6. Chinese multinational enterprises bridging technologies across home and host regions

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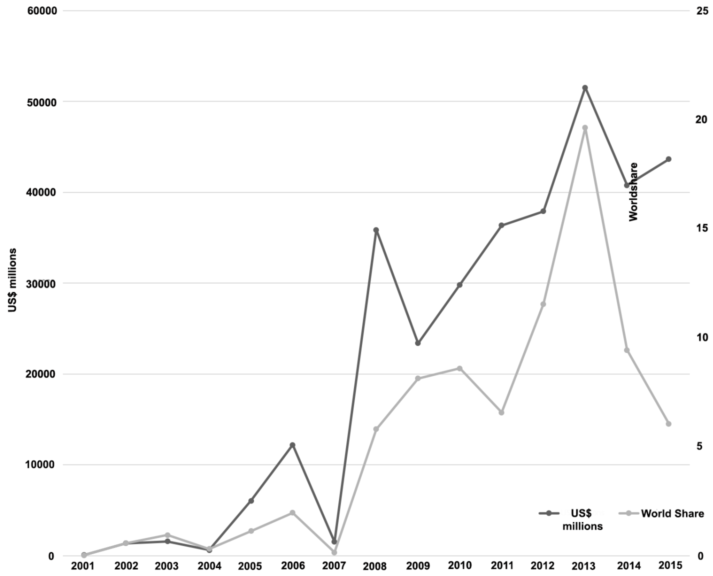
INTRODUCTION

This chapter explores the technological characteristics of medium- and medium–high-tech Chinese multinational enterprises (MNEs) undertaking cross-border acquisitions in the EU, USA and Japan. There are interesting issues to explore, because China recently has become an important global investor: in 2015 it was the third largest in the world after the USA and Japan, and the third main foreign direct investment (FDI) destination after the USA and Hong Kong. China's outstanding investment stock amounts to US$1010 billion, which is around 4 percent of world outward FDI (UNCTAD, 2016). The largest share of Chinese FDI stock is located in developing countries (84 percent including Hong Kong, which receives 58 percent). Advanced country destinations include the EU (6 percent of total Chinese FDI stock) and the USA (3 percent), which registered a strong and continuous increase between 2003 and 2012, of some 77-fold for FDIs in Europe and 47-fold for FDI to the US (UNCTAD, 2016).

Since the second half of the first decade of the 2000s, most of this increase has been in the form of cross-border acquisitions (CBAs), which have risen in both value and world share, peaking in 2013 at more than US$50 billion, corresponding to about 20 percent of all acquisitions worldwide and almost 50 percent of total outflows from China (UNCTAD, 2016) (Figure 6.1). In 2015, China's CBAs represented 34 percent of its total FDI outflows and, according to UNCTAD (2016), a number of cross-border megadeals, such as Haier's acquisition of GE Appliances in the USA, ChemChina's purchases of Pirelli in Italy and Syngenta in Switzerland, and Cosco's deal for Piraeus Port, have reinforced the perception of China as a leading investor in developed economies.



Source: UNCTAD (2016).

Figure 6.1 Chinese cross-border acquisitions (value and %)

In general, CBAs of companies located in advanced countries are considered the fastest and most effective means of accessing firm-specific strategic assets and key capabilities (Chung and Alcacer, 2002). Several empirical studies conducted on large samples of firms find that Chinese MNEs invest in developed countries mainly for knowledge-seeking reasons (see, among others, Amighini et al., 2013) and this is confirmed by case studies of well-known companies such as Haier, the world leading Chinese company specialized in white goods (Duysters et al., 2009).

The strategic assets obtained via acquisitions provide Chinese MNEs with reputation and allow them to acquire and control the resources needed to access local and global markets. In addition, in principle, acquisitions could enable Chinese MNEs to rapidly close their technology gap by facilitating the development of new skills and R&D competences, and providing opportunities for organizational, managerial, marketing and technological learning (Amendolagine et al., 2015).

Acquisitions allow Chinese multinationals not only to access firm-specific assets from the target company but also provide the opportunity to access knowledge and other relevant technological assets embedded in the home region of the acquired firm. The latter often is accomplished through the development of formal and/or informal networks with local actors, such as suppliers, customers, universities and research centres, in the target region (Cantwell and Mudambi, 2011; Li et al., 2012; Piscitello et al., 2015). Thus, regions with strong technological bases and extensive knowledge assets provide Chinese MNEs with opportunities to tap into these knowledge pools and upgrade their technological capabilities and skills (Awate et al., 2015). The absorption of relevant knowledge and technologies is not automatic and depends on the presence of several conditions; the most important, according to the literature, being the absorptive capacity of the acquiring MNE (Cantwell and Mudambi, 2011; Crescenzi et al., 2016). The ability to understand, absorb and apply external knowledge acquired through acquisitions is affected by internal factors such as the MNE’s prior knowledge, R&D spending and human skills, and also by external factors, which include the external knowledge environment in the MNE’s home region. Chapters 7 and 8 also address similar issues of acquisitions and internationalization, through case studies of specific Chinese firms.

In this chapter, we consider Chinese MNEs as nodes, connecting the home and host regions, which are characterized by several ‘knowledge bases’ based on their accumulated technological specialization. We operationalize these as the technological classes in the patents awarded to the actors in the focal regions. We assume that the location of Chinese MNEs at the interface between the home and host regions, gives them access to different pieces of knowledge, which may (or may not) contribute to their learning and technological capabilities building processes. To take account of the (possibly) different technological specializations of the home and host regions, we introduce the notions of technologically distant regions (TDRs) to describe the situation where the home and host regions have knowledge bases specialized in very different technological areas, and technologically proximate regions (TPRs) to describe the situation when the home and host regions’ knowledge and technology bases are similar. We ask what types of innovative activities (in terms of technological specialization, experience of patenting, patent portfolio size and involvement in international collaborations) are undertaken by Chinese MNEs that invest in more (or less) technologically distant regions. The focus is on Chinese MNEs investing in Europe, Japan and the USA.

The chapter is organized as follows. The next section provides information on the data and methodology, and a description of cross-border acquisition host countries and regions and industry specializations. We present the findings of our empirical analysis before the final section which discusses some conclusions.

DATA AND METHODOLOGY

Data on acquisitions by Chinese MNEs come from two sources: Zephyr (Bureau van Dijk - BvD) and SDC Platinum (Thomson Reuter),[1] both of which provide the name and location of the acquirer and target company, deal status (such as, 'completed', 'rumoured', 'pending'), percentage of the ownership transferred from target to investor, and date of the project. Our analysis focuses on all completed majority stake deals during 2003–2011[2] and, following previous studies on the effects of acquisitions on patenting (Ahuja and Katila, 2001; Cloodt et al., 2006; Valentini and Di Guardo, 2012), we focus on medium- and high-tech manufacturing and service industries based on NACE code classifications.[3] The final sample includes 95 acquisitions of European, Japanese and US target firms.

Data on acquisitions are matched and harmonized at the investor and target firm levels; for both target and acquiring firm, we collected information on the ownership structure of the acquiring Chinese MNE, the exact location of domestic and foreign subsidiaries, industry specialization and patenting activity. The data for these additional variables come from the Orbis database, published by Bureau van Dijk.

To classify home and host regions as either TDRs or TPRs, we use a Technology Proximity Index (TPI), calculated using the Patent Convention Treaty (PCT) applications contained in the OECD REGPAT Database (Maraut et al., 2008). The TPI is calculated as the correlation coefficient of two technological vectors, whose elements are the number of a region's patents in each four-digit level technological class (Jaffe, 1986; Bottazzi and Peri, 2003). The index is equal to zero if two regions hold patents in completely different technological classes and is equal to 1 if two regions apply for patents in the same technological classes.[4] We measure the technology proximity between the home and host regions for the 95 deals in our sample and assign them to the corresponding TDR or TPR category depending on whether the value for technological distance is below or above the median value.

The analysis employs a subsample of 37 deals involving a Chinese MNE that had applied for at least one patent before the CBA. For these firms, we consider a number of patent-related variables that are likely to capture some features of the innovative activities undertaken by these firms, measured using the EPO-PASTAT database and defined as follows.[5]

Technological specialization considers that each patent can be assigned to a technological class and, therefore, also to a technological area[6] and to a specific industry sector (NACE Rev. 2).[7] We calculate three indicators:

1. Average scope of patent, measured as the number of IPC classes referred to in the patent documents in the Chinese MNE patent portfolio: the higher

the number of the technological classes, the greater the technological breadth of the patent (Lerner, 1994);
2. Share of patents in the same sector as the acquirer (primary NACE code);
3. Herfindahl–Hirschman Index (HHI) of patent portfolio diversification, calculated as the sum of the squares of the share of the acquirers' patents in different technologies. High values indicate a patent portfolio characterized by concentration in few technological areas; lower values indicate a patent portfolio with no dominant technological focus.

Patent experience, measured as the year in which the Chinese MNE applied for its first patent.
Patent portfolio size, measured as the number of patent applications filed by the Chinese MNE before the acquisition. We distinguish between the number of applications filed at the State Intellectual Property Office (SIPO) of the People's Republic of China and the number of patents filed at the United States Patent and Trademark Office (USPTO).
Non-collaborative patents, defined as the number of patents applied for by the Chinese MNE involving only Chinese inventors (domestic patents) and the number involving only foreign inventors (foreign patents).
Collaborative patents, measured as the number of patents applied for by the Chinese MNE involving foreign inventors from developed countries (i.e. European and Chinese inventors, US and Chinese inventors).

CHINESE ACQUISITIONS IN EUROPE, JAPAN AND THE USA

In the period 2003–2011, Chinese CBAs in medium- to high-tech industries increased substantially following the general trend depicted in Figure 6.1. Since 2007, despite a downturn in 2010, this rise has been quite significant. Figure 6.2 shows the increasing role of European countries in Chinese acquisitions, and the continuing stable role of Japan. Table 6.1 provides information on the geographical distribution of Chinese acquisitions in the EU, Japan and the USA. Between 2003 and 2011, the countries most targeted for acquisitions were the USA (32 percent of the total number of acquisitions), followed by Germany (21 percent), the UK and Japan (9 percent each) and the Netherlands (8 percent). Other attractive target countries were France and Italy.

in EU, Japan and USA (2003–2011)

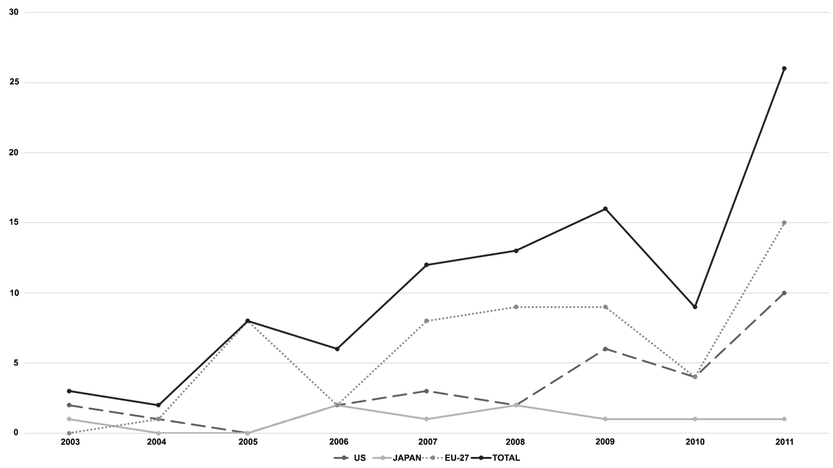
Table 6.1 shows also that almost 70 percent of Chinese acquisitions were in the manufacturing sector, and among them 25 percent is in electronics and electric products, followed by the automotive and machinery and equipment industries. In the service industry, 32 percent of the acquisitions were in the computer

Table 6.1 Chinese acquisitions: geographical distributions and main sectors of specialization (#, % and main destination regions)

	Chemicals & pharma	Electronic & electric products	Machinery & equipment	Motor vehicles & other transport equipment	Other manufacturing industries	Computer programming & consultancy	Other service industries	Total
Austria				1 (7.14)				1 (1.05)
Belgium	2 (18.18)							2 (2.11)
Denmark		1 (4.17)			1 (20.0)			2 (2.11)
France	1 (9.09) Ile de France		1 (8.33)	2 (14.29) Alpes Cote d'Azur		1 (14.29)	1 (4.55)	6 (6.32)
Germany		4 (16.67) Baden Wurttemberg	8 (66.67) Baden Wurttemberg & Bavaria	4 (28.57) Bavaria	1 (20.0)		3 (13.64)	20 (21.05)
Italy		2 (8.33) Lombardy	2 (16.67) Lombardy		1 (20.0) Lombardy			5 (5.26)
Japan	1 (9.09) Southern Kanto	3 (12.5) Southern Kanto			1 (20.0)	2 (28.57) Southern Kanto	2 (9.09)	9 (9.47)
Netherlands	2 (18.0)	2 (8.33)	1 (8.33)	1 (7.14)			2 (9.09)	8 (8.42)

	Chemicals & pharma	Electronic & electric products	Machinery & equipment	Motor vehicles & other transport equipment	Other manufacturing industries	Computer programming & consultancy	Other service industries	Total
Portugal	1 (9.09)							1 (1.05)
Sweden				1 (7.14)			1 (4.55)	2 (2.11)
United Kingdom	3 (27.27) Yorkshire			3 (21.43) Greater London		1 (14.29)	2 (9.09)	9 (9.47)
USA	1 (9.09)	12 (50.0) California & Hawaii		2 (14.29) Michigan	1 (20.0)	3 (42.86) Washington	11 (50.0) California	30 (31.58)
Total	11 (100)	24 (100)	12 (100)	14 (100)	5 (100)	7 (100)	22 (100)	95 (100)

Source: Bvd Zephyr and SDC Platinum.



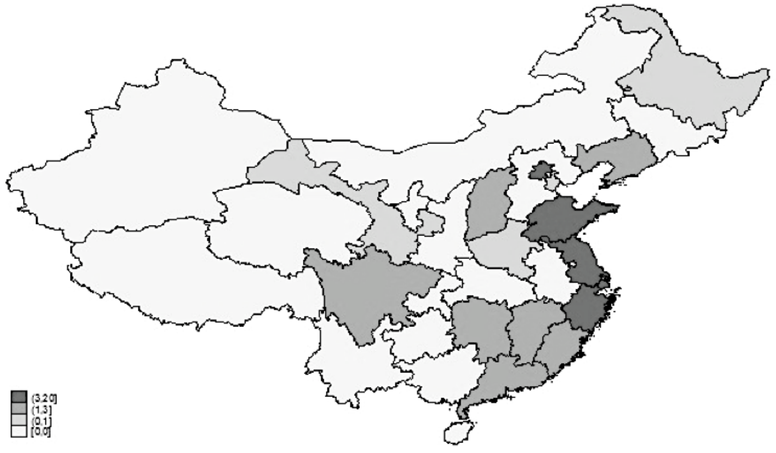
Source: Bvd Zephyr and SDC Platinum.

Figure 6.2 Number of Chinese high-tech cross-border acquisitions

and programming sector with the remaining 68 percent in a variety of sectors including publishing activities, information services and telecommunications.

It is interesting that most electronics industry acquisitions are concentrated in the USA, particularly California and Hawaii. Acquisitions in Germany are mainly in automotive with investments going to Bavaria, a key specialized cluster, and machinery to Bavaria and Baden Wurttemberg, both highly specialized in machinery. In the automotive sector, Chinese companies have acquired firms in the UK, France and the USA, in regions with strong specialization in automotive such as Michigan and the southern Alpine region of France. Finally, in computer programming and consultancy acquisitions have been undertaken in the USA in Washington State and in Japan in the Tokyo region.

Figure 6.3 presents the geographical origin of Chinese acquiring MNEs, showing that more than 60 percent of them were distributed across four main provinces: Beijing (accounting for 23 percent of Chinese MNEs undertaking cross-border acquisitions), Hong Kong (14 percent),[8] Shanghai (13 percent) and Zhejiang (South of Shanghai) (11 percent). Other important provinces include Jiangsu (North of Shanghai), the neighbouring provinces of Beijing: Shanxi and Shandong, Sichuan and Guangdong on the border with Hong Kong.



Source: Bvd Zephyr and SDC Platinum.

Figure 6.3 *Geographical origin of Chinese high-tech cross-border acquisitions (2003–2011)*

TECHNOLOGICAL DISTANCE BETWEEN HOME AND HOST COUNTRY REGIONS

In this section, we explore the differences between Chinese MNEs that connect TDRs (defined as regions with a TPI below the median) and those that connect TPRs (TPI above the median). We focus on the subset of 37 deals where the acquirers were involved in patenting activity before making acquisitions in the EU, Japan or USA, and we investigate the heterogeneity in the knowledge bases of the groups identified above. Table 6.2 presents the main results of our analysis, which are discussed below.

First, we examine acquirers' technological specialization (Table 6.2, Column 1). We expect specialized and diversified firms to have different preferences about the degree of technological similarity of the regions in which they choose to invest. For Patent Scope (Table 6.2, Column 1a), we find that the inventions developed by acquirers who choose to invest in TDRs, span more technologies compared to the group, which chooses to invest in TPRs. However, the difference is not statistically significant.

Table 6.2, Column 1b reports the Share of Patents in the Same Industry as the acquirer firm. Acquirers investing in TDRs are less interested in the technology related to their main specialization than the other group. This indicates that MNEs undertaking acquisitions in TDRs have technological competences that go beyond their own industry (not statistically significant difference).

Finally, the HHI (Table 6.2, Column 1c) indicates that MNEs investing in TDRs are those that, prior to the acquisition, exhibited a stronger pattern of diversification in their innovation activities (the difference between TDRs and TPRs is statistically significant). The higher HHI for companies investing in TPRs implies that their patent portfolios are concentrated in fewer technological competences than the patent portfolios of the other group. Overall, we find that Chinese investors with more technologically diversified patent portfolios target TDRs. There are two possible explanations for this stylized fact. On the one hand, investors with some experience in investing in unfamiliar sectors are more likely to search for acquisitions in regions that will extend their technological horizon and bring new knowledge competences. On the other hand, the location of target companies in technologically advanced host regions, might provide a stronger motivation for the acquisition and more opportunities to access new technologies and diverse knowledge (Cantwell and Iammarino, 2001; Meyer et al., 2011; Beugelsdijk and Mudambi, 2013; Dau, 2013; Iammarino and McCann, 2013).

Table 6.2, Column 2 presents the results for Patent Experience and, although the differences between Chinese MNEs undertaking acquisitions in TDR and TPRs are not statistically significant, we observe that firms investing in TDRs have longer experience of patenting activity. This suggests that more experienced MNEs seek for investments in regional contexts that differ technologically from their home region. In this case, the acquisition can be considered to be more challenging since it exposes the acquirer company to new technological knowledge.

Table 6.2, Column 3 shows that Chinese MNEs connecting TDRs have a larger Patent Portfolio Size, measured by both SIPO and USPTO patents (both statistically significant). In addition, the difference in magnitude between SIPO and USPTO patents is notable, which can be attributed to both the effect of recent Chinese policies to encourage domestic patenting (Hu and Jefferson, 2009) and the quality of Chinese inventions, which would be unlikely to stand up to examination at a foreign patent office (Eberhardt et al., 2011). Anderson et al. (2015) confirm the strong increase in domestic patenting activity and show that, often, Chinese acquisitions are aimed at reverse transfer of technologies that can be put into production quickly in the domestic market. Given the more stringent examination procedures in the USPTO compared to the SIPO, the difference between patent portfolio size measured using USPTO patents can be interpreted also as a qualitative difference. The (on average) larger USPTO patent portfolio of acquirers investing in TDRs indicates higher level technological competences compared to the other group.

Table 6.2 *Patent portfolio characteristics by regional technological similarity of the deal*

	1) Technological Specialization			2) Patent Experience	3) Patent Portfolio Size		4) Non-Collaborative Patents		5) Collaborative Patents		
	(a) Patent Scope	(b) % Patents in the same sectors	(c) HHI		(a) # SIPO	(b) # USPTO	(a) Domestic	(b) Foreign	(a) Total	(b) China–EU	(c) China–USA
	1.48	0.003	0.10	2005.10	43.79	0.21	23.95	2.26	0.10	0.00	0.10
TPRs	2.14	0.001	0.04	2003.54	187.38	2.77	76.38	6.77	0.23	0.08	
TDRs											0.15
Diff	2.23	0.35	3.69*	1.01	3.44*	3.02*	4.54**	4.06*		1.48	0.07
Group1–									0.45		
Group2											

Our finding that Chinese MNEs investing in TDRs have larger patent portfolios suggests that firms with stronger knowledge bases are more likely to risk investment in more technologically distant regions. This result is consistent qualitatively with the literature that finds an inverse-U shaped relation between innovation success and technological distance (Ahuja and Katila, 2001). It emphasizes that very innovative and experienced firms understand that investing in regions that are technologically distant can be difficult from the point of view of knowledge integration.

In the last two columns of Table 6.2, we examine the extent of external collaboration between the two groups of acquirers MNEs. Table 6.2, Columns 4 and 5 respectively, report the average number of non-collaborative and collaborative patents. Note that Non-Collaborative Patents, which involve only domestic or only foreign inventors, are far more frequent than Collaborative Patents involving Chinese and foreign inventors from the EU, Japan or the USA – a result that is in line with Branstetter et al. (2013) and Giuliani et al. (2016). International collaborations involving co-inventions (or cross-border inventions) constitute valuable channels for the transfer of knowledge from developed to emerging countries (Montobbio and Sterzi, 2011) because they frequently are characterized by intensive knowledge sharing over extended periods of time, and by face-to-face interactions among inventors with different levels of technological competence, both features that facilitate international knowledge spillovers. The limited engagement of Chinese MNEs in international collaborations and co-patenting suggests that they may, nevertheless, not be able to take advantage of this channel to improve their innovative capacity, accumulate technological capabilities and catch-up with the more advanced countries (Agrawal et al., 2006; Alnuaimi et al., 2012).

However, it seems that Chinese MNEs connecting TDRs have a significantly higher number of patents involving foreign investors, meaning that these companies employ foreign inventors. A limitation of patent data is that they do not reveal the mechanisms through which such foreign patents emerge (such as labour mobility, foreign subsidiary, foreign consultants); however, this result is in line with the more intense patenting activity of Chinese MNEs investing in TDRs, discussed earlier.

CONCLUSIONS

In this chapter, we explored the differences between Chinese MNEs that connect technologically distant regions (TDRs) and those connecting regions with more similar technological bases (TPRs). We used firm-level data on high- and medium-tech acquisitions undertaken by MNEs in Europe, Japan and the USA. Our descriptive analysis suggests that Chinese MNEs with a strong knowledge base, measured as more diversified and larger patent portfolios, invest more in TDRs and exploit their cross-border acquisitions to extend their knowledge and capabilities to new sectors in order to expand their technological horizons. We found also that, although this type of MNE is more involved with foreign inventors (for instance, through consultancies, external experts, foreign workforce), they are not more likely than other Chinese MNEs to establish international patenting collaborations. The number of collaborative patents among the companies considered in our analysis is limited, which might suggest that, while Chinese MNEs are rapidly expanding their operations and production activities abroad, they are internationalizing their innovative activities to a lesser extent. Much of their innovation and patenting activity seems to be confined to the home country territories and, likely, is aimed mainly at reverse knowledge transfer of international technologies to the domestic market.

Our research suggests that Chinese policy-makers should develop and strengthen policies oriented towards technological capability building in the domestic market (Lema et al., 2015). This can be achieved in various ways such as increasing the country's attraction for MNEs from advanced countries; learning from advanced country MNEs can be a viable first step for laggard multinational from emerging countries to enhance their technological capabilities (Li et al., 2012). Policy makers should aim also at increasing investment in higher education and creating incentives for return migration of engineers, scientists and managers (World Bank, 2010). In general, measures aimed at strengthening the national system of innovation should be continued (Lundvall et al., 2009), but with more attention paid to the development of local innovation systems. Crescenzi et al. (2012) show that innovation activity in China is spatially concentrated and innovative regions generate few knowledge spillovers to other regions. In the next few years, China must promote dispersal of production and urbanization, and, also, innovation.

The analysis in this chapter has some limitations, which suggest that our results should be interpreted with caution. First, we are not able to investigate whether the technological distance between the home and host regions is an antecedent to or a cause of some of the characteristics of Chinese MNEs observed here. Also, despite the temporal lag, we cannot account for reverse causality. However, we believe that the observed differences are reasonable considering the setting of our analysis and the conventional wisdom that, to be able to identify and absorb diverse international knowledge, requires the prior accumulation of specific knowledge. Second, we do not look at the outcomes of the investigated international connections: do Chinese MNEs connecting TDRs show more successful performance or higher levels of innovation after a CBA compared to those connecting TPRs? Do the former MNEs learn faster than the latter? Third, a natural extension to this study would be to include in the empirical analysis other characteristics, such as financial indicators, of the

Chinese MNEs and target firms. Fourth, our focus on patents is a major limitation since they may not be suited to measuring innovation in the context of an emerging country such as China. We are unable to observe learning processes and innovative outcomes that do not result in patent applications. All these issues represent areas for future research.

NOTES

1. The overlap between the two databases is partial: 28 percent of the acquisitions appear only in Zephyr, and 31 percent appear only in SDC Platinum.
2. The start year is 2003 because, according to UNCTAD (2015), most outward foreign investments from emerging to advanced countries occurred after that date.
3. The 2-digit NACE codes are 20, 21, 26, 27, 28, 29 and 30 (for manufacturing) and 59, 60, 61, 62, 63,64, 65, 66, 69, 70, 71, 72, 73, 74, 78 and 80 (for services). The SDC classification applies to deals taken from the SDC-Platinum database.
4. This measure is also referred to as 'cosine distance' since it can be interpreted as the cosine of the angle between the two technological vectors. When the vectors are orthogonal (i.e., the two regions innovate in completely different technological areas), the cosine is equal to 0.
5. For a more detailed description of the indicators see Squicciarini et al. (2013).
6. The technological classification is the same as used to calculate the TPI.
7. The EPO-PATSTAT Database (2016) provides a table linking the patent applications to NACE Classification, based on the concordance table developed by Van Looy et al. (2015).
8. We include in our database those acquisitions originating in Hong Kong, undertaken by companies from Mainland China.

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