; Asheim and Isaksen 2002; Gertler 2003; Storper and Venables 2004; Asheim and Gertler 2004), shared institutional context (Gertler 2003; Doloreux and Parto 2005) and embeddedness in local networks (Owen-Smith and Powell 2004; Boschma and ter Wal 2007; Morrison and Rabellotti 2009; Capello and Faggian 2005) The latter point has emphasize on the socialized processes of local knowledge creation (Capello and Faggian 2005).

There has been a growing consensus among scholars also on the impact of having access to knowledge at the global scale (Niosi and Bellon 1994; Carlsson 2006; Kaiser and Prange 2004; Fromhold-Eisebith 2007; Bunnell and Coe 2001). Although not rejecting the idea of localized knowledge, there has been a shift from sole emphasis on intra-regional exchange of knowledge to a complementary non-local inter-regional linkages (Bathelt, Malmberg, and Maskell 2004; Amin and Cohendet 2005; Gertler and Levitte 2005; Tödtling, Lehner, and Trippl 2006). The argument is based on rejecting the tacit/local vs. codified/global distinction by highlighting the knowledge flows also among network members (Amin and Cohendet 2005; Bunnell and Coe 2001) and emphasizing other type of proximities that can facilitate interactive learning (Boschma 2005). In this regard, Bathelt, Malmberg and Maskell (2004) introduced a model distinguishing between local and non-local knowledge. They argued that the information and resource flow is made possible through channels or pipes (Owen-Smith and Powell 2004), in particular global knowledge can be accessed through channels which they labeled "global pipelines". While access to external information can take place through both through person-based and organization-based channels, global pipelines specifically refer to *organization-based* linkages; this excludes networks of personal relationships (Lorenzen and Mudambi 2012).

Recent works have particularly analyzed the engagement of firms in interactive learning and the spatial dimension of sourcing of knowledge from outside their firm boundaries (Trippl, Tödtling, and Lengauer 2009; Grillitsch, Tödtling, and Höglinger 2013; Grillitsch and Trippl 2014; Aslesen and Freel 2012; Plum and Hassink 2011; Tödtling, Lehner, and Trippl 2006; Fitjar and Rodríguez-Pose 2012). In fact, higher degree of novelty of innovation is attributed to sourcing knowledge globally (Fitjar and Rodríguez-Pose 2012). The result of a case study of Barletta footwear district shows that the competitiveness of firms depends on external sources of knowledge (Boschma and ter Wal 2007). The case study of Colline Novaresi wine cluster in Italy also shows that larger and more innovative firms search for knowledge outside their geographical proximity (Morrison and Rabellotti 2009). The result of studies on five Norwegian region-cities further shows that collaboration with extra-regional actors would matter more for innovations in comparison to local actors (Fitjar and Rodríguez-Pose 2012).

2.3. Group affiliation and catching-up

Embeddedness in networks (Granovetter 1985) is regarded essential in the economic transactions (Powell 1990) as it can facilitate the transmission of information among the network members (Owen-Smith and Powell 2004). Economic geographers have analyzed the impact of network embeddedness brought as a result of co-location on the innovation performance (Morrison and Rabellotti 2009; Boschma and ter Wal 2007). In the context of developing countries, the result of analysis on wine clusters indicates that knowledge actually flows within a core group of firms that represent a higher absorptive capacity (Giuliani and Bell 2005; Giuliani 2007). The impact of network embeddedness and knowledge sharing is at the heart of International Business literature (Meyer, Mudambi, and Narula 2011), that highlights how firms can benefit from a dual embeddedness and information circulation between their headquarter and their host locations, and also each host location and its immediate environment (Ebersberger and Herstad 2012).

The impact of network embeddedness for catching-up has also particularly been highlighted in the business group literature. Business groups consist of several cooperating firms (Granovetter 1995) that establish *collaborative* arrangements that can enhance their collective economic actions (Colpan and Hikino 2010). They constitute an organizational with specific features, that are not found in standalone firms nor in MNCs; furthermore, they differ from both

the conglomerates and multidivisional firms (Carney et al. 2011; Mahmood and Zheng 2009): unlike conglomerates, business groups are more coordinated, and unlike the multidivisional firms, they are less centralized (Mahmood and Zheng 2009); furthermore, business groups differ from both the aforementioned organizational models as they rely on a more complex web of mechanisms for coordination. Korean *Chaebol* or Japanese *Keiretsu* are well known examples of Asian business groups (Pyatt 1996).

Business groups are particularly important in developing countries as they substitute for the lack of institutions that support businesses (Khanna and Palepu 1997; Khanna and Rivkin 2001), and, not surprisingly, they dominate the business landscape in these countries (Mahmood and Zheng 2009) and have been acknowledged as a driver of development and catching up for these economies (Khanna and Palepu 1997; Chang and Hong 2000; Yiu, Bruton, and Lu 2005). The networked organizational form of business groups can compensate for the poor availability of resources and services (Fisman and Khanna 2004; Yiu, Bruton, and Lu 2005). The firms that are affiliated to business groups can gain a competitive advantage as they can have access to opportunities that lie outside their boundaries (Ramaswamy, Li, and Petitt 2012). In this regard, the value of business groups for the catching up economies has been studied extensively (Amsden and Hikino 1994; Fisman and Khanna 2004; Chang, Chung, and Mahmood 2006). Recent works have also highlighted that the network structure of the groups and the circulation knowledge among group members can also impact their internationalization strategies; in fact many MNCs coming from emerging markets such as India are part of a business group: Mahindra and Tata are cases in point (Becker-Ritterspach and Bruche 2012).

How business groups benefit from the networked structure has been the subject of several studies (Khanna and Rivkin 2001; Amsden 2009; Lorenzen and Mudambi 2012). Previous works have emphasized that business groups consist of independent firms under a common *administrative and financial control* (Chang and Hong 2000), which often share brand identity and rely on each other for financing (Fisman and Khanna 2004; Amsden 2009). The bond between these firms can be either economic (such as ownership, financial and commercial) or social ties (such as family, kinship and friendship) (Yiu, Bruton, and Lu 2005). Lorenzen and Mudambi (2012) argued for the advantages offered by the network structure of business groups, highlighting in particular the centralized network of personal relationships that channels the

resources to the local innovation activities. The result of analysis by Vissa and colleagues (2010) finds support for an external orientation of business group-affiliated firms.

Relationships such as family ties play an important role in the success of group affiliated firms (Luo and Chung 2005). In any case, the shared ownership allows for a transfer of resources from one subsidiary to another (Amsden 2009). Khanna and Rivkin (2001) argued that business groups reduce the transaction cost by means of social ties that enable the dissemination of information flow among their members, which will also lower the contractual disputes. The case study from machine tools industry in Taiwan (Chen and Lin 2012) indicates that the benefits gained from the formation of business groups is twofold: on the one hand, it enables to overcome the disadvantages emanating from the small scale of local firms and, on the other hand, it offers the flexibility to interact with organizations that offer complementary resources: this is the case for the major Taiwanese tool makers who, thanks to the group form, are able to satisfy the diverse demands of customers who prefer to purchase different tools from the same manufacturer. It must be noted that the flows of resources would embrace both internal sharing of resources as well as external (Amsden 2009). To sum up, while business groups can be categorized in different ways based on their network structure, this networked structure brings advantages for the flows of resources both internally and externally.

While international joint ventures have been discussed as the main channel to globalization of business group firms (Lu and Ma 2008; Mahmood and Zheng 2009), Amsden and Hikino (1994) have argued that business groups also play a major role in gathering foreign technology in emerging markets. The active role played by both local and national governments in the economic activities has brought a new perspective for the emerging economies (Boisot and Child 1996; Gammeltoft, Barnard, and Madhok 2010). In this context, it has been shown that international firms would benefit more by engaging in collaborations and joint ventures with *business group* affiliated firms due to their economic and political advantages (Lu and Ma 2008).

3. Data, sample and method

3.1. Pune Cluster

India has a long history of the formation of business groups in very different institutional environments (Sarkar 2010). For the purpose of this study, we have used data from the case of Pune region, which is located in the state of Maharashtra. While several studies have focused on

the role of Bangalore cluster as the main IT hub in India (e.g. (Chaminade and Vang 2008), more recent works emphasized the role of Pune as a prominent cluster of IT and automotive in India (Lv., Plechero, and Basant forthcoming). Pune alongside Bangalore hosts several important academic institutes and access to skilled labor has been regarded as an important factor for firms located in this cluster (Basant and Chandra 2007; Crescenzi, Rodríguez-Pose, and Storper 2012). The large number of foreign R&D centers of MNCs in Pune is another indicator of the rising importance of this cluster (Zinnov 2008).

3.2. Sample

This research project relies on a survey conducted in Pune region (India) in 2008 in two sectors of software and automotive, which has also been used by other scholars in studying the geography of collaboration (Chaminade 2011; Lv., Plechero, and Basant forthcoming). The survey was conducted by face-to-face interviews followed up by phone calls if necessary. While in the case of SMEs CEOs were the main respondents, for larger firms R&D managers or their deputies answered the questionnaire. This should increase the reliability of answers and, in particular, the knowledge of respondents with regard to the organizational form of the firms. The initial sample had been selected from several databases purchased from Indian industry, which covers only *formal units*. Therefore, the initial sample had not included informal units, especially in the case of the automotive industry, which is dominated by repair shops[31]. In total, 494 firms answered the questionnaire, making a response rate of 37% (221 firms) for the software and 54% (273 firms) for the automotive industry. For the purpose of this paper, we have dropped four firms with missing values on organizational form.

The validity of the survey was checked through a pilot and consultation with industry experts. The non-response bias check was checked by doing a t-test on respondents and non-respondents based on the firm size and no significant differences were found.

[31] According to the data from Ministry of Science and Technology, the major suppliers are the main firms included in the estimations and formal databases

3.3. Key variables

3.3.1. Dependent variable

The dependent variable is *International linkages* for innovation that takes value 1 if a firm sourced knowledge for innovation from international actors and value 0 otherwise[32]. The variable was constructed by asking firms where the most important source of technology and knowledge for the product/process innovation developed in 2007 was located; respondents could indicate three options: local, domestic, or international. The sources of technological knowledge considered by the questionnaire were: existing employees, existing employees who are returnees from abroad, suppliers, clients, competitors, consultancy companies, universities and government. As explained in the previous sections, global pipelines would embrace the organization based linkages (Lorenzen and Mudambi 2012). Therefore, sourcing of knowledge from employees as one form of person-bases linkages have not been considered. Furthermore, firms were asked to indicate the *"main"* resource that had been used, thus excluding multiple geographical selections for a single source. This question is similar to the CIS question and has been used also by previous scholars for analysis of external linkages (Laursen and Salter 2006; Frenz and Ietto-Gillies 2009; Fitjar and Rodríguez-Pose 2012).

3.3.2. Explanatory variables

The key explanatory variable is the *organizational form of the firm*: a categorical variable taking value 0 if it is an Indian-standalone firm (baseline), value 1 if it is a non-Indian multinational company (a firm headquartered outside India), and value 2 if it is an Indian firm with group affiliation. Two questions were used to construct this variable. The first one asked the firm whether it was part of an enterprise group or not[33], and the second one asked, in case of a positive answer, in which country the head office was located. If firms indicated that they are part of an enterprise group located inside India, they are considered as an Indian business group firm. However, if location is outside India, it is considered as a non-Indian multinational

[32] Only 18 firms (3.67%) indicated that they had not used any external resources no matter the geographical location.

[33] The survey defined a business group as a group, which consists of two or more legally defined enterprises under common ownership. Each enterprise in the group may serve different markets, as with national or regional subsidiaries, or different product markets. The head office is also part of an enterprise group.

company. This variable has been constructed in similar way in previous studies on the analysis of domestic business groups (Castellacci 2012).

3.3.3. Control variables

Four control variables were considered.

R&D: we controlled for the absorptive capacity of firms in exploiting external linkages through a dummy variable indicating the existence of intramural R&D. Previous works have shown that there is a close relationship between R&D activities of firms and their ability to exploit external linkages (Grimpe and Sofka 2009).

Size: this variable is based on a question that asks firms to indicate the number of employees, distinguishing among three ranges: the variable takes value 0 if a firm employs less than 50 employees, value 1 if the number of employees is comprised between 50–99, and value 2 for firms with more than 99 employees. This variable controls for the effects of the possible negative effect of liability of smallness on the likelihood for a firm to engage in external linkages (Nieto and Santamaría 2010).

Exploitation of markets with innovations: this variable takes value 1 if firms indicated that they had expanded to international markets with new products. This is to control for the effects of the basic form of globalization of innovation on firm's engagement in global linkages (Archibugi and Michie 1995).

Industry: to control for the type of industry, we have industry dummies for automotive (baseline) and software.

New venture: variable takes value 1 if firms are less than five years old.

Table 1. Description of variables.

List of Variables	Description
International linkages	Dummy variable, equals 1 if firms have indicated "international" as the location of the most important source of knowledge.
Organizational forms	Categorical variable, equals 0 if Indian-standalone, equals 1 if the firm is headquartered outside India (Non-Indian firm (MNC)), and equals 2 if the firm is headquartered in India and part of an enterprise group (Indian-group affiliate).
Global Exploitation-innovation	Dummy variable, equals 1 if the firm expanded to international markets with new products.
R&D	Dummy variable, equals 1 if engaged in intramural R&D, and 0 otherwise.
Size	Categorical variable, equals 0 if less the firm has than 50 employees, equals 1 if 50–99, and equals 2 if more than 99 employees.
New venture	Dummy variable, equals 1 if less than five years old, and 0 otherwise.
Sector	Dummy variable, equals 1 if software, and 0 if automotive.

3.4. Model

As our dependent variable, *International linkages*, is a binary variable, we used a logistic regression model. We can excluded that our results are severely biased by multicollinearity as the maximum Variance Inflation Factor is around 2, well below the threshold of 10, and no pairs of independent variables are highly correlated to each other (Appendix A).

4. Results

4.1. Descriptive statistics

Appendix A presents the descriptive statistics for our sample. The 30% of firms indicated that they used international sources for the main innovation developed in the previous year. The Table also indicates that 45% of firms belong to software industry and 55% to automobile, indicating a rather balanced sample with regard to industry. Interestingly, only 31% indicated intramural R&D activities[34]. However, as highlighted by previous scholars, most

[34] Adding extramural R&D activities to the variable does not make any difference to the results.

innovations in developing countries are not driven by R&D (Pietrobelli and Rabellotti 2011). Furthermore, 18% of firms indicated that they expanded to international markets with new products that accounted for the exploitation of innovation (Archibugi and Michie 1995) .

The percentage of existing organizational forms in our sample is shown in Table 2; while 49% of firms are standalone, 36% belong to a business groups. In other words, in line with research discussed earlier (Khanna and Palepu 1997; Chang and Hong 2000; Lu and Ma 2008), firms affiliated to a group characterize the industrial structure of emerging economies like India. Multinational companies (firms that are headquartered outside India) make up the 15% of enterprises in our sample. For this reason, we argue that while conducting the analysis we should distinguish between the domestic firms that belong to a group and those that do not have such affiliation. We observe that by distinguishing between business groups and independent firms different results are encountered.

Table 2. Distribution of firms by organizational form.

Organizational form	Frequency	Percent
Indian-standalone	240	48.88
Non-Indian firm (MNC)	74	15.07
Indian-group affiliate	177	36.05
Total	491	100.00

4.2. The econometric analysis

Table 3 contains the results of main estimations. Model 1 shows the impact of the explanatory variable (organizational form) without the controls. Results from our baseline model (Model 2) indicate that large and medium firms are more likely to use global linkages for their innovations, as compared to small firms. These results are in line with previous studies indicating that, due to liability of smallness, smaller firms lack the necessary capabilities to engage in innovation activities and using external resources (Nieto and Santamaría 2010; Colombo et al. 2012).

Firms in the software industry are also more likely to use global resources for their innovations; this also can be related to the knowledge-bases of firms in software industry that

can collaborate more easily along the global value chain and in distance. In other words, while transactions inside the automotive industry may require physical presence and geographical proximity, the interactions within software industry may be carried out more easily over long-distance and through the virtual world. These results can also be related to the current discussion on the knowledge bases and global linkages (Asheim and Coenen 2005; Liu, Chaminade, and Asheim 2013).

The surprising result from this analysis is that firms carrying out R&D activities are *less* likely to use external resources on the global scale. However, as our sample is limited only to one dominant cluster in the emerging economy of India, with only 31% of firms indicating existence of intramural R&D, we can argue that these firms are located in a cluster with strategic purpose of accessing *local knowledge*. Furthermore, as highlighted by previous scholars, the most innovations in developing countries are based on *non-R&D* (Pietrobelli and Rabellotti 2011).

In order to examine the differences between Indian and non-Indian firms in the likelihood of engagement in external global linkages, first we have included in our model a dummy variable showing whether there exists a difference between these firms or not (Model 3). In this model we do not make a distinction between group affiliated and non-affiliated firms. The results indicate that MNCs are significantly more likely to use global knowledge linkages for their innovations. This is an expected result, as foreign firms engage both in linkages with other firms in their group as well as the local firms in their host location, what has been termed "dual embeddedness" (Meyer, Mudambi, and Narula 2011).

To analyze the role of affiliation to a business group and its impact on the likelihood of engagement in global linkages, there is a need for distinguishing between Indian firms that are part of a group and standalone firms. In Model 4, Indian standalone firms (baseline) are compared to firms that are part of domestic business groups and non-Indian firms (MNCs). The results indicate that affiliation to a business group influences the likelihood of using global resources. In other words, while Model 3 that considered only the affiliation to a MNC does not highlight any differences between domestic firms' engagement in global linkages, the distinction between standalone firms and business groups brought in by Model 4 makes it evident the existence of a difference in their likelihood of using global knowledge associated with the organizational form of the firm. This is in line with previous research that indicated

firms affiliated to business groups are more likely to be engaged in global interactions (Mahmood and Zheng 2009; Lu and Ma 2008). Interestingly, we cannot observe any difference in engagement in global exploitation of innovation; that is, we cannot find a significant relationship between firms that are engaged in export of new products and engagement in global sourcing of knowledge for innovations.

Table 3. Results of logistic regression.

	Model1	Model 2	Model 3	Model 4
Non-Indian firm (MNC)	3.648***			1.732***
	(0.398)			(0.469)
Indian-group affiliate	0.565**			0.730**
	(0.248)			(0.368)
baseline=Indian-standalone				
Non-Indian firm (MNC)			1.131***	
			(0.325)	
		0.247	0.293	0.306
Global Exploitation-innovation				
		(0.375)	(0.388)	(0.396)
R&D		-1.180***	-0.975***	-0.869**
		(0.356)	(0.363)	(0.388)
New venture		0.398	0.321	0.195
		(0.317)	(0.333)	(0.342)
Medium		1.367***	1.133***	1.037***
		(0.319)	(0.335)	(0.342)
Large		2.327***	1.871***	1.889***
		(0.474)	(0.476)	(0.495)
baseline=small				
Software		4.332***	4.388***	4.064***
		(0.505)	(0.509)	(0.523)
baseline=auto				
Constant	-1.671***	-4.552***	-5.133***	-4.792***
	(0.177)	(0.451)	(0.506)	(0.488)
N	491	483	483	483
chi2	84.628***	118.667***	122.673***	131.390***
Log likelihood	-231.503	-142.347	-136.24	-134.009
Psuedo R2	0.228	0.513	0.534	0.542

Legend: * p<.1; ** p<.05; *** p<.01

4.3. Robustness Checks

Our dependent variable distinguished between firms that depending on their engagement in global sourcing of knowledge; therefore we may face a bias of not taking into consideration

firms without any external linkages[35]. For this matter, we have created a categorical dependent variable with categories of "no external resources", "local resources", "domestic resources" and "global resources". By using a multinomial logistic regression model, the results indicate that affiliation to MNCs increases the likelihood of engagement in sourcing of knowledge at all geographical levels, in comparison to independent firms. However, compared to independent firms, those affiliated to business groups are more likely to source knowledge at the global rather than national level. This confirms our results that affiliation to business groups matters for the likelihood of engagement in global linkages. Furthermore, while our results shows a negative likelihood of firm's engagement in international sourcing of knowledge for firms with R&D activities, this result does not hold for those that have used regional sources. We have also checked for the effect of size on the engagement in global sourcing of knowledge, finding that excluding large firms from the sample does not impact the results.

Our data do not allow us to distinguish between different typologies of group affiliated firms (Colpan and Hikino 2010), in particular controlling for firms that are part of bigger groups and perhaps EMNCs is crucial. For this matter we have matched our sample with the information from PROWESS database that is maintained by the Centre for Monitoring the Indian Economy (CMIE). This is a highly recognized database for detecting group-affiliation (Vissa, Greve, and Chen 2010; Khanna and Rivkin 2001). However, we were able to match 55 firms of our sample (around 10% of total firms) and of those only 21 firms (around 4% of total firms) belonged to a business group. Therefore while we are not able to control for the EMNC effect, we can assume for a very low number of affiliates to EMNCs in our sample.

5. Concluding remarks

Previous studies have emphasized the role of global linkages in the catching-up process (Simmie 2004; Giuliani and Bell 2005; Morrison, Rabellotti, and Zirulia 2013). The present research aims at extending this discussion by considering the role of business groups, because of their prominence as an organizational form in emerging economies. Business groups dominate a substantial fraction of firms in developing countries (Mahmood and Zheng 2009). An important feature of firms belonging to a business group is that they are part of a network organizations, and therefore they are expected to be in more favorable conditions to engage in global

[35] As stated before, only 18 firms have indicated no usage of external resources.

collaboration for innovations as compared to independent standalone firms (Lu and Ma 2008; Mahmood and Zheng 2009) because of the possibility to develop networking capabilities thanks to the interaction within the business group.

This paper has attempted to contribute to the economic development literatures by highlighting the role of business groups for catching-up. The results of this study confirm that business groups constitute a major share of firms in an emerging economy region like Pune. While the previous literature confirmed the role of business groups in compensating for resources in case of non-supporting institutions (Khanna and Palepu 1997), as in the case of emerging economies, this study highlights that they also have higher capabilities in using global resources for their innovation activities. In particular, this can be related to the searching capabilities that have been advanced by firms within an enterprise group. In other words searching for external sources of knowledge is a capability that is gained by business groups due to their network structure; therefore the group affiliated firms are also more externally oriented in their searching behavior (Vissa, Greve, and Chen 2010).

Due to the political-economic situation in most emerging economies these firms are more prone engagement in international joint ventures (Mahmood and Zheng 2009; Lu and Ma 2008). Therefore, one explanation for the engagement of business groups in global collaborations can be related to them being desirable targets for international partnerships. Thus, although business groups are not formed to gain advantages through global interaction like MNCs, they can also function as global pipelines (Bathelt, Malmberg, and Maskell 2004). The reverse causality can be another argument in favor of our results, indicating that firms with higher capabilities are also more likely to engage in global collaborations. Indeed, if we accept that, in general, business groups are firms with higher innovativeness (Chang, Chung, and Mahmood 2006), their expansion into global markets would also require a closer collaboration, in particular with market actors.

The advantages of business group affiliation and global linkages should also be extended to the advantages gained specifically by SMEs that constitute an important part of many business groups (Chen and Lin 2012). Importantly, as liability of smallness prevents the engagement of SMEs in external global linkages (Narula 2004; Segarra-Blasco and Arauzo-Carod 2008), affiliation to business groups does not only mean advantages in terms of sharing internal resources but also externally global resources. In this regard, the advantages of clusters

are twofold: while gaining advantages of local resources (Asheim 1996; Giuliani, Rabellotti, and Dijk 2005; Ceci and Lubatti 2012), co-location can also facilitate the matching process in the formation of business groups.

The results may have policy implication for emerging economies. Although the literature and policy initiatives emphasized the knowledge-spillovers from foreign multinational companies or outward FDI of emerging multinational, the results of our study on the case of Pune region firms highlight the role of domestic networked firms that can act as boundary spanners by means of linkages with global actors for their innovations. Therefore, while the role of MNCs should not be disregarded, business groups can be recognized as important actors within the innovation system of the emerging economies, both in terms of their abilities in managing internal resources and their capacity for tapping into globally external knowledge that can be regarded as valuable for clusters.

As with any exploratory analysis using novel, dedicated survey data, this study is characterized by important limitations. The most important one relates to the survey nature of data, in particular whether the aforementioned firms truly engage in global sourcing of knowledge or not, or are truly affiliate to a business group: this important information was gathered by surveying the respondents and it could not be validated by means of other sources, as the PROWESS database proved to be unsuitable to this analysis. The second limitation concerns the lack of data on the typologies of business groups. In particular controlling for firms that are part of a bigger group and in particular an MNC from India is crucial. Further research may consider to extending the analysis by distinguishing between different types of business groups.

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Appendix A: Correlation between variables (n=491)

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
(1) Linkages international	0.299	0.458	1.00											
(2) Indian-standalone	0.489	0.500	-0.30	1.00										
(3) Non-Indian firm (MNC)	0.151	0.358	0.53	-0.41	1.00									
(4) Indian-group affiliate	0.360	0.481	-0.08	-0.73	-0.32	1.00								
(5) Global Exploitation-innovation	0.183	0.387	0.30	-0.09	0.12	0.01	1.00							
(6) R&D	0.314	0.464	-0.14	-0.02	-0.19	0.16	0.10	1.00						
(7) New venture	0.320	0.467	0.22	-0.08	0.27	-0.12	-0.01	-0.15	1.00					
(8) Small	0.523	0.500	-0.34	0.41	-0.25	-0.24	-0.17	-0.10	-0.01	1.00				
(9) Medium	0.324	0.468	0.17	-0.22	0.20	0.08	0.03	0.08	0.08	-0.73	1.00			
(10) Large	0.147	0.354	0.23	-0.30	0.08	0.25	0.19	0.04	-0.09	-0.43	-0.29	1.00		
(11) Software	0.446	0.498	0.67	-0.16	0.47	-0.18	0.41	-0.04	0.27	-0.23	0.12	0.14	1.00	
(12) Automotive	0.554	0.498	-0.67	0.16	-0.47	0.18	-0.41	0.04	-0.27	0.23	-0.12	-0.14	-1.00	1.00

CHAPTER 6

CONCLUSION

The general aim of this thesis has been to enhance our understanding on the impact of global collaboration for innovation, through an exploratory research. In particular, by contextualizing the searching behavior of firms, this thesis has examined the impact of external knowledge sourcing at different spatial scales on firm innovation. By drawing on various frameworks from economic geography, international business and innovation studies this thesis contributes to the field of geography of innovation.

The three essays had aimed at answering to the thesis research questions:

1. What is the interplay between local and global linkages for novelty of firm innovation?
2. How do differences in innovation capabilities impact the likelihood of engagement in interactive learning for innovation process at different spatial scales?
3. Does knowledge sourcing from developing (South) or advanced economies (North) has different impacts for firm's innovation?

The **first paper** used firm level data from two different contexts: India, an emerging economy, and two, highly developed Scandinavian countries: Norway and Sweden. This paper helps us understand whether there exists a difference in terms of ability to generate more novel innovations among firms located in two different contexts (advanced economic and emerging economy), and the benefits they can gain from collaboration for innovation at different spatial level. The argument is based on the existence of differences in firms' absorptive capacity associated to the context in which firms are embedded. The results indicate that differences indeed exist between SMEs in India and those in Scandinavia: while Indian firms benefit more from local

collaborations, Scandinavian firms gain higher advantages from global collaborations. Furthermore the paper highlights that, while access to a variety of resources is important for the innovation process, perhaps firms embedded in an emerging economy like India can gain more benefits by collaborating with regional market-related actors compared to their counterparts in Norway and Sweden.

The **second paper** explores the impact of interactive learning from one specific type of actor, users, on novelty of innovation. The results of this paper indicate that, while firms in both advanced and emerging economies gain advantage by collaborating with international users, the benefits gained from these collaborations depend on both the location of the focal firm and the location of users. The results illustrate the crucial role of users from developing countries, particularly for firms in developed economies. In this vein, there has been a shift from users as the source of information for market adaptation of products developed in the North, to more collaboration resulting in highly novel innovations. Furthermore, our results suggests that firms in low- and middle-income countries will benefit more from South-South collaborations than from South-North ones, at least in terms of innovation, as the technological distance to the customer may be too large to actually facilitate learning and innovation in the firm. This corresponds with recent studies on the role quality and dynamics of the local market in the South (Whang and Hobday 2011).

The results of the **third paper** emphasize the role of business groups for the catching-up process. The paper addresses the relation between high level of local embeddedness and engagement in global linkages for innovations by comparing the engagement of group-affiliated firms with standalone firms. By using data from Indian firms in Pune region, the results indicate that affiliation to a business group increases the likelihood of engagement in global linkages for

innovation. In particular this can be related to the searching capabilities that have been advanced by firms within an enterprise group. In other words, searching for external sources of knowledge is a capability that is gained by business groups due to their network structure; therefore, as highlighted in previous studies, group affiliated firms are also more externally oriented in their searching behavior (Vissa, Greve, and Chen 2010).

6.1. Discussion and Conclusion

Based on the findings presented in this dissertation, it can be concluded that the difference in the impact of global–local linkages on innovation at the micro-level can be related to firms' heterogeneity of technological capabilities. This becomes particularly viable when analyzing the innovativeness of firms. The findings presented show that, while engagement in global linkages can have a positive impact on the innovation performance of firms, this is dependent on the context in which they are embedded.

The role of location has been analyzed from two angles: one considers the location of the focal firm; the other is related to the location of the external actors involved in the innovation process. Particularly with the emergence of firms from developing economies and new hubs of innovation activities in emerging economies (Chaminade and Vang 2008), the issues of location have become more complex. The outcomes of this dissertation show that firms from emerging economies are indeed engaged in innovation activities with a higher degree of novelty.

However, the role of location is not only limited to the internal innovation processes that firms enact; it can also be attributed to the higher diversity of demand in developing countries. A growing middle class with technologically sophisticated requirements for cheaper products (Whang and Hobday 2011; Yeung 2007) has challenged firms to generate truly novel innovation, thus

putting an end to the 'plug & play' era. Indeed, the results of our analysis, particularly from the second paper, show that firms from developed economies are collaborating more closely with clients in the developing countries in order to understand their needs and introducing products with the highest degree of novelty. The ample amount of recent works on reverse innovation (Govindarajan and Ramamurti 2011b; Immelt, Govindarajan, and Trimble 2009; Ray and Ray 2011) is also confirmation of the rising importance of demand from middle-income countries.

It can be argued that firms in emerging economies gain a higher contribution for their competitiveness by understanding the demand from markets in other developing countries. This can be gained as a result of interaction with local actors, as discussed in the first paper, but also by collaborating with actors in other emerging economies that may have similar requirements to their own home market. In other words, firms in emerging economies can perhaps have a better understanding of the demand in other developing countries, in comparison to the advanced economies. It can also be argued that firms from emerging economies may lack the absorptive capacity (Cohen and Levinthal 1990) necessary to benefit from collaborations with a very different set of actors from advanced economies and to understand the demand emanating from a very different context.

The impacts of external linkages in the technological development have been another theme emerging from the overall conclusions of this dissertation. The overall results show that firms from emerging economies have shifted from mere imitators to true innovators, and this is highly related to collaborating with external actors. However, while in some cases they would benefit more from local collaborations, as in the case of Indian SMEs, in others this has been the result of collaboration with other actors in other developing countries, as in the case of the second paper.

While previous works have emphasized the role of geographical proximity and its benefit for SMEs, this dissertation has argued for an integrated understanding by comparing SMEs from two Scandinavian countries and India. As discussed earlier, while local linkages have become more vital in the case of India, the Scandinavian SMEs in our sample gained more advantage from global collaborations. Recent work on a Norwegian sample also confirms our overall results (Fitjar and Rodríguez-Pose 2012). These results have direct policy implications. Scandinavian countries have invested highly in their regional innovation systems and have a very mature and well-functioning innovation system. This can have a dual impact, on one hand leading to lock-in of firms (Tödtling and Trippl 2005) and on the other preparing the required settings to attract global firms (Cantwell and Mudambi 2011). Previous studies have indicated that too much emphasis on local collaborations can lead to over-embeddedness, but the results of this study indicate that this may not be the case in countries with high levels of diversity in all aspects (Ghemawat 2001).

The embeddedness of firms in networks, and particularly affiliation of business groups (Khanna and Palepu 1997; Chang and Hong 2000; Yiu, Bruton, and Lu 2005), is another important aspect that can impact firms' searching behavior and in particular global sourcing of information. This results yield very important implications as, while business group-affiliated firms are regarded as having highly localized embeddedness, which functions as a substitute for the lack of institutions that support businesses, they are also active in getting globally connected and act as boundary-spanners. The policy implications of this analysis indicate that a, particular attention should be paid to the role of business groups for economic development, as they constitute the major part of firms in emerging economies. They can have benefits both for local purposes, as discussed in previous works within catching-up (Khanna and Palepu 1997; Khanna and Rivkin 2001) but also through their collaborations with global actors.

6.2. Limitations

This study, as with any other research, has limitations that should be addressed by future studies.

The first and most important is related to data. While this dissertation has taken advantage of building on unique datasets that makes a comparative study between emerging and developed economies possible, this also has drawbacks. The low response rate in some countries is the main problem identified, which has led to this research being considered exploratory research.

The second limitation is related to using survey data. This is related first to how the questions are perceived by the respondents, and second to their level of information. While an attempt has been made to minimize errors by choosing the most expert respondents, complete elimination of biases and errors is not possible. This leads to the second shortcoming of the survey data: they do not allow for capturing causality between global linkages and innovation performance. As discussed in the second paper, this is a particularly common problem when studying the relation between global expansion and increased performance. Establishing causality can only be overcome by using longitudinal data. However, the lack of innovation surveys, especially in the case of emerging economies, does not allow such a study to be undertaken, at least in a short period. The exploratory research shows directions and indicates possible changes that can be the topic of further in-depth research. The third shortcoming of the survey data is related to restricting the answer to the question on active collaborations for innovation only to innovative firms. For this reason, we have also faced a selection bias as we had to drop out non-innovative firms, therefore the comparison had been only between innovative firms with different degree of innovation novelty.

The third limitation is related to our lack of data at the regional level: while we have assumed the impact of contextual factors by distinguishing between firms from advanced economies and developed countries, this should also be extended to a meso-level framework. The local environment with their different institutional and economic factors can have an impact also on firm's engagement in local and global linkages.

6.3. Future Work

In line with the limitations discussed earlier, this research recommends several avenues for future research.

We have used organization-based linkages in our analysis; however, the role of employee or linkages based on person-based linkages requires also attention. Perhaps the role of diaspora or immigrant employees in facilitating global linkages may represent a promising research topic.

The role of 'location' has been related to differences at the national level, as our low number of observations has not allowed us to conduct analysis based on regional differences and at the meso-level. The contributions of this dissertation can certainly be extended by taking into account regional differences, particularly among the emerging economies.

While our analysis has mainly been driven by the role of market-related factors, the role of global university–industry collaborations for firms in the emerging economies is another important research agenda for the future. In this regard the use of scientific publications and bibliometric data extracted from particular locations in the emerging economies can lead to a better understanding of the collaborations taking place between involved actors in the South.

Our exploratory studies have revealed that the engagement of firms located in south with other actors, such as users, also located in the south, would play a pivotal role in the innovation

outcomes. However, what still remains for further investigation is a deeper analysis of the south-south interactions. In other words, whether closer interactions amongst the major emerging economies would yield in innovation outcomes with higher novelty or not, is still a subject for further exploration.

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APPENDIX

INGINEUS Questionnaire

Impact of Networks, Globalisation and their INteraction with EU Strategies

INGINEUS is an international research project funded by the European Union that studies global innovation networks. It involves 14 research institutes and universities in seven European countries plus Brazil, China, India and South Africa. For further information on the project INGINEUS please see www.ingineus.eu

In South Africa the Gordon Institute of Business Science is responsible for undertaking the survey on behalf of the research consortium INGINEUS.

The Gordon Institute of Business Science (see www.gibs.co.za) is fully responsible for the protection of your data. Your responses are treated with full confidentiality. Results are summarised in spreadsheets together with information collected from other enterprises in the sample. Data protection is fully guaranteed.

CONTACTS FOR SURVEY QUERIES:

If you have any questions to the survey, please contact the following persons:

Tashmia Ismail: ismailt@gibs.co.za

Helena Barnard: barnardh@gibs.co.za

Gordon Institute of Business Science (GIBS)

26 Melville Road, Illovo, Johannesburg

Tel: 011 7714000

For more information on INGINEUS please visit our web site at www.inginues.eu .

- Answer by placing a cross in the relevant box, except where a written comment is needed.
- Answer for your specific enterprise e.g. stand-alone firm or specific subsidiary etc.
- Answer all questions as they relate to your enterprise in 2008.
- Where data for three previous years are requested, include 2006, 2007 and 2008.
- The abbreviation 'MNC' is used for ‘multi-national corporation’ throughout the survey.

1. Please briefly describe your enterprise’s main product (goods or services)

1.1	Agro-processing	
1.2	ICT	
1.3	Automotive	

1.1. Main areas of focus (agro-processing)

101	Processing and preserving of meat and production of meat products	
102	Processing and preserving of fish, crustaceans and molluscs	
103	Processing and preserving of fruit and vegetables	
104	Manufacture of vegetable and animal oils and fats	
105	Manufacture of dairy products	
106	Manufacture of grain mill products, starches and starch products	
107	Manufacture of bakery and farinaceous products	
108	Manufacture of other food products	
109	Manufacture of prepared animal feeds	

1.2. Main areas of focus (ICT)

26:30:00	Manufacture of communication equipment	
62:01:00	Computer programming activities (This class includes the writing, modifying, testing and supporting of software)	
62:02:00	Computer consultancy activities	
62:03:00	Computer facilities management activities	
62:09:00	Other information technology and computer service activities	

1.3. Main areas of focus (automotive)

25241	Manufacture of technical parts and accessories of plastic	
28408	Pressing, stamping and roll forming	
2914	Manufacture of bearings, gears, gearing and driving elements	
3161	Manufacture of electrical equipment for engines and vehicles	
343	Manufacture of parts and accessories for motor vehicles and their engines	
74205	Engineering activities for projects in specific technical fields	
	Others	

Others (please indicate)

2. Are you:

2.1	A standalone company?	
2.2	A subsidiary of an MNC?	
2.3	The headquarters of an MNC?	

3.1. How many full-time equivalent (FTE) employees does your enterprise have?

3.1	Fewer than 10 FTE employees	
3.2	10 to 49 employees	
3.3	50 to 249 employees	
3.4	250 to 999 employees	
3.5	1000 or more employees	

3.2. Does your enterprise have a significant share of sales activity abroad?

YES		
NO		

3.2.1. If you answered 'Yes' to the question above then please provide the percentage (%) of total sales derived from export.

%	

3.3. Do you have significant R&D activity?

YES		
NO		

3.3.1. If you answered 'Yes' to the above then please estimate the number of full time equivalents employed in R&D.

4.1. In geographical terms, is your enterprise's largest market?

4.1.1	Internal to your enterprise	
4.1.2	A regional market (local region in your country)	
4.1.3	Domestic market (rest of the country)	
4.1.4	An export market	

5. If an export market (4.1.4) was selected then please indicate the 3 most important destinations in terms of sales.

4.2.1	North America	
4.2.2	South America	
4.2.3	Western Europe	
4.2.4	Central and Eastern Europe	
4.2.5	Africa	
4.2.6	Japan & Australasia	
4.2.7	Rest of Asia	
4.2.8	The rest of the world (developing)	

6. Which is the most important source of technology for your enterprise (including hardware, software and knowledge)?

5.1	We produce most technological inputs in-house	
5.2	We buy most of our inputs from other branches of our own MNC	
5.3	We buy most of our technological inputs from non-MNC firms	
5.4	We buy most of our inputs from MNCs with which we are not formally connected	
5.5	We buy most of our inputs from public-sector organisations, e.g. research institutes, universities etc	

7. Please indicate if your enterprise experienced innovation in the past 3 years (2006-2008) in any of the following. You may tick more than one option.

		New to the world	New to the industry	New to the firm	None
6.1	New products				
6.2	New services				
6.3	New or significantly improved methods of manufacturing or producing				
6.4	New or significantly improved logistics, distribution or delivery methods for your inputs, goods and services				
6.5	New or significantly improved supporting activities for your processes (e.g. purchasing, accounting, maintenance systems etc.)				

8. Regarding the development of the most important innovation of your firm in the last 3 years: who did you actively collaborate with and in which geographical location? Region refers to a sub national area, please select all that apply.

		Your Region	Your Country	North America	South America	Western Europe	Central & Eastern Europe	Africa	Japan & Australasia	Rest of Asia
7.1	Clients									
7.2	Suppliers									
7.3	Competitors									
7.4	Consultancy companies									
7.5	Government									
7.6	Local Universities/Research Institutions/Lab									
7.7	Foreign Universities/Research Institutions/Labs									
7.8	Other									

Other (please specify)

8. Has your enterprise developed formal/informal linkages (e.g. research relationships) with the following kinds of foreign organizations? (*Informal* implies no written contract or financial obligation exists)

Please tick all relevant boxes.

		Yes, formal	Yes, informal	No
8.1	Clients			
8.2	Suppliers			
8.3	Competitors			
8.4	Consultancy companies			
8.5	Government			
8.6	Foreign universities/research institutions/labs			
8.7	Other			

Other (please specify)

9.1. Regarding internationalisation, does your firm offshore (or has your firm offshored) production or any R&D activities? (*Offshoring* encompasses activities both internal and external to the firm for the purposes of serving home country or global markets in a location outside the enterprise's home country)

YES		
NO		

9.2. Complete only if 'Yes' selected in Question 9.1 above.
What were the important regional factors in the decision to offshore your enterprise's production and/or R&D innovation activities into a host region(s)?
Mark all important factors.

		Offshoring of production	Offshoring of innovation
9.2.1	Availability of specialised knowledge in the host region		
9.2.2	Availability of qualified human capital at a lower cost than in your own country		
9.2.3	Access to knowledge infrastructure and services in the host region (R&D infrastructure, technical support services etc.)		
9.2.4	Access to other infrastructure, cheaper production resources and services (land, inputs or unskilled labour, ICT, electricity, roads, airports, ports etc.)		
9.2.5	Opportunity to sell existing products and achieve greater access into new markets		
9.2.6	Incentives for the location of activities in the host region (e.g. favourable regulations, special tax regimes, testing facilities and trials etc.)		
9.2.7	Efficient financial markets (including Venture Capital)		
9.2.8	The level of ethical standards and trust		
9.2.9	The enforcement of intellectual property rights		
9.2.10	Following clients who are outsourcing i.e. 'follow sourcing'		
9.2.11	Other, please specify below		

Other (please specify)

10. Please indicate how the following functions are performed by your enterprise, including different subsidiaries of the same firm. Please select all that apply.

		By your unit in your location	At subsidiaries of firm in a developed location(s)	At subsidiaries of firm in a developing location(s)	Outsourced to a partner in your country	Outsourced to a partner outside your country in a developed location	Outsourced to a partner outside your country in a developing location
10.1	Strategic Management						
10.2	Product development (research, design and engineering)						
10.3	Marketing, sales and account management						
10.4	Operations (manufacturing, service supply)						
10.5	Procurement, logistics, distribution (obtaining, storing and transporting inputs and outputs)						
10.6	Corporate governance (legal, finance, accounting, government relations)						
10.7	Human resource management						
10.8	Technology and process development (maintenance, redesign of equipment)						
10.9	Firm infrastructure (building and maintenance IT systems)						
10.10	Customers and after sales service						

11. Indicate the extent to which the following factors represented a challenge or barrier when developing a new good or service in collaboration with firms, universities or other organisations located <u>abroad</u>?

Please note only one answer may be selected per row.

		Extreme Barrier	Serious Barrier	Moderate Barrier	Small Barrier	Not a barrier at all
11.1	Finding relevant new knowledge					
11.2	Overcoming organisational barriers and gaining management acceptance					
11.3	Changing the current location of operations and the associated cost thereof					
11.4	Managing globally dispersed projects and cultural differences					
11.5	Harmonising tools, structures and processes					

12. During the PAST three years, how did your enterprise experience the following factors in the internationalisation of your innovation activities?

		Highly Negative	Moderately Negative	Moderately Positive	Highly Positive	Factor Not Experienced
12.1	Practical support from centres for the internationalisation of innovation and technology transfer					
12.2	Public incentives and economic support					
12.3	The international exposure and contacts of universities, public research and administrative structures					
12.4	Relevant labour force training and skills					
12.5	The regulations, practice and jurisprudence around intellectual property rights					
12.6	The rules and practice regarding foreign direct investment and trade policy					
12.7	The rules and practice regarding migration policy regulations for employing foreign scientists/technicians/expert					
12.8	The availability of risk capital for innovation activities with an international dimension					
12.9	The corporate governance environment (rules concerning firm ownership, shareholder's rights, etc.)					

13. Considering your future innovation activities, please assess the need for improving the following factors:

		Very high need	Moderately high need	Moderately low need	Very low need	Factor not needed
13.1	Practical support from centres for the internationalisation of innovation and technology transfer					
13.2	More public incentives and economic support					
13.3	Better access to international research networks					
13.4	Higher skills in the labour force					
13.5	More stringent regulations, practice and jurisprudence around intellectual property rights					
13.6	Better and clearer rules regarding foreign direct investment and trade					
13.7	More open and flexible migration policy regulations for employing foreign scientists/technicians/experts					
13.8	Greater availability of risk capital for innovation activities with an international dimension					

14. How have you reacted (or are planning to react) to the current global economic crisis?

14.1	Few or no changes	
14.2	Increasing efforts at innovation on your part	
14.3	A serious reduction of your innovative activities	
14.4	Relocation abroad of your innovative activities	
14.5	Relocation of innovative activities to you from abroad	

Contact information

Company	
Address	
Address 2	
City/town	
State	
ZIP/postal code	
Country	
Email address	
Phone number	

THANK YOU!

Emerging Trends Questionnaire

Insert logo of partner institution here

QUESTIONNAIRE FOR FIRMS

"INNOVATION-BASED STRATEGIES FOR GLOBALIZATION"

Questionnaire for "SECTOR"

(INDIA)

Person that makes the interview_____

Date of the interview_____

NOTE: Please answer all questions in relation to the status and activities of your unit in 2007

I. COMPANY BACKGROUND

1. Company name _____

2. Is this unit….

☐ A single plant firm

☐ Part of an enterprise group[1] . If part of an enterprise group, this unit is

☐ The head office ☐ A subsidiary

In which country is the head office of your group located?_____

If your unit is part of an enterprise group, please answer all subsequent questions in relation to this plant in INDIA <u>only</u>.

Do not include results from parent or other enterprises outside of INDIA.

3. Year of establishment in India _____

4. Location city of this unit _____

5. Web site _____

6. Ownership

☐ Percentage of domestic capital _____%

☐ Percentage of foreign capital _____%

7. Number of employees (average full-time equivalent for 2007)

☐ 1-9 ☐ 50-99 ☐ 250-499 ☐ 1000-2499

☐ 10-49 ☐ 100-249 ☐ 500-999 ☐ More than 2500

8. Please indicate the total sales (in 2007)

☐ Less than 2 million US$ ☐ Between 10-50 million US$ ☐ More than 100 million US$ ☐ Between 2-10 million US$ ☐ Between 50-100 million US$

9. Please indicate the estimated percentage of your company's sales according to the following categories:

	% sales
Products **manufactured by your unit** according to design specifications provided by external buyers (*Original Equipment Manufacturing – OEM*)	
Products **developed and designed by your unit according to performance requirements of buyers** (*Original Design Manufacturing – ODM*)	
Products **developed and designed by your unit** and sold under your **own brand** (*Original Brand Manufacturing – OBM*)	
Others (please describe)	

10. a Please indicate the destinations of your sales in 2007 (estimated percentage on total sales)

Destination	**% sales**
Domestic market	
North America (US and Canada)	
Western Europe[2]	
Asia (except domestic)	
Other, please specify_____	
	100%

10. b Click here ☐ if you estimate that more than 50% of your domestic sales are further exported to international markets

11. Please indicate the origin of suppliers in 2007 (estimated percentage on total purchases)

Origin	% purchases
Domestic market	
North America (US and Canada)	
Western Europe[3]	
Asia (except domestic)	
Other, please specify_____	
	100%

12. Please indicate to which segments in the automotive industry you supply your main product.

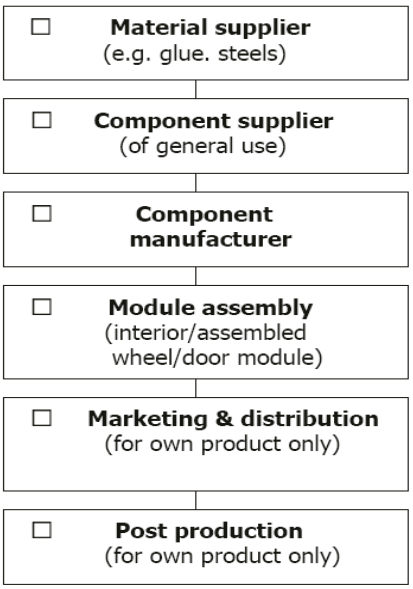
Light vehicles: **High commercial vehicles:**

☐ Passenger cars
☐ Commercial vehicles
☐ Medium-heavy commercial vehicles
☐ Heavy trucks
☐ Buses and coaches

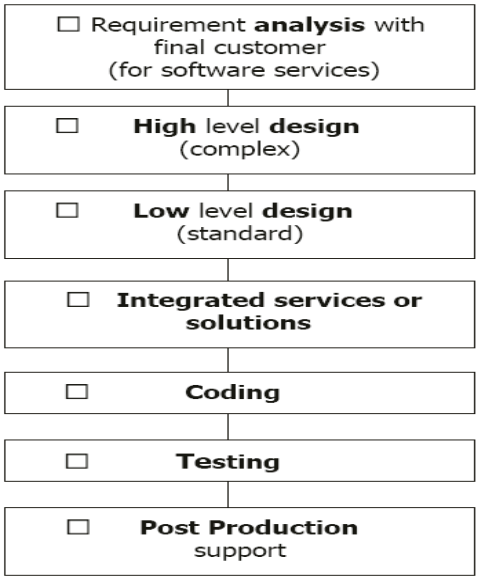
13. Please describe the highest value product, process or activity of your unit (2007)[4]

14. a. In the automotive component industry, which of these activities in the value chain did your unit perform in 2007? (Tick each box in the graph where your unit was involved)

Graph I: AUTOMOTIVE COMPONENT INDUSTRY VALUE CHAIN



14. a. In the software industry, which of these activities in the value chain did your unit perform in 2007? (Tick each box in the graph where your unit was involved)



14. b. As a supplier of automotive components, please indicate if you are:

☐ First tier supplier ☐ Second tier supplier ☐ Third tier supplier ☐ Other _____

II. STRATEGY TO ACCESS LOCAL AND FOREIGN MARKETS

15. Please indicate which strategy is mainly being used to access each of the markets: (mark with a X all that apply)

	Quality[5]	Cost[6]	New products or services	Strategic partnership
Access domestic market	☐	☐	☐	☐
Access markets in other developing countries[7]	☐	☐	☐	☐
Access other markets in industrialized countries	☐	☐	☐	☐

III. RESOURCES

16. a. Is your machinery and equipment behind or ahead the average of the industry in India?

☐ Ahead ☐ Behind ☐ Average ☐ Not known

b. For how many years (ahead or behind)? ____

17. How many patents per employee did your unit registered in 2007? ____

18. In 2007, what was the estimated proportion of employees in each of the following categories?

a. By position	%
Shop floor	
Supporting staff[8]	
Managers	

b. By education	%
Technical education/training	
University degree	
Postgraduate studies	

19. Does your unit employ any of the following systems of production organization? (check all that apply)

☐ Quality control systems
☐ Just in time
☐ Continuous improvement
☐ Quality circles, team work
☐ Internal manuals
☐ Other (please specify) _____

20. Does your unit have any quality certification? If so, which one?

☐ ISO

☐ Other, please specify_____
☐ Other, please specify_____

21. Do you have an R&D department?

☐ No ☐ Yes, how many employees in the R&D dept as a percentage of total staff?_____ %

IV. TYPE AND IMPORTANCE OF INNOVATION

***Product innovation*[9] *and Process innovation*[10]**

	22. During 2007, did your unit introduce any of the following innovations? If you did not, leave the rows blank If you did, please put a cross under one of the three columns indicating the degree of novelty	New to the world[11]	New to domestic market[12]	New to the firm[13]
Product	**P1.** New or significantly **improved goods**[14].			
	P2. New or significantly **improved services**.			
Process	**PR1.** New or significantly **improved methods** of manufacturing[15]			
	PR2. New or significantly **improved logistics**[16]			
Organizational	**O1. New internal management practices**[17]			
	O2. New methods of organising external relations[18]			

23. Which one of the product/process/organizational innovations selected on the previous question 22 **had the most significant impact**[19] **on your unit performance during 2007?** (Please indicate the code P1, P2…..)

_____

24. For the most important innovation for your unit (as selected on question 23) **please indicate who contributed mainly to its development.** (Select the most appropriate option)

☐ Mainly your unit
☐ Your unit together with other companies
☐ Your unit together with a university or research center
☐ Other (please specify)_____

25. Please indicate if this innovation (as selected on question 23) **had an impact on your main strategies to access international or domestic markets**. (Check all that apply)

☐ It contributed to increase the quality of our products or services
☐ It contributed to reduce the costs of manufacturing our products or supplying our services
☐ It helped improving our delivery time
☐ As a consequence, we developed new products or services
☐ Other, please specify

26. Look at the following list of innovation activities. Did your company engage in any of those in 2007? If you did not, leave the rows blank. If you did, please indicate with a cross whether the activity was conducted **mainly** locally, domestically or internationally.	**Local**	**Domestic**	**International**
Intramural R&D[20]			
Extramural R&D[21]			
Acquisition of machinery and equipment[22]			
Acquisition of other external knowledge[23]			
Training[24]			

V. LINKAGES AND CHANNELS

Sources of technology and knowledge

27. Were the following sources of technology and knowledge important for your product/process innovation developed in 2007? If not, leave the rows blank. If yes, please indicate with a cross whether the sources were **mainly** local, domestic or international	**Local**	**Domestic**	**International**
Existing employees (excluding returnees from abroad)			
Existing employees who are returnees from abroad			
Suppliers			
Clients			
Competitors			
Consultancy companies			
Universities			
Government			
Other (please specify)_____			

Content of the collaboration

28. For companies that collaborated with local, domestic or international universities or research centers in 2007, which of these following activities have been important for your unit? (Mark with a X all that apply)	**Local**	**Domestic**	**International**
Training			
Research activities (R&D)			
Other (please specify)_____			

29. For the following transactions with other firms please indicate if in 2007 they took place mainly locally, domestically or internationally. (Please put a cross under one of the three columns)	**Local**	**Domestic**	**International**
Acquisition of inputs			
Acquisition of machinery			
Outsourcing			
Research collaboration			
Other (please specify)_____			

30. For companies that benefited in 2007 from any of the following supporting schemes to foster innovation or technology dissemination, please indicate which of them have been important to support your company's innovation strategies. (Mark with a X all that apply)

	Supporting schemes from		
	From local government	From national government	International funding
Tax incentives			
Funds to develop new products and acquire technology			
Export support[25]			
Information on technological opportunities			
Other (please specify)			

THANK YOU VERY MUCH FOR YOUR PARTICIPATION. WE ARE VERY GRATEFUL!

Person we should contact if there are any queries regarding the form (please fill the form or attach business card):

Name: _____
Job title: _____
Organisation: _____
Phone: _____
Fax: _____
E-mail: _____

[1] A group consists of two or more legally defined enterprises under common ownership. Each enterprise in the group may serve different markets, as with national or regional subsidiaries, or serve different product markets. The head office is also part of an enterprise group.

[2] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

[3] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

[4] By highest value product or process we refer to the most important one in terms of sales, price per unit or volume.

[5] Better quality than your competitors in that market.

[6] Lower costs than your competitors in that market.

[7] Asia, Africa, Latin America etc.

[8] Accounting, financial, administrative, etc.

[9] A product innovation is the market introduction of a new good or service or a significantly improved good or service with respect to its capabilities, such as improved software, user friendliness, components or sub-systems. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises.

[10] A process innovation is the implementation of a new or significantly improved production process, distribution method, or support activity for your goods or services. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises. Exclude purely organisational innovations.

[11] Your enterprise introduced a new or significantly improved good or service onto the global market before your competitors.

[12] Your enterprise introduced a new or significantly improved good or service onto the domestic market before your competitors (it may have already been available in other markets).

[13] Your enterprise introduced a new or significantly improved good or service that was already available from your competitors in your market.

[14] Exclude the simple resale of new goods purchased from other enterprises and changes of a solely aesthetic nature.

[15] Include new methods of producing goods or services.

[16] Include delivery or distribution methods for your inputs, goods or services.

[17] For example new business practices for organizing work or procedures, new knowledge management systems, marketing for innovative products and services, new method of workplace organization.

[18] For example with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc.)

[19] The most important impact in terms of sales/export etc.

[20] Creative work undertaken within your enterprise to increase the stock of knowledge and its use to devise new and improved products and processes (including software development).

[21] Same activities as above, but performed by other companies (including other enterprises within your group) or by public or private research organisations and purchased by your enterprise.

[22] Acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved products and processes.

[23] Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organisations.

[24] Internal or external training for your personnel specifically for the development and/or introduction of new or significantly improved products and processes (that is, training related to new products or processes, not training in general)-

[25] Including attendance to fairs, demonstrations, etc.

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