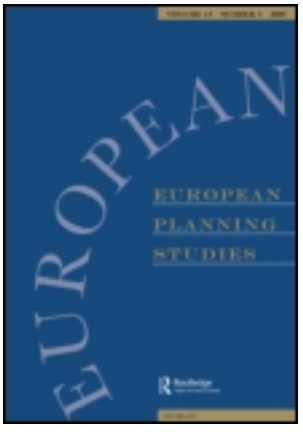

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Are Knowledge Bases Enough? A Comparative Study of the Geography of Knowledge Sources in China (Great Beijing) and India (Pune)

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RESEARCH BRIEFING

Are Knowledge Bases Enough? A Comparative Study of the Geography of Knowledge Sources in China (Great Beijing) and India (Pune)

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Abstract *Using firm-level data collected through a survey in 2008 followed by semi-structured interviews with firms in 2009–2010, this article systematically compares the geography of linkages of the software industry between two regions, one in India (Pune) and one in China (Great Beijing). In contrast to what the literature on knowledge bases and regional innovation systems argues the paper points out to marked differences both in the organization as well as in the geographical spread of the knowledge sources in the software industry between Pune and Greater Beijing. The paper suggests that the literature of knowledge bases could benefit from incorporating the insights from strategy studies as well as innovation systems studies.*

1. Introduction

This paper introduces the first results of the project "Emerging trends in Asia: from cost-based producers to global suppliers of innovation: implications for industry growth in developed and developing countries", funded by the Swedish Research Council. The general objective of this project is to understand the extent and scope of the globalization of innovation activities and discuss its implications for developed and developing countries. This general objective can be divided into the following specific objectives: (a) to unfold global distribution of activities in the value chain of a selection of industries; (b) to describe the changing role of particular regions in developing countries, specifically in China and India in the global value chain; (c) to identify the critical elements supporting

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the transition from low-cost producers to innovators of firms located in those particular regions and in a specific industry[1] and (d) to identify inter-regional differences in terms of the endowment of those factors. Among these factors, we consider the level of technological competences, the linkages of the firms, the internationalization strategy of the firms and the regional innovation system (RIS) in which the firms are located.

The two regions in the project are Pune in India and Great Beijing in China. In the project, three industries are systematically compared: automotive (auto parts), software and green-biotech in both regions. Information was collected during 2008 and 2009 through a survey and semi-structured interviews with firms in Pune and Great Beijing. For the survey, we used the same questionnaire to collect information at the firm level in the three industries and the two regions, which allows us to control for inter-industry differences (i.e. differences between industries, even in the same region) as well as inter-regional differences (i.e. differences between regions in the same industry).

This paper mainly focuses on the organization and geography of interactions between firms and other organizations in two of the three industries: software and auto parts. This paper contributes to the most recent economic geography literature that argues that industries differ in their knowledge bases and that consequently one may expect that different industries show different patterns of local–global interactions. By systematically comparing two industries in two regions, our results show stronger differences between regions in the same industry than between industries in the same region, thus pointing out to other factors explaining the geography of innovation in that particular industry rather than their knowledge bases.

This paper is structured as follows. Section 2 presents the theoretical background of this paper . Section 3 describes the two regions under study: Pune in India and Great Beijing in China. Section 4 presents the research design and methods. This is followed by the main findings. This paper in rounded off with some alternative explanations to the findings beyond differences in the knowledge bases of the two studied industries.

2. Main Theoretical Framework

It is generally accepted that innovation is socially embedded and that it is the result of continuous interactions and exchange of knowledge between organizations (Kline & Rosenberg, 1986; Freeman, 1987; Lundvall, 1992). For long, economic geographers have argued that due to the tacit nature of knowledge, these interactions often take place at the local level, that is, between organizations that are geographically close (Cooke, 1995; Storper & Venables, 2004; Asheim & Gertler, 2005; Boschma, 2005).

The role of geographical proximity has been challenged recently by empirical evidence suggesting that global linkages seem to be more important than local interactions in a variety of clusters (Hagedoorn & Narula, 1996) or at least a very valuable complement to the local "buzz" (Bathelt *et al.*, 2004; Gertler & Levitte, 2005; Gertler, 2008). They argue that rise of the internet and the increase in the codification of knowledge may make face-to-face and inter-personal communication less necessary. Knowledge (codified) can be transferred across large geographical distances without the need of local interaction, but it still requires a certain common understanding between the partners involved in the knowledge exchange for that knowledge to be useful for innovation. Relational proximity can link together actors that are geographically distant, thus enabling the transfer of knowledge even when geographical proximity is absent (Amin & Cohendet, 2005; Gertler, 2008).

Most recent literature shows that both local and global interactions coexist in almost every cluster and industry (Giuliani & Bell, 2005; Giuliani *et al.*, 2005a, 2005b; Giuliani, 2007; Moodysson, 2008; Moodysson *et al.*, 2008) as both tacit and explicit knowledge are crucial ingredients for innovation (Nightingale, 1998).

However, there are significant differences between industries in the importance of local–global linkages for innovation. As some authors argue, industries differ substantially in their knowledge bases (Pavitt, 1984; Asheim & Coenen, 2005; Asheim & Gertler, 2005; Moodysson *et al.*, 2008; Martin & Moodysson, 2010; Blazek *et al.*, 2011; Garman Johnsen, 2011; Gülcan *et al.*, 2011; Martin & Moodysson, 2011; Plum & Hassink, 2011; Sotarauta & Kosonen, 2011; Tödtling *et al.*, 2011) and these differences have important implications in terms of the geographical spread of their knowledge-intensive activities (Laestadius, 1998; Asheim & Gertler, 2005; Asheim *et al.*, 2007). Industries dominated by synthetic knowledge bases will, in principle, display different patterns of knowledge sourcing within and across national borders than industries dominated by analytical or symbolic knowledge bases.

This paper focuses mainly on two of the three industries considered in the project: software and auto parts. These two industries vary in terms of the nature of knowledge mainly used in their innovation process, their main drivers of technological change and their technological intensity.

The automotive firms' knowledge base combines mechanical, electrical and transportation technologies (Wiig & Herstad, 2009). In this respect, one could argue that their dominant knowledge base is synthetic. This is particularly true for the firms considered in this study, which are mainly suppliers of mechanical auto parts to the main automotive assemblers both in Great Beijing and in Pune. Software firms, on the other hand, are providers of specialized knowledge and technical solutions (Castellacci, 2008), which, in turn, is the result, in many cases, of substantial R&D as well as a strong reliance on established process and protocols, similar to life sciences. Firms in this project are mainly software service providers that, for example, provide software for banking firms/services or for biotechnology processes. In this respect, we could consider this industry as dominated by analytical knowledge bases. We expect that the access to global value chains would happen less extensively and more gradually in industries or activities within those industries where knowledge is less codified (automotive design) than in others where knowledge is more readily codified (software).

This line of research has been recently complemented by a number of studies (see, e.g. Tödtling *et al.* in this issue) comparing the same industry in two different geographical locations. The later studies argue that while the knowledge bases are undoubtedly an important factor explaining differences in the geographical location of knowledge sources, other factors—such as the type of RIS in which the firms are located—should also be considered.

This paper relates more to the last stream of literature, extending the analysis to regions and industries in emerging economies. Hitherto, the empirical evidence supporting the knowledge-based approach is based on evidence from developed countries. One of the research questions guiding this paper was to discuss if the arguments also hold for regions and industries in the developing world. Using the firm-level data collected through a survey in 2008 followed by semi-structured interviews with the firms in 2009–2010, this paper systematically compares the geography of linkages of two industries (automotive and software)[2] between two regions, one in India (Pune) and one in China (Great Beijing). The purpose of this paper is to assess if inter-industry differences are stronger than inter-regional differences in

terms of knowledge sourcing, that is, if the differences between software and automotive firms are stronger than differences between firms located in Great Beijing and Pune. Following the literature on knowledge bases, we would expect this to be the case.

3. Great Beijing and Pune

Great Beijing is considered to be the scientific and technological (S&T) heart of China and thus the leading S&T region in China in terms of both its research infrastructure and its innovation performance (Guan *et al.*, 2009). In total, 71 universities and 371 research institutes were located in Great Beijing at the end of 2003 (Chen & Kenney, 2007). These include some of Asia's best-known universities and research institutions such as the Chinese Academy of Sciences (CAS), Peking University and Tsinghua University. In 2005, CAS employed more than 37,000 scientists and engineers, while in 2002, the Peking University and Tsinghua University employed approximately 26,000 scientists and technicians (Chen & Kenney, 2007). One of the most important IT science parks, the Zhongguancun Science Park (ZGC) is also located in Great Beijing in the Haidian district in close proximity to CAS, Peking University and Tsinghua University. Moreover, it is estimated that around 400 R&D centres from multinational corporations (MNCs) are located in Great Beijing and Shanghai, representing approximately 50% of all R&D centres located in China in 2005–2006 (China Knowledge, 2009).

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

Industrially, Great Beijing has a specialization in high-tech industries. In recent years, approximately between one-fourth and two-thirds of the city's total industrial added value have been attributable to high-tech business (Chen *et al.*, 2009).

Due to the rising costs in Great Beijing city, some of the innovation and production activities that previously were located in Great Beijing have moved to the neighbouring provinces of Tianjin and Hebei. Jointly Great Beijing, Tianjin and Hebei form one of the largest city regions or megalopolis in called Jing-Jin-Ji region. This is the region considered for this paper.[3]

On the other hand, Pune (India) is increasingly attracting the attention of academics as a growing research and innovation centre in India, gradually catching up with Bangalore. Its proximity to Mumbai as well as the combined presence of foreign companies, research laboratories and good education and research institutions is considered to be attractive for multinational companies to establish their production and, more recently, R&D activities in Pune. In 2008, it was estimated that around 600 R&D centres of MNCs were established in India. Of these, approximately 100 were set in Pune and around 312 in Bangalore (Zinnov, 2009).

In 2007, the Pune region had 9500 manufactured units[4] in contrast with the 4529 that the region hosted in 1985, showing a continuous growth, in particular, in recent years. The majority of the firms in the area are micro-firms (4790) and small and medium firms (4600), while large firms are few (1.15% of the total units), although they account for

15% of the total employment (Mccia, 2009). Pune is characterized by a strong presence of firms in the IT, auto-component, chemical and pharmaceutical industries. Biotechnology is also represented nowadays as an emerging sector in the local cluster (Basant & Chandra, 2007). The automotive industry, one of the oldest in Pune, had an expansion period between 1960 and 1990 and at the beginning of 2000. Between 2001 and 2005, more than 5000 small and medium enterprises (SMEs) manufacturing auto-related products were registered with the local District Industries Centre. The Pune region also has a long tradition in agro-processing, and nowadays, the food-processing industry is becoming a new important hub. Around 1700 firms and a total of 30,000 employees belong to the last subsector (Mccia, 2008). The IT industry and the biotech industry represent the two new drivers of the Pune economy. For the IT industry in the area, it is possible to count over 1000 IT and information technology enabled services companies and about 200 IT parks (Mccia, 2009).

The Pune region, like Bangalore, offers a large numbers of educational facilities such as important academic institutions and technology development centres (e.g. Tata Research Development Center) able to maintain a variety of linkages with the local industry (Basant & Chandra, 2007). The city of Pune counts 6 universities and 600 functional colleges (Mccia, 2008). The presence of a certain number of educational institutions in Pune allows good access to skilled labour, training and R&D facilities devoted to the needs of the local market. Technical and engineering education aimed at training, in particular, the employees in the ICT and auto-component industries in the area is ensured by the presence of engineering and professional colleges such as the Pimpri Chinchwad College of Engineering and the Modern Education Society's College of Engineering. The colleges sustain the current growth of local expertise in the field of engineering services and design. Other institutions are relevant for training and research in biotechnology and pharma such as the Indian Drugs Research, the Agharkar Research Institute and the National Chemical Laboratory.[5]

In summary, both Pune and Great Great Beijing can be considered as knowledge hubs in their respective countries, increasing significantly their international role as both recipients and transmitters of knowledge-intensive activities worldwide.

4. Method

The empirical analysis is based on the firm-level primary data collected through a survey in the Pune (India) and Great Beijing (China) regions in 2008 in two industries: software and auto parts.

4.1 *The Sample*

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

In the Great Beijing area, we used a sample extracted from different databases from a market research company (Sinotrast) as well as from a software testing centre (CSTC) for the software industry only. The survey was conducted mainly by phone with an average

response rate of 20%. The firms from the CSTC database were contacted by email. The response rate in this last case was around 7%. Few interviews were conducted face to face. Like in Pune, the interviewee was mainly the owner for SMEs and the R&D managers for large firms.[6] In both samples, we conducted a test of non-response to assess if the sample was representative, which it was in both regions.

The survey targeted firms in three sectors in both regions: automotive component, green-biotech and software. In total, 1087 questionnaires were collected. In total, 42.59% of the sample consisted of firms in the automotive component sector, 38.55% in the software sector and 18.86% in the green-biotech sector. The data for the green-biotech were problematic,[7] so they were excluded from the analysis in this paper (Table 1).

In Great Beijing, most of the firms are standalone companies (single-plant firms), while in Pune, it is possible to find both single plants and subsidiaries of multinationals, for both the automotive and the software industries, as Table 2 shows.

The sample covers companies of all sizes. Although SMEs are quite predominant, large firms are more common in the automotive industry in Great Beijing than in Pune, while in the software industry, there are a greater proportion of large firms in Pune than in Great Beijing, which is coherent with the proportion of MNCs and subsidiaries of MNCs in the software industry in Pune.

The survey inquired firms about their innovation activities, internationalization strategies, competences and local–global linkages. This paper focuses, in particular, on the linkages for innovation (Table 3).

4.2 *Measurement of Linkages*

To capture the firms' type, nature and geographical location of linkages, in particular, in relation to the firms' innovation activities, firms were asked in the survey specific questions about

(1) Which actors were considered an important source of technology of knowledge for the product or process innovation developed in 2007?[8] The firms were given a list of sources and were asked to select the sources that were important for the development of that innovation and leave the option blank if that source was not important.
(2) In case it had been important, the firms were then asked to indicate if that source was mainly local, domestic or international.

In the next section, some descriptive analyses of the sample in the two regions related to the specific questions are presented. The specific questions to be answered in the study

Table 1. Sample of firms divided by region and industry

	Region		
Sector	Great Beijing	Pune	Total
Automotive components	190 (41.04%)	273 (58.96%)	463 (100%)
Software	198 (47.26%)	221 (52.74%)	419 (100%)
Total	388 (46.85%)	494 (59.66%)	882 (100%)

Table 2. Distribution of the firms by the type of unit

	Companies per category[a]		Company distribution[b]	
	Great Beijing	Pune	Great Beijing (%)	Pune (%)
Automotive components				
A single-plant firm	147	153	77.37	56.25
The head office of an enterprise group	0	42	0.00	15.44
A subsidiary of an enterprise group	43	77	22.63	28.31
Total	190	272	100.00	100.00
Software				
A single-plant firm	164	87	82.83	39.37
The head office of an enterprise group	1	10	0.51	4.52
A subsidiary of an enterprise group	33	124	16.67	56.11
Total	198	221	100.00	100.00

[a]Number of answers in the sector for each category.
[b]Percentage distribution per sector in each category on total responding companies.

require comparing the distributions of the linkages across the two regions and the different sectors. The idea is to isolate the differences and single out the equalities to have a clearer picture of the commonalities and of the specificities of each regional or sectoral system. In this paper, this analysis is undertaken descriptively, portraying the two regions without entering the discussion of causal forces or co-founding factors. Different tests are run to compare the distribution between sectors in the same region and between regions in the same sector and identify differences that are significant at 1%, 5% or 10%: *t*-tests for the means, PR TESTs to compare two different proportions and chi-square tests when

Table 3. Distribution of companies by size

	Companies per category[a]		Company distribution[b]	
	Great Beijing	Pune	Great Beijing (%)	Pune (%)
Automotive components				
Small: 1–49	85	170	44.74	62.27
Medium: 50–249	75	75	39.47	27.47
Large: 250 to more than 2500	30	28	15.79	10.26
Total	190	273	100.00	100.00
Software				
Small: 1–49	88	88	44.44	39.82
Medium: 50–249	87	85	43.94	38.46
Large: 250 to more than 2500	23	48	11.62	21.72
Total	198	221	100.00	100.00

[a]Number of answers in the sector for each category.
[b]Percentage distribution per sector in each category on total responding companies.

there is a need to see if the distributions between different types of linkages were similar or not between the two regions or sectors. Differences have been tested in four different ways. Test 1 refers to the differences across countries. It compares the distribution of responses of the firms located in Pune and in Great Beijing, independently of the industry. Test 2 indicates if there exist significant differences across industries in the whole sample. It compares the distribution of responses of the firms in the auto-part industry to those in the software industry, independently of where they are located. Test 3 analyses the significance of the differences between industries in Great Beijing, and Test 4 refers to the differences between industries in Pune. The results are discussed next.

5. Findings

5.1 *Composition of the Networks: Actors*

As Table 4 shows, there are significant differences in the importance that firms in Pune and Great Beijing attribute to different sources of knowledge, in particular, employees, suppliers, universities and government. These differences are significant at the 1% level. Clearly, a larger proportion of firms located in Great Beijing consider employees, suppliers, universities and government to be more important as a source of technology and knowledge than firms located in Pune.

Comparing the two sectors, there are significant differences between the network of firms in the automotive industry and the software industry, particularly with regard to the importance of returnees, suppliers, clients, competitors, universities and government. Suppliers and clients are significantly more important for the automotive industry, while returnees, competitors, universities and government are clearly more important for the software industry.

In Great Beijing, one can observe significant differences between the automotive and the software industries only when it comes to suppliers and government. Suppliers are more important for automotive firms, while the government is considered to be a more relevant source of knowledge by the software firms. Indeed, the government plays a very important role in the software industry in Great Beijing through public procurement, but it also plays a more direct role by funding laboratories for spin-off software firms which develop software applications that are being directly used for defence, as the interviews suggested.[9] Nevertheless in general, both industries behave in a quite similar way when it comes to the sources of knowledge and technology for innovation. In Pune, on the other hand, there are more differences between the two industries, with returnees, universities and consultants being more important for the software industry than for the auto-part industry and clients and competitors being significantly more important for the auto-part industry than for the software industry.

5.2 *Geography of the Linkages*

Table 5 presents the main results for the geography of the linkages, distinguishing between local, domestic and international linkages. The tests refer to the differences in the distribution of each source between local, domestic and international.

Firms in Great Beijing and Pune show significantly different patterns in the geographical distribution of their main sources for innovation (Test 1), and this applies to all the

Table 4. Importance of sources of technology and knowledge for product or process innovation developed in 2007

				Distribution between countries			Distribution within countries						
Sector	China	India	Total	China	India	Total	China	India	Total	Test 1	Test 2	Test 3	Test 4
Type of sources automotive													
Existing employees (excluding returnees)	139	104	243	57.2	42.8	100	73.16	38.1	52.48	7.43***	−1.71*	−2.04**	0.23
Returnees from abroad	29	11	40	72.5	27.5	100	15.26	4.03	8.64	4.23***	−7.03***	−1.75*	−7.97***
Suppliers	131	121	252	51.98	48.02	100	68.95	44.32	54.43	5.23***	3.76***	6.33***	−0.41
Clients	153	246	399	38.35	61.65	100	80.53	90.11	86.18	−2.94***	5.71***	1.02	6.76***
Competitors	113	147	260	43.46	56.54	100	59.47	53.85	56.16	1.20	2.78***	0.28	3.81***
Consultancy companies	38	34	72	52.78	47.22	100	20	12.45	15.55	2.20**	−4.70**	1.26	−7.21***
Universities	47	2	49	95.92	4.08	100	24.74	0.73	10.58	8.26***	−5.10***	−1.76*	−6.12***
Government	65	21	86	75.58	24.42	100	34.21	7.69	18.57	7.22***	−4.14***	−2.95***	−2.28**
Others	2	0	2	100	0	100	1.05	0	0.43	1.70*	−1.27	0.62	−2.23**
Total	190	273	463	41.04	58.96	100	100	100	100				
Type of sources ICT													
Existing employees (excluding returnees)	162	82	244	66.39	33.61	100	81.82	37.1	58.23	9.27***	−1.71*	−2.04**	0.23
Returnees from abroad	44	67	111	39.64	60.36	100	22.22	30.32	26.49	−1.87*	−7.03***	−1.75*	−7.97***
Suppliers	73	102	175	41.71	58.29	100	36.87	46.15	41.77	−1.92*	3.76***	6.33***	−0.41
Clients	151	144	295	51.19	48.81	100	76.26	65.16	7.041	2.49**	5.71***	1.02	6.76***
Competitors	115	81	196	58.67	41.33	100	58.08	36.65	46.78	4.39***	2.78**	0.28	3.81***
Consultancy companies	30	90	120	25	75	100	15.15	40.72	28.64	−5.78***	−4.70**	1.26	−7.21***
Universities	65	33	98	66.33	33.67	100	32.83	14.93	23.39	−4.32***	−5.10**	1.76	−6.12***
Government	97	31	128	75.78	24.22	100	48.99	14.03	30.55	7.76***	−4.14***	−2.95***	−2.28**
Others	1	4	5	20	80	100	0.51	1.81	1.19	−1.23	−1.27	0.62	−2.23**
Total	198	221	419	47.26	52.74	100	100	100	100				

Notes: Test 1: Comparison of distribution across countries; PR TEST (test of proportion). Test 2: test between two sectors, together Pune and Great Beijing; PR TEST (test of proportion). Test 3: test between sectors in Great Beijing; PR TEST (test of proportion). Test 4: test between sectors in Pune; PR TEST (test of proportion).

*P-value significant at the 10% level.

**P-value significant at the 5% level.

***P-value significant at the 1% level.

Table 5. Geography of sources of technology and knowledge for product or process innovation developed in 2007

	Company distribution**													
		China					India							
	No (%)	Local (%)	Domestic (%)	International (%)	Total	No (%)	Local (%)	Domestic (%)	International (%)	Total	Test 1	Test 2	Test 3	Test 4
Automotive components														
Existing employees (excluding returnees from abroad)	26.84	41.05	30.00	2.11	190	61.90	36.26	1.83		273	101.7873***	41.5828***	10.1397**	72.7651***
Existing employees who are returnees from abroad	84.74	6.32	7.37	1.58	190	95.97	2.20	1.10	0.73	273	19.1705***	59.7521***	6.8370*	67.9763***
Suppliers	31.05	17.89	45.79	5.26	190	55.68	27.47	16.48	0.37	273	64.3280***	83.7641***	40.6328***	89.0088***
Clients	19.47	13.68	55.26	11.58	190	9.89	68.13	20.15	1.83	273	138.2084***	137.3643***	6.9886*	217.7036***
Competitors	40.53	13.68	40.53	5.26	190	46.15	46.52	6.96	0.37	273	109.5475***	80.6710***	0.8424	99.8358***
Consultancy companies	80.00	3.16	16.32	0.53	190	87.55	10.26	2.20		273	37.8216***	81.6396***	3.6282	118.0033***
Universities	75.26	5.79	17.89	1.05	190	99.27	0.73			273	69.1488***	29.5778***	3.6143	39.2557***
Government	65.79		16.32	17.89	190	92.31		7.69		273	65.9458***	38.8974***	10.7974***	36.9661***
Others	98.95	0.53	0.53		190	100.00				273	2.8862	4.3404	1.0459	4.9815*
Software														
Existing employees (excluding returnees from abroad)	18.18	41.92	39.90		198	62.90	14.03	13.12	9.95	221	128.6153***	41.5828***	10.1397**	72.7651***
Existing employees who are returnees from abroad	77.78	5.56	10.61	6.06	198	68.68	4.52	13.12	12.67	221	6.4846***	59.7521***	6.8370*	67.9763***
Suppliers	63.13	9.60	23.23	4.04	198	53.85	6.33	17.19	22.62	221	30.9114***	83.7641***	40.6328***	89.0088***
Clients	23.74	19.19	51.52	5.56	198	34.84	9.50	20.36	35.29	221	83.6862***	137.3643***	6.9886*	217.7036***
Competitors	41.92	11.11	40.40	6.57	198	63.35	10.86	9.50	16.29	221	58.8325***	80.6710***	0.8424	99.8358***
Consultancy companies	84.85	4.04	10.10	1.01	198	59.28	1.81	11.31	27.60	221	60.6416***	81.6396***	3.6282	118.0033***
Universities	67.17	9.60	22.22	1.01	198	85.07	2.26	6.79	5.88	221	38.7655***	29.5778***	3.6143	39.2557***
Government	51.01	17.68	31.31		198	85.97	2.71	4.52	6.79	221	99.3244***	39.8974***	10.7974***	36.9661***
Others		99.49	0.51		198	98.19	0.90	0.90		221	2.0431	4.3404	1.0459	4.9815*

Notes: Test 1: Comparison of distribution across countries; chi-square test (test of proportion). Test 2: test between two sectors, together Pune and Great Beijing; chi-square test (test of proportion). Test 3: test between sectors in Great Beijing; chi-square test (test of proportion). Test 4: test between sectors in Pune; chi-square test (test of proportion).

*P-value significant at the 10% level.

**P-value significant at the 5% level.

***P-value significant at the 1% level.

considered sources or partners. All the chi-square values are significant at 1%. In general, firms in Great Beijing rely much more on domestic sources than firms in Pune, independently of the sector.

There are also persistent and significant differences between industries as Test 2 shows. The geography of the networks of the automotive and the software industries is significantly different for all the sources considered. This does not mean that they differ in which sources are important, but that they differ in the geographical location of those sources. Looking also at the percentages, one can easily observe that the firms in Pune use more intensively the local or international network than Great Beijing.

These aggregated differences can be better understood when looking at the intra-regional differences. While the two sectors in Great Beijing rely mainly on domestic sources, in Pune, there is a clear distinction between the auto sector, which relies mainly on local sources––or none at all–and the software sector, which relies mainly on international sources–or none at all.[10] It is these differences that are reflected in the inter-industry tests. So, what can be observed are not the differences between industries that are consistent in different regions, but regional differences. What is that makes Pune firms behave in a different way than Great Beijing firms even in the same industry?

6. Discussion: Different Linkages, Different Strategies and Markets?

Considering together the composition of the network and its geography, one can observe that there are significant differences in the composition and geography of the network in both industries between Pune and Great Beijing. While the automotive industry in Great Beijing relies mainly on domestic sources, the automotive firms in Pune prime local interactions. And while software firms in Great Beijing rely also on domestic sources, the software firms in Pune have more international linkages. In Great Beijing, a strong preference for domestic links is observed, independently of the industry, while Pune would be a very good example of a local–global RIS with certain sectors showing a tendency towards local or international linkages. These results are interesting compared with those reported by Tödtling *et al.* in this special issue. Both Pune and Great Beijing can be considered as RIS with a thick institutional infrastructure, with a large number of industrial support institutions from centres for vocational training to testing facilities accessible to all firms within the region (Cooke, 1992; Tödtling & Trippl, 2005). Nevertheless, both the organization and the geography of the networks differ significantly, with the Pune firms showing stronger local–global linkages than the Great Beijing firms, which are mainly targeting domestic markets.

One of the key aspects to take into account when explaining the differences in networking of Pune versus Great Beijing firms is the strategy of the firms, particularly, with reference to the software industry, which, in turn, reflects different trajectories in the emergence and development of the RIS. As it can be seen in Table 6, while Chinese software firms mainly target the domestic market, the Indian software firms have, in general, a very international profile.

A closer look at the RIS of Pune and Great Beijing may provide some clues on the relationship between the market and the geography of the network. Pune has a strong specialization in the automotive industry, and more particularly, in engineering, that dates back to the mid-1960s.[11] As compared with other parts of India, Pune has been attracting mainly European automobile MNCs, which established their manufacturing

Table 6. Main market

	Company distribution[a]	
	Great Beijing (%)	Pune (%)
Automotive components		
Domestic market	86.99	95.57
Foreign market	13.01	4.43
Total	100.00	100.00
Software		
Domestic market	90.02	51.44
Foreign market	9.98	48.56
Total	100.00	100.00

[a]Number of answers in the sector for each category.

facilities and later their R&D (applied research) facilities in Pune to benefit from the proximity to Mumbai as well as to tap on the local pool of specialized engineers. Mercedes-Benz, BMW, Volkswagen and Scania are some examples of firms with subsidiaries in Pune. This strong specialization of the region in the automotive industry may explain (at least partly) the strength of the local linkages. In comparison, despite the great number of automotive companies established there, Great Beijing is not considered to be the hub of the automotive industry in China, which is mainly located around Shanghai. The auto-part companies interviewed in the project were all suppliers of the auto-assembling companies that were located mainly in Shanghai or in other low-cost parts of China. In both cases (Pune and Great Beijing), the main market is domestic, that is, firms, particularly MNC firms are established in Great Beijing or Pune to access the local market.

Software firms in Pune are clearly targeting the international market. Most of the interviewed firms started to work as subcontractors of large MNCs. Most of them are specialized in very specific market niches (e.g. software for stock markets or software for automotive design[12]) that they commercialize worldwide. In some cases, the firm had such specialized knowledge that it was acquired by a MNC, and then turning into a MNC itself.[13] In sharp contrast with the Pune firms, Great Beijing-based software firms are clearly targeting the domestic market. One of the reasons for this is that the domestic IT market has grown dramatically over the previous year.[14] Even some of the few companies that started targeting the international markets have turned into the domestic market after their international business volume decreased significantly during the crisis.[15] As it was repeated in most of the interviews, Chinese software firms want to position themselves in the rapidly growing domestic market, where they have the advantage of the language and the contacts, and only when they are consolidated as leaders in the domestic market, they move to the international markets. Their network is mainly domestic, reflecting this market orientation also: clients are domestic as well as the most important partners.

So, while knowledge bases may be one important factor explaining differences in the geography of knowledge networks, it is not a sufficient one. As our evidence suggests, the same industry in two countries/regions with a similar level of development can behave in a different way with regard to both the organization and the geography of the network, even when they are dominated by the sane knowledge base. Looking at the strategy of the firms, the market and the development of the RIS can provide some additional

explanations to the different geographical spread of their knowledge networks, but other factors may also be crucial to explain differences. More systematic comparison of the same industry across different regions around the world may provide new insights into the determinants of the geography of sourcing in different industries. A deeper look at the type of activities that are being conducted by the firms in Pune and Great Beijing in the value chain may also provide some new insights into the reasons of the observed differences between Pune and Great Beijing (Tables 7 and 8).

Table 7. Summary of main results: summary of findings and differences in the geography and organization of knowledge sourcing in Great Beijing and Pune

	Inter-regional differences	Inter-industry differences	Intra-regional difference, Great Great Beijing	Intra-regional difference, Pune
Composition of the network	Pune and Great Beijing differ significantly in the importance attributed to employees, suppliers, clients, universities and government for Automotive (autoparts) and existing employees, competitors, consultants, universities and government for software			
	software and Automotive (autoparts) differ significantly on the importance of all sources, with the exception of existing employees	software and Automotive (autoparts) in Great Beijing differ only in the importance attributed to suppliers (more important in auto) and government (more important in software)	software and Automotive (autoparts) in Pune differ in returnees, clients, competitors, consultancy and universities	
Geography of the network	Significant. Pune more local–global, while Great Beijing more domestic	Significant, but more due to variety in Pune's industries than in Great Beijing's industries	Not significant. Both industries rely mainly on domestic sources	Significant. Auto relies more on local sources and software on international sources

Table 8. Detailed account of intra-regional differences

	Automotive (auto parts)	Software		
	Pune	Great Beijing	Pune	Great Beijing
Main market	Domestic	Domestic	International	Domestic
Most common source	Clients followed by competitors	Clients followed by employees	Clients followed by suppliers	Employees followed by clients
Composition of the network	Clients and competitors more important in auto in Pune than in software in Pune	Suppliers, competitors and consultancy companies are more important for auto than for software	Returnees, consultancy companies, universities more important in software than in auto in Pune	Universities and government are very important partners compared with auto in Great Beijing
Geography of network	Mainly relying on local sources	Mainly relying on domestic sources	Mainly relying on international sources	Mainly relying on domestic sources

As a final word on the following steps of the project, the results presented represent only a small fraction of the analysis that we are currently conducting with the data collected in the project. Among other issues, we are studying the impact of the geography of the networks on the degree of novelty of innovations (Chaminade & Plechero, 2010) or the relationship between competences and modes of globalization of innovation (Plechero & Chaminade, 2010). Further work will include a deeper analysis of the specialization of Pune and Great Beijing firms in the global value chain and their implications for the geography of knowledge sources and the extension of the analysis to firms in other European countries (such as Sweden and Norway).

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Notes

1. Some of the research questions that were driving the project were the following: Within a particular industry, what is the role of Indian and Chinese firms in terms of innovation activities? Are they truly innovators or just imitators of what the industry world leaders are doing? What can we expect in the future, in terms of innovation, from firms in China and India?
2. According to Pavitt's (1984) view, the geography of knowledge flows is also influenced and characterized by different industrial patterns depending on the specific driver of technological change prevailing in an industry. For the project we decided to include a science-driven industry (green-biotech); scale-intensive (automotive sector), and specialized supplier (software industry).

3. For simplification, in this paper, we use the term Great Beijing to refer to this extended Jinng-Jin-Ji region.
4. A firm may have more than one manufacturing unit or facility.
5. The latest, funded in 1950 and part of the Council for Scientific and Industrial Research, is recognized as one of the most important research-oriented academic institutions in India in the field of chemical and biochemical sciences, and it is well known for its flourishing patent activity and the numerous contract researches, consultancies and training services offered not only to Indian firms but also to foreign MNCs (Basant & Chandra, 2007).
6. In the sample related to Great Beijing region, 17 firms are located outside the regional borders.
7. In India, most of the firms that answered the questionnaire were mainly pharmaceutical companies developing drugs rather than pure green-biotech companies. Therefore, the data of the two regions could not be compared.
8. All the questions in the questionnaire referred to activities conducted the year before, in this case, 2007. Previously to this question on sources of knowledge, the firms were asked about their most important innovation in 2007 (product/process/organizational). The question of linkages naturally followed that line of enquiry, so the firms could refer to the most important innovation.
9. Interview with a principal researcher of a small spin-off company specialized in speech solutions and speech recognition (10 November 2009).
10. In a sense, the behaviour of the firms in Pune is very consistent to what we would expect from the knowledge-based approach. Auto parts industry, as an industry dominated by synthetic knowledge bases, relies more strongly on local sources of knowledge and technology than software firms, which rely strongly on international sources.
11. Interview with the Director General of the Mahratta Chamber of Commerce (13 August 2009).
12. Interview with the CEO and co-founder of a small software company in Pune specialized in software for the stock exchange (14 August 2009).
13. Interview with the President and Executive director of a large software company in Pune (13 August 2009).
14. Interview with the Executive Vice-president, business development, of a large IT firm in Great Beijing (11 November 2009).
15. Interview with the Director, Global sales & Marketing, of a large Chinese/American software firm (13 November 2009).

References

Amin, A. & Cohendet, P. (2005) Geographies of knowledge formation in firms, *Industry and Innovation*, 12(4), pp. 465–486.

Asheim, B. & Coenen, L. (2005) Knowledge bases and regional innovation systems: Comparing Nordic clusters, *Research Policy*, 34(8), pp. 1173–1190.

Asheim, B. & Gertler, M. (2005) The geography of innovation: Regional innovation systems, in: J. Fagerberg, D. Mowery & R. Nelson (Eds) *The Oxford Handbook of Innovation*, pp. 291–317 (Oxford: OUP).

Asheim, B., Coenen, L. & Vang, J. (2007) Face-to-face, buzz, and knowledge bases: Sociospatial implications for learning, innovation, and innovation policy, *Environment and Planning C: Government and Policy*, 25(5), pp. 655–670.

Basant, R. & Chandra, C. (2007) Role of educational and R&D institutions in city clusters: An exploratory study of Bangalore and Pune regions in India, *World Development*, 35(6), pp. 1037–1055.

Bathelt, H., Malmberg, A. & Maskell, P. (2004) Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation, *Progress in Human Geography*, 28(1), pp. 31–56.

Blazek, J., Zizalova, P., Rumpel, P. & Skokan, K. (2011) Where does the knowledge for knowledge intensive industries come from? The case of biotech in Prague and ICT in Ostrava, *European Planning Studies*, 19(7).

Boschma, R. (2005) Proximity and innovation: A critical assessment, *Regional Studies*, 39(1), pp. 61–74.

Castellacci, F. (2008) Technological paradigms, regimes and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation, *Research Policy*, 37(6–7), pp. 978–994.

Chaminade, C. & Plechero, M. (2010) *From New to the Firm to New to the World. Effect of Geographical Proximity and Technological Capabilities on the Degree of Novelty in Emerging Economies*, CIRCLE Electronic Working Papers 2010/12, Lund: CIRCLE.

Chen, K. & Kenney, M. (2007) Universities/research institutes and regional innovation system: The cases of Beijing and Shenzhen, *World Development*, 35(6), pp. 1056–1074.

Chen, S., Chen, Y. & Wen, P. (2009) Mncs' offshore R&D mandates and host countries' locational advantages, *China Information*, 23(1), pp. 159–187.

China Knowledge (2009) China Education and R&D system. Available at http://www.chinaknowledge.com/Business/CBGdetails.aspx?subchap=1&content=8#RDInChina (accessed 2 November 2010).

Cooke, P. (1992) Regional innovation systems: Competitive regulation in the new Europe, *Geoforum*, 23(3), pp. 365–382.

Cooke, P. (1995) *The Rise of the Rustbelt* (New York: Palgrave Macmillan).

Freeman, C. (1987) *Technology Policy and Economic Performance: Lessons from Japan* (London: Pinter).

Garman Johnsen, I. (2011) Constructing regional advantage in Oslo Norway: The case of the animation industry, *European Planning Studies*, 19(7).

Gertler, M. (2008) 8. Buzz without being there? Communities of practice in context, *Community, Economic Creativity, and Organization*, l(9), pp. 203–227.

Gertler, M. S. & Levitte, Y. M. (2005) Local nodes in global networks: The geography of knowledge flows in biotechnology innovation, *Industry and Innovation*, 12(4), pp. 487–507.

Giuliani, E. (2007) The selective nature of knowledge networks in clusters: Evidence from the wine industry, *Journal of Economic Geography*, 7(2), pp. 139–168.

Giuliani, E. & Bell, M. (2005) The micro-determinants of meso-level learning and innovation: Evidence from a chilean wine cluster, *Research Policy*, 34(1), pp. 47–68.

Giuliani, E., Pietrobelli, C. & Rabellotti, R. (2005a) Upgrading in global value chains: Lessons from Latin American clusters, *World Development*, 33(4), pp. 549–573.

Giuliani, E., Rabelotti, R. & Van Dijk, M. P. (2005b) *Clusters Facing Competition: The Importance of External Linkages* (Aldershot: Ashgate Publishing).

Guan, J., Yam, R., Tang, E. & Lau, A. (2009) Innovation strategy and performance during economic transition: Evidences in Great Beijing, China, *Research Policy*, 38(5), pp. 802–812.

Gülcan, Y., Akgüngör, S. & Kustepeli, Y. (2011) Knowledge generation and innovativeness in Turkish textile industry: Comparison of Istambul and Denizli, *European Planning Studies*, 19(7).

Hagedoorn, J. & Narula, R. (1996) Choosing organizational modes of strategic technology partnering: International and sectoral differences, *Journal of International Business Studies*, 27(2), pp. 265–284.

Hong, W. (2008) Decline of the center: The decentralizing process of knowledge transfer of Chinese universities from 1985 to 2004, *Research Policy*, 37(4), pp. 580–595.

Kline, S. & Rosenberg, N. (1986) An overview of innovation, in: L. A. Rosenberg (Ed.) *The Positive Sum Strategy*, p. 289 (Washington, DC: National Academy of Sciences).

Laestadius, S. (1998) Technology level, knowledge formation and industrial competence in paper manufacturing, in: G. Eliasson & C. Green (Eds) *Microfoundations of Economic Growth. A Schumpeterian Perspective*, pp. 212–226 (Ann Arbor, MI: The University of Michigan Press).

Lundvall, B.-A. (Ed.) (1992) *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning* (London: Pinter).

Martin, R. & Moodysson, J. (2010) *Innovation in Symbolic Industries: The Geography and Organisation of Knowledge Sourcing*, CIRCLE Electronic Working Papers 2010/07 Available at: www.circle.lu.se (accessed 1 October 2010).

Martin, R. & Moodysson, J. (2011) Innovation in symbolic industries: The geography and organisation of knowledge sourcing, *European Planning Studies*, 19(7).

Mccia (2008) *Profile and Analysis of PUNE Manufacturing Inc. An Intelligence Report on Growth of Pune Industries*, I. a. A. Pune: Mahratta Chamber of Commerce.

Mccia (2009) *IT Directory*, I. a. A. Pune: Mahratta Chamber of Commerce.

Moodysson, J. (2008) Principles and practices of knowledge creation: On the organization of "buzz" and "pipelines" in Life Science Communities, *Economic Geography*, 84(4), pp. 449–469.

Moodysson, J., Coenen, L. & Asheim, B. (2008) Explaining spatial patterns of innovation: Analytical and synthetic modes of knowledge creation in the Medicon Valley life-science cluster, *Environment and Planning A*, 40(5), pp. 1040–1056.

Nightingale, P. (1998) A cognitive model of innovation, *Research Policy*, 27(7), pp. 689–709.

Pavitt, K. (1984) Sectoral patterns of technical change: Towards a taxonomy and a theory, *Research Policy*, 13(6), pp. 343–373.

Plechero, M. & Chaminade, C. (2010) *Different Competences, Different Modes in the Globalization of Innovation? A Comparative Study of the Pune and Great Beijing Regions*, CIRCLE Electronic Working Papers 2010/03, Lund: CIRCLE.

Plum, O. & Hassink, R. (2011) On the nature and geography of innovation and interactive learning: A case study of the biotechnology industry in the Aachan Technology Region, Germany, *European Planning Studies*, 19(7).

Sotarauta, M. & Kosonen, K.-K. (2011) Digital or local buss, global or national pipelines—do knowledge bases matter? *European Planning Studies*, 19(7).

Storper, M. & Venables, A. (2004) Buzz: Face-to-face contact and the urban economy, *Journal of Economic Geography*, 4(4), pp. 351–370.

Tödtling, F. & Trippl, M. (2005) One size fits all? Towards a differentiated regional innovation policy approach, *Research Policy*, 34(8), pp. 1203–1219.

Tödtling, F., Lengaver, L. & Höglinger, C. (2011) Does location matter for knowledge sourcing? A study of ICT firms in two regions in Austria, *European Planning Studies*, 19(7).

Wiig, H. & Herstad, S. (2009) Prospective implications of offshored knowledge-based activities: Outlook for industries in the EU and emerging economies, Ingineus Working Paper, Mimeo.

Zinnov (2009) *Strategic Guide on Indian R&D Captives*, Zinnov Report. Available at http://www.zinnov.com/randd/collaterals/Report%20on%20R&D%20Offshoring%202008.pdf (accessed 2 November 2010).