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Managerial foreign experience and corporate innovation

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ABSTRACT

This study examines the impact of managerial foreign experience on corporate innovation using manually collected data of Chinese listed companies. We find that managerial foreign experience is positively associated with corporate innovation. This association is robust to a series of robustness checks, including the use of Heckman two-step sample selection model, propensity score matching procedure, and the market reaction to the appointing announcements of managers with foreign experience. Further analyses indicate that senior managers with foreign experience have a more significant impact on corporate innovation than junior managers with foreign experience; both foreign study experience and foreign work experience have important impacts on corporate innovation; managers with foreign experience in private enterprises have more initiatives to innovate than in state-owned enterprises; and managers who gain foreign experience in the United States tend to be more influential and innovative than those who have foreign experience from other countries or regions. Overall, our results suggest that managerial foreign experience matters for corporate innovation in emerging markets.

1. Introduction

It is widely acknowledged that innovation has become an important corporate strategy for a company to achieve and sustain competitive advantage (e.g., Nelson and Winter, 1985; Baer, 2012). Due to the importance of innovation for a firm's competitiveness, a number of studies have explored firm characteristics that stimulate this corporate behavior (e.g., Bhattacharya and Ritter, 1980; Waegenaere et al., 2012; Aghion et al., 2013; Chava et al., 2013; He and Tian, 2013; Bernstein, 2015; Cornaggia et al., 2015). Recently, financial economists have focused on the impact of certain managerial characteristics on corporate innovation. These characteristics include managerial ability (Chen et al., 2015), managerial incentives (Lin et al., 2011), CEO overconfidence (Hirshleifer et al., 2012), CEO turnover (Bereskin and Hsu, 2014), and CEO's general skills (Custódio et al., 2017). However, no existing studies have systematically examined whether managerial foreign experience can promote corporate innovation.

We fill this void by examining the impact of managerial foreign experience on corporate innovation in an emerging market, China. In China, managerial foreign experience is an important and rare characteristic for corporate managers. Although China has undergone rapid economic development since the 1970s, it is still an emerging economy with weak legal institutions, weak investor protection, and less developed labor markets. Chinese students study and/or work abroad, hoping to obtain advanced knowledge, superior management practices, and highly specialized skills. The vast majority of them choose

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developed countries or regions to go and the number of the students studied in the United States (U.S.), the United Kingdom (U.K.), and Australia together have accounted for more than 75% of the total students abroad. The top ten countries where Chinese students studied abroad have all been developed nations or regions.[1]

As the largest emerging economy in the world, China's rapidly expanding corporate sector and securities market are becoming increasingly integrated with the global economy, as seen in China's accession to the World Trade Organization (WTO), and an increasing number of Chinese firms seeking listing status overseas. However, China is still lagging behind in innovation (Lin et al., 2011). Since the early 1990s, provincial governments have adopted policies to attract talents with foreign experience, hoping to foster entrepreneurial activity and promote the entry of new business (Zweig, 2006; Giannetti et al., 2015). Especially, in December 2008, Chinese central government issued a policy called the "High-level Overseas Talent Introduction Plan" (well-known as "The Thousand Talents Plan").[2] This plan aims to promote the development of strategic emerging industries, accelerating the transformation of economic development patterns, and enhancing independent innovation productivity. Till 2013, approximately 4180 top talents (including high-tech entrepreneurs and scientists) were successfully brought back from abroad and employed in different fields after the plan was carried out after five years.[3]

Compared with the huge population in China, managers with foreign experience are scarce. Moreover, most of these talents gained their knowledge, technical skills, and expertise in developed countries or regions (e.g., the U.S. and U.K.). They are believed to have creative abilities, advanced experience, and highly specialized skills, compared to those without foreign experience. For this reason, Chinese government provides them with many benefits, including local awards, schooling for their children, jobs for spouses, and housing allowances (or even free housing). In this regard, this topic is of particular interest to Chinese policy makers and policy makers in emerging markets outside China.

Using manually collected data of managers' foreign experience over the period of 2001–2013, we find that managerial foreign experience is positively associated with corporate innovation in China. This association is robust to a series of robustness checks, including firm fixed effects model, Heckman two-step sample selection model, propensity score matching (PSM) procedure, and the market reaction to the appointing announcements of managers with foreign experience. Further analyses indicate that senior managers with foreign experience have a more significant impact on corporate innovation than junior managers with foreign experience; both foreign work experience and foreign study experience have important impacts on corporate innovation; managers with foreign experience in private enterprises have more initiatives to implement innovation activities than in state-owned enterprises (SOEs); and managers who gain foreign experience from the U.S. tend to be more influential in innovation activities than those who gain foreign experience in non-U.S. countries or regions. In summary, our evidence is consistent with the notion that managerial foreign experience matters for corporate innovation in emerging markets.

This study contributes to the extant literature in two ways. First, our study enriches the small but growing literature on the economic effects of individual foreign experience. Although individual foreign experience is important, little empirical evidence is available about the relationship between foreign experience and corporate behavior. Using the data of 1999–2009, Giannetti et al. (2015) explores the impact of directors with foreign experience on firm performance in China. Motivated by Giannetti et al. (2015), we attempt to explain the channels by which foreign experience translates into superior performance. Specifically, we examine the change of corporate innovation in input (Research & Development investment, R&D) and output (the number of patents), following the arrival of managers with foreign experience. We find that foreign experience not only contributes to R&D investment (input), but also to the increase of patents (output). Our evidence, together with these prior studies, point to corporate decisions influenced by managerial foreign experience.

Second, our study explores a mechanism (innovation) by which corporate expertise can move across countries and thus contributes to the broader literature of how countries with weaker legal institutions and lower levels of capital market development impact the effect of corporate expertise on firm performance. Using hand-collected data of Chinese listed companies, we find that foreign experience promotes corporate innovation of Chinese listed firms. Moreover, foreign experience gained in the U.S. has a more pronounced impact on innovation than that gained in non-U.S. countries or regions. Consistent with Miletkov et al. (2017), our study provides additional evidence that foreign experience matters more in countries with less developed labor markets or weaker legal institutions.

The remainder of this study is organized as follows: Section 2 develops our hypotheses. Section 3 describes the research design. Section 4 provides the empirical results. Section 5 presents the robustness checks. Section 6 conducts further analyses and Section 7 concludes the paper.

2. Hypotheses development

We develop our hypotheses from three perspectives: the upper echelon perspective, failure-tolerant perspective, and eyeball effect perspective.

[1] The special report on the tendency of Chinese students' studying abroad in 2016, available at http://mt.sohu.com/learning/d20170204/125473892_558682.shtml. (in Chinese).

[2] On December 23, 2008, the Chinese central government launched an influential policy, namely "The Thousand Talents Plan". This plan targets people under age 55 with overseas working or studying experience who are willing to work in China on a full-time basis. The returnee talents would be awarded the title of "National Distinguished Expert", be invited to occupy key positions in corporations, and be provided with preferential policies and treatments. Please refer to http://www.1000plan.org/en/ for detailed information.

[3] http://news.sina.com.cn/o/2014-02-19/204229511742.shtml (in Chinese).

2.1. The upper echelon perspective

The upper echelon theory (Hambrick and Mason, 1984) states that organizational outcomes, strategic choices and performance levels are partially predicted by managerial background characteristics, such as career experience, education, socioeconomic roots, financial position, and group characteristics. In addition, Hambrick and Mason (1984) document that managers who have received substantial formal management education are more able to handle more complex management challenges (e.g., innovation), compared to managers with less formal training.

Managers with foreign experience usually study or work in developed economies. Our data indicate that the top five countries or regions where managers study or work include the U.S., Hong Kong, the U.K., Japan, and Canada. These managers should have highly specialized skills, advanced management experience, and creative abilities, hence can transfer their knowledge and technological skills to high productivity. Meanwhile, after years of studying or working abroad, these individuals should have broader views, are readily open to new ideas, and have the ability to become acclimatized to changes and risks. These characteristics should have essential impacts on their strategic choices.

Once managers with foreign experience are placed in the right positions in Chinese firms, they have the platform to employ their skills and talents. To signal their abilities, they are better able to identify opportunities and make decisions to invest significant resources in innovation activities, hoping to reap high benefits in the future (Lumpkin and Dess, 1996).

However, it is not always true that visiting monks chant scripture better. After years of life abroad, managers with foreign experience might become unfamiliar with Chinese corporate culture and the way in which Chinese companies operate and manage, due to China's tremendous economic growth in recent years. Therefore, their management's philosophy and operating style may not be easily understood and accepted by the managers and employees without foreign experience. A successful implementation of corporate innovation requires managerial coordination throughout all levels of the organization (Kuratko et al., 2005), and every level of management be coordinated to carry out specific roles (Kuratko et al., 2014). Hence, without a good understanding of the operating mode adopted by Chinese companies and supports from managers at different levels, it may be difficult for managers with foreign experience to implement corporate innovation as a strategy.

2.2. The failure-tolerant perspective

Unlike routine tasks, such as mass production and marketing, innovation involves a long multi-stage process that is full of uncertainty (Holmstrom, 1989). Most successful innovation opportunities result from a conscious and purposeful search and unexpected failure may be an important step towards a company's later success. Due to the future contingencies and intrinsically risky processes, exceptional tolerance for failure is necessary for effective innovation. Hence, risk-taking behavior of managers is essential for inventive activities (Francis and Smith, 1995). Indeed, Manso (2011) shows that the optimal innovation-motivating compensation schemes for managers should exhibit tolerance for early failures and reward for long-term success.

Managers with foreign experience may have experienced difficulties when they work or study in foreign countries and can accept the fact that achieving goals may require long-term effort. During their years in foreign countries, these talents have to resolve difficulties and tolerate failures alone, since they rarely have friends or relatives around them. Therefore, managers with foreign experience can better understand and become more tolerant of possible unsatisfactory results in innovation, thus enabling their organizations to maintain clear goals for the systematic practice of innovation. Consequently, they may create a failure-tolerant and participative environment for innovation, encouraging employees to express ideas and share insights by reducing the perceived risks and penalties associated with failures.

While one might become stronger after experiencing failures, it is also possible that one might be afraid of failure. When managers with foreign experience are appointed in high positions, risk becomes an essential consideration when they make decisions. As they learn clearly what failures will bring about and that the innovation process has significant possibilities of failures (Wu, 2008), they may become prudent and risk-averse when making strategic decisions of innovation.

2.3. The eyeball effect perspective

In an emerging market like China, highly skilled talents with foreign experience are scarce resources at the nation and firm level. Following national talent policies, Chinese enterprises are increasingly inviting managers with foreign experience to occupy important positions. However, the number of these talents is very limited. Therefore, they may become super stars in the corporate sector and even the capital market. They will receive the attention and monitoring from employers, employees, the government, financial analysts, institutional investors, and even the public (namely, the eyeball effect). These talents are more likely to concentrate on innovation activities, such as scientific, technological, organizational, financial and commercial endeavors, hoping to lead to implementation of innovation (Viederyte, 2016).

These managers usually have contracts with employers and their performance is assessed annually. As these talents are viewed as super stars, their assessment will attract more attention. As a result, the eyeball effect may push managers with foreign experience to focus on short-term performance, instead of investing more time, effort, resources, and attention to innovation activities.

We argue that managerial foreign experience may affect innovation via two channels. One, it may increases a firm's willingness to invest in R&D, which is the input for innovation. This is because managers with foreign experience might appreciate the importance of R&D to firm growth more than managers without foreign experience. Two, given the same amount of R&D,

managers with foreign experience might be better in choosing R&D projects and administer the whole innovation process, which increases the chance of innovation success and ultimately leads to more innovation output.

In summary, the above discussion leads us to hypothesize that:

H1a. *Ceteris paribus*, managerial foreign experience has a positive impact on corporate innovation.

H1b. *Ceteris paribus*, managerial foreign experience does not have an impact on corporate innovation.

3. Research design

3.1. Data sources

Our sample initially was comprised of listed firms on the Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) during the period 2001–2013. We choose 2001 as the beginning year of the sample period because firms disclose managerial background information normally from 2001. We exclude financial firms (e.g., banks, insurance companies and investment trusts) as they have different structures from other companies. We then exclude observations with missing variables. Applying the above criteria yielded a final sample of 18,236 observations.

Following Giannetti et al. (2015), we define that a manager has foreign experience if he or she has worked or studied outside the mainland China. The managerial foreign experience data is manually collected from annual reports downloaded from the official websites of the SHSE (www.sse.com.cn) and SZSE (www.szse.cn). We double-check the data with Baidu (http://baike.baidu.com), Sina (http://finance.sina.com.cn), and the official websites of individual listed companies. In this way, we obtain information on the academic degrees managers achieved, working experience, and the names of countries where they studied or worked. We delete the individuals who worked for a foreign branch of a Chinese company or were employed by a Chinese branch of a foreign company, ensuring that foreign experience captures actual exposure to a foreign environment.

The data of institutional investors are obtained from the WIND system, other financial and corporate governance data used in this study are obtained from the China Stock Market & Accounting Research (CSMAR) system. All the data are cross-checked for consistency.

3.2. Models

Following prior studies (e.g., He and Tian, 2013; Chemmanur et al., 2014; Fang et al., 2014), we employ the OLS model to examine our hypotheses. To mitigate the potential endogeneity, we regress the contemporaneous innovation measures on the one-period lag values of managers with foreign experience and other explanatory variables. The basic empirical model employed is:

$$\begin{aligned}\text{Patent\_invention(Patents\_total)}_{i,t} = {} & \alpha_0 + \alpha_1 \text{Managers with foreign experience}_{i,t-1} + \alpha_2 \text{Institutional ownership}_{i,t-1} \\ & + \alpha_3 \text{Managerial ownership}_{i,t-1} + \alpha_4 \text{Firm age}_{i,t-1} + \alpha_5 \text{Firm size}_{i,t-1} + \alpha_6 \text{ROA}_{i,t-1} \\ & + \alpha_7 \text{Leverage}_{i,t-1} + \alpha_8 \text{Cash ratio}_{i,t-1} + \alpha_9 \text{Asset turnover}_{i,t-1} + \alpha_{10} \text{Sales growth}_{i,t-1} \\ & + \text{Industry} + \text{Year} + \varepsilon \end{aligned} \quad (1)$$

where α_i represents regression coefficients, ε is an error term. The dependent variable *Patent_invention* (*Patents_total*) is our proxy for corporate innovation, while *Managers with foreign experience* is the test variable, which measures managers with foreign experience in firms. Control variables include *Institutional ownership*, *Managerial ownership*, *Firm age*, *Firm size*, *ROA*, *Leverage*, *Cash ratio*, *Asset turnover*, *Sales growth*, *Industry*, and *Year*. All the main variables are defined in Appendix A.

3.3. Variables

3.3.1. Dependent variable: innovation

Following prior studies (e.g., Chen et al., 2015), we employ two measures of innovation, which are both patent-based metrics. The first measure, *Patent_invention*, is the natural logarithm of one plus firm *i*'s invention patents. The second, *Patents_total*, is the natural logarithm of one plus firm *i*'s all patents, including invention patents, design patents, and utility model patents.[4]

As a further analysis, we also examine the impact of foreign experience on the change of R&D investment. *R&D* is the natural logarithm of R&D expenditure plus one. Moreover, we examine the impact of managerial foreign experience on the number of patents after controlling for *R&D* in model (1) as a further analysis, because the amount of R&D investment (input) is likely to be related to the number of patents (output) and it is possible that managers with foreign experience may be more attracted to firms with higher levels of R&D investment.

[4] The number of patent citations may be a very good proxy to measure the quality of corporate innovation. However, patents citation data are not publicly available in China. We acknowledge this limitation in our study.

Table 1
Sample distribution.
This table presents sample distribution during the sample period 2001–2013.

Year	Total	*Dummy_foreign experience* = 0	*Dummy_foreign experience* = 1	Percentage (%)
2001	930	854	76	8.17
2002	1016	927	89	8.76
2003	1076	966	110	10.22
2004	1142	1013	129	11.30
2005	1208	1059	149	12.33
2006	1194	1051	143	11.98
2007	1140	1004	136	11.93
2008	1228	1077	151	12.30
2009	1308	1154	154	11.77
2010	1476	1293	183	12.40
2011	1895	1660	235	12.40
2012	2285	1956	329	14.40
2013	2338	1979	359	15.36
Total	18,236	15,993	2243	12.30

3.3.2. Test variable: Managers with foreign experience

We use two variables to measure managers with foreign experience. The first one is *Dummy_foreign experience*, a dummy variable which equals 1 if a firm has at least one manager with foreign experience in year *t*, 0 otherwise. The second is *Number_foreign experience*, which is the number of managers with foreign experience in a firm in year *t*.

3.3.3. Control variables

Following prior studies (e.g., He and Tian, 2013), we control for a vector of firm characteristics that have been shown to affect innovation activities. The control variables include *Institutional ownership* (the ratio of the shares held by institutional investors divided by the total shares), *Managerial ownership* (the ratio of the number of shares held by managers to the total number of shares in issue), *Firm age* (the difference between year *t* minus the year when a firm was established), *Firm size* (the natural logarithm of the book value of total assets), *ROA* (net income divided by total assets), *Leverage* (the book value of total debts divided by the book value of total asset), *Cash ratio* (the book value of monetary funds divided by the book value of total assets), *Asset turnover* (total revenues divided by the book value of total assets), and *Sales growth* (the increased percentage of sales revenue). Moreover, we add industry and year dummies to control for the industrial fixed effect and dynamic changes in the macroeconomic environment common to all firms over the sample period, respectively. Appendix A provides definitions of all variables used in our analysis and all continuous variables are winsorized at 1% at both tails to mitigate the undue influence of extreme values.

Table 2
Descriptive statistics.
This table reports descriptive statistics of the main variables defined in Appendix A. during the sample period 2001–2013. All continuous variables are winsorized at 1% at both tails.

Variables	N	Mean	Std	Median	Min	Max
Panel A: Variable of innovation						
Patent_invention	18,236	0.604	1.049	0.000	0.000	4.331
Patents_total	18,236	0.952	1.412	0.000	0.000	5.283
Panel B: Variable of managerial foreign experience						
Dummy_foreign experience	18,236	0.123	0.328	0.000	0.000	1.000
Number_foreign experience	18,236	0.167	0.533	0.000	0.000	8.000
Senior_foreign experience	18,236	0.102	0.303	0.000	0.000	1.000
Junior_foreign experience	18,236	0.031	0.172	0.000	0.000	1.000
Work_foreign experience	18,236	0.054	0.225	0.000	0.000	1.000
Study_foreign experience	18,236	0.105	0.306	0.000	0.000	1.000
Dummy_U.S. experience	18,236	0.034	0.182	0.000	0.000	1.000
Number_U.S. experience	18,236	0.064	0.289	0.000	0.000	5.000
Panel C: Control variables						
Institutional ownership	18,236	0.183	0.217	0.081	0.000	0.780
Managerial ownership	18,236	0.027	0.091	0.000	0.000	0.549
Firm age	18,236	11.848	5.033	12.000	1.000	33.000
Firm size	18,236	21.445	1.142	21.328	18.724	25.011
ROA	18,236	0.032	0.076	0.034	−0.389	0.245
Leverage	18,236	0.205	0.164	0.190	0.000	0.733
Cash ratio	18,236	0.198	0.180	0.146	0.001	1.021
Asset turnover	18,236	0.710	0.574	0.560	0.033	3.443
Sales growth	18,236	0.224	0.588	0.134	−0.767	4.216
R&D	10,527	3.159	6.690	0.000	0.000	19.749

Table 3
Correlation analysis.
This table reports the correlation coefficients on the main variables defined in Appendix A. The bottom triangle of this table presents the Pearson correlation coefficients and the right top triangle reports the Spearman correlation coefficients. *, **, and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively.

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Patent_invention	(1)	1	0.076***	0.242***	0.219***	−0.058***	0.154***	0.174***	−0.142***	0.157***	0.198***	0.056***
Dummy_foreign experience	(2)	0.097***	1	0.042***	0.004	−0.022***	0.054***	0.049***	−0.031**	0.054***	0.024***	0.006
Institutional ownership	(3)	0.215***	0.032***	1	0.003	0.385***	0.371***	0.240***	−0.114***	0.029***	0.208***	0.038***
Managerial ownership	(4)	0.176***	0.029***	−0.101***	1	−0.064***	0.002	0.172***	−0.141***	0.168***	0.043***	0.055***
Firm age	(5)	−0.041***	0.022***	0.334***	−0.118***	1	0.137***	−0.038***	0.121***	−0.197***	0.055***	−0.116***
Firm size	(6)	0.224***	0.065***	0.345***	−0.113***	0.109***	1	0.115***	0.213***	−0.002***	0.133***	0.119***
ROA	(7)	0.148***	0.032***	0.180***	0.105***	−0.008	0.166***	1	−0.394***	0.305***	0.211***	0.306***
Leverage	(8)	−0.139***	−0.030***	−0.066***	−0.189***	0.033***	0.169***	−0.360***	1	−0.320***	−0.096***	−0.015**
Cash ratio	(9)	0.110***	0.054***	0.016**	0.220***	−0.141***	−0.029**	0.250***	−0.323***	1	0.056***	0.191***
Asset turnover	(10)	0.109***	0.009	0.189***	−0.049***	0.098***	0.120***	0.168***	−0.113***	0.031***	1	0.172***
Sales growth	(11)	−0.021**	−0.003	0.029***	−0.001***	−0.014*	0.048***	0.194***	−0.028***	0.187***	0.082***	1

Table 4
Univariate analysis.
This table reports the results of univariate analysis on the mean difference of the two innovation measures *Patent_invention* and *Patents_total* between firms having managers with foreign experience and firms having no managers with foreign experience. The *t*-values for mean differences are based on *t*-tests. **denotes significance at the 5% level (two-tailed).

	Dummy_foreign experience = 1		*Dummy_foreign experience* = 0		Differences
	Obs	Mean	Obs	Mean	*T* value
Patent_invention	4995	0.664	13,241	0.537	0.127**
Patents_total	4995	1.024	13,241	0.865	0.159**

4. Empirical analyses

4.1. Descriptive statistics

Table 1 presents sample distribution. During the sample period 2001–2013, the total number of observations is 18,236. Of the total observations, 2243 of them have at least one manager with foreign experience (*Dummy_foreign experience* = 1), accounting for 12.30%. In 2001, only 8.17% of the firms have at least one manager with foreign experience, while the ratio increases to 15.36% by 2013, thanks to Chinese governmental policies to attract highly skilled migrants to return to work for China.

Table 2 presents the descriptive statistics for the variables used in our regressions. The mean and standard deviation of *Patent_invention* (*Patents_total*) are 0.604 and 1.049 (0.952 and 1.412), respectively, which demonstrate that there is a big difference in the outputs of innovation among sample firms. On average, only 12.3% of firm-year observations have at least one manager with foreign experience, though the number of managers with foreign experience can be as high as eight in some firms.

In terms of control variables, the firms in our sample have an average *Institutional ownership* of 18.3%, *Managerial ownership* of 2.7%, *Firm a*ge of 11.848, *Firm size* of 21.445, *ROA* of 0.032, *leverage* of 0.205, *Cash ratio* of 0.198, *Asset turnover* of 0.710, *Sales growth of* 0.224, and *R&D expenditure* of 3.159.

In addition, most managers with foreign experience gained their experience in the U.S. (4856 manager-firm-year observations), followed by Hong Kong (2288), the U.K. (1630), Japan (1194), Canada (891), Australia (767), Germany (586), Singapore (504), France (370) and Taiwan (364).

Table 5
Managerial foreign experience and corporate innovation.
This table presents the results of the impact of managerial foreign experience on corporate innovation. The dependent variables include *Patent_invention* and *Patents_total* and the test variables are *Dummy_foreign experience* and *Number_foreign experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level.*, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	(1)	(2)	(3)	(4)
$Dummy\_foreign\ experience_{i,t-1}$	0.145**		0.162**	
	(2.52)		(2.48)	
$Number\_foreign\ experience_{i,t-1}$		0.115***		0.122***
		(2.85)		(2.84)
$Institutional\ ownership_{i,t-1}$	0.432***	0.436***	0.500***	0.504***
	(4.76)	(4.81)	(4.47)	(4.50)
$Managerial\ ownership_{i,t-1}$	1.435***	1.439***	2.138***	2.142***
	(5.35)	(5.36)	(6.77)	(6.78)
$Firm\ age_{i,t-1}$	−0.021***	−0.021***	−0.031***	−0.031***
	(−4.86)	(−4.87)	(−5.64)	(−5.65)
$Firm\ size_{i,t-1}$	0.229***	0.226***	0.295***	0.292***
	(9.91)	(9.82)	(10.58)	(10.47)
$ROA_{i,t-1}$	0.496***	0.495***	0.549***	0.548***
	(3.43)	(3.42)	(2.92)	(2.91)
$Leverage_{i,t-1}$	−0.344***	−0.343***	−0.668***	−0.667***
	(−3.27)	(−3.27)	(−4.77)	(−4.76)
$Cash\ ratio_{i,t-1}$	0.074	0.075	0.207*	0.209*
	(0.78)	(0.80)	(1.77)	(1.79)
$Asset\ turnover_{i,t-1}$	0.140***	0.138***	0.244***	0.242***
	(3.20)	(3.17)	(4.26)	(4.24)
$Sales\ growth_{i,t-1}$	−0.075***	−0.073***	−0.113***	−0.111***
	(−3.29)	(−3.18)	(−3.83)	(−3.73)
Constant	−4.492***	−4.429***	−5.587***	−5.522***
	(−9.41)	(−9.31)	(−9.68)	(−9.57)
Year fixed effect	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES
Observations	18,236	18,236	18,236	18,236
Adjusted R^2	0.29	0.29	0.35	0.35

Table 6
Firm fixed effects model.
This table reports the results using firm fixed effects model. The dependent variable is *Patent_invention* and the test variable is *Number_foreign experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		
	(1)	(2)	(3)
$Number\_foreign\ experience_{i,t}$	0.044***	0.046***	0.034**
	(3.18)	(3.31)	(2.47)
$Institutional\ ownership_{i,t}$		0.257***	0.181***
		(7.43)	(5.20)
$Managerial\ ownership_{i,t}$		0.020	0.047
		(0.14)	(0.33)
$Firm\ age_{i,t}$		0.040***	0.031***
		(17.82)	(12.70)
$Firm\ size_{i,t}$			0.127***
			(12.63)
$ROA_{i,t}$			−0.148**
			(−2.01)
$Leverage_{i,t}$			0.226***
			(4.93)
$Cash\ ratio_{i,t}$			−0.066*
			(−1.89)
$Asset\ turnover_{i,t}$			0.041***
			(2.88)
$Sales\ growth_{i,t}$			−0.032***
			(−4.01)
Constant	0.855***	0.082***	−2.575***
	(66.39)	(2.90)	(−12.48)
Year fixed effect	YES	YES	YES
Firm fixed effect	YES	YES	YES
Observations	18,236	18,236	18,236
Adjusted R^2	0.100	0.006	0.029

4.2. Correlation analysis

We calculate Person and Spearman coefficients among variables and report the results in Table 3. The results suggest that *Dummy_foreign experience*, *Institutional ownership*, *Managerial ownership*, *Firm size*, *ROA*, *Cash ratio*, and *Asset turnover* are significantly and positively associated with *Patent_invention*, while *Firm age*, *Leverage*, and *Sales growth* have significant and negative correlations. All the correlations between the independent variables are relatively low.

To further test the existence of multicollinearity, we compute the variance inflation factor (VIF) for all independent variables. The largest one is 1.90, far below the rule of thumb cutoff of 10.00 for multiple regression models (Kennedy, 1998). Therefore, we think that multicollinearity is unlikely to be a serious problem in our study.

4.3. Univariate analysis

Table 4 reports the results of univariate tests of the dependent variable of this study. The mean of *Patent_invention* (*Patents_total*) is 0.664 (1.024) for the firms having managers with foreign experience and 0.537 (0.865) for the firms without these talents, and the differences are both statistically significant at the 5% level. This means that firms having managers with foreign experience have higher innovation output than firms without these talents.

4.4. Multivariate results

The results of the OLS model are reported in Table 5. These models are derived from two measures of innovation, *Patent_invention* and *Patents_total*.

H1a is supported by the positive and significant coefficients on two measures of managerial foreign experience in regressions with both *Patent_invention* and *Patents_total*. Specifically, the coefficients on *Dummy_foreign experience* in Columns (1) and (3) are 0.145 and 0.162, significant at the 5% level, indicating that one standard deviation increase in *Dummy_foreign experience* is associated with 7.87% and 4.99% increases in invention patents and all patents, respectively. Also, the coefficients on *Number_foreign experience* in Columns (2) and (4) are 0.115 and 0.122, significant at the 1% level, indicating that one standard deviation increase in the number of managers with foreign experience results in an increase in invention patens and all patents by 14.29% and 9.07%, respectively. The findings suggest that managerial foreign experience promotes corporate innovation, both statistically and economically.

Table 7
Heckman two-stage analysis.
This table reports the regression results of Heckman model. The first step is a probit model with a binary foreign experience dummy (see model (2)). *Mean_percentage_foreign experience* is an exogenous variable, which is the mean percentage of appointing managers with foreign experience appointed by firms in the same industry in the same year, excluding the firm concerned. The second stage is the ordinary least square regression of the impact of foreign experience on corporate innovation (see model (1) in Section 3.2). The dependent variables include *Patent_invention* and *Patents_total* and the test variable is *Number_foreign experience*. *IMR* denotes the inverse Mills ratio, which is generated from the first step and included in the second step of this model. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

First-step regression		Second-step regressions		
	Dummy_foreign experience$_{i,t}$		*Patent_invention*$_{i,t}$	*Patents_total*$_{i,t}$
	(1)		(1)	(2)
State control$_{i,t-1}$	−0.163**	*Number_foreign experience*$_{i,t-1}$	0.082**	0.091**
	(−2.33)		(2.23)	(2.20)
Top 1$_{i,t-1}$	−0.332*	*Institutional ownership*$_{i,t-1}$	0.332***	0.390***
	(−1.68)		(4.22)	(3.89)
Board size$_{i,t-1}$	−0.005	*Managerial ownership*$_{i,t-1}$	0.788***	1.215***
	(−0.32)		(4.58)	(5.72)
Board independence$_{i,t-1}$	−0.029	*Firm age*$_{i,t-1}$	−0.012***	−0.024***
	(−0.08)		(−2.70)	(−3.93)
Firm age$_{i,t-1}$	−0.026***	*Firm size*$_{i,t-1}$	0.151***	0.214***
	(−3.48)		(6.73)	(7.41)
Firm size$_{i,t-1}$	0.156***	*ROA*$_{i,t-1}$	0.481***	0.540***
	(5.09)		(3.41)	(2.88)
Leverage$_{i,t-1}$	−0.050	*Leverage*$_{i,t-1}$	−0.343***	−0.666***
	(−0.28)		(−3.80)	(−5.41)
ROA$_{i,t-1}$	0.176	*Cash ratio*$_{i,t-1}$	0.032	0.093
	(0.54)		(0.48)	(1.07)
Market-to-book ratio$_{i,t-1}$	0.014**	*Asset turnover*$_{i,t-1}$	0.042	0.099**
	(2.28)		(1.48)	(2.43)
Sales growth$_{i,t-1}$	−0.035	*Sales growth*$_{i,t-1}$	−0.041***	−0.075***
	(−1.54)		(−3.87)	(−5.21)
Mean_percentage_foreign experience$_{i,t-1}$	1.929***	IMR	1.399***	1.363***
	(5.78)		(4.56)	(3.54)
Constant	−4.250***	Constant	−2.790***	−3.583***
	(−6.20)		(−6.15)	(−6.16)
Year fixed effect	YES	Year	YES	YES
Industry fixed effect	YES	Industry	YES	YES
Observations	21,635	Observations	17,919	17,919
Pseudo R^2	0.042	Adjusted R^2	0.30	0.35

The coefficients on the control variables are generally consistent with prior studies. Consistent with Aghion et al. (2013), *Institutional ownership*, *Managerial ownership*, and *Firm size* are positively and significantly related to *Patent_invention* (*Patents_total*), suggesting that firms with higher institutional ownership, managerial ownership, larger size have better innovation performance. The coefficients on *ROA* and *Asset turnover* are positively significant at the 1% level. The former demonstrates that firms with better financial performance have more resources to be spent on innovation and the latter indicates firms with larger asset turnover ratio have better innovation outcomes. However, *Firm age* and *Leverage* are significantly and negatively related to innovation. The former indicates that older and more matured firms lack the incentives to innovate and the latter shows that more leveraged firms have more financial pressures and could afford less on corporate innovation.

5. Endogeneity

So far our evidence indicates a positive relation between managerial foreign experience and corporate innovation. However, the results can be driven by an endogeneity bias. For example, it may not be random that a firm appoints managers with foreign experience and this may cause a self-selection bias. It is also possible that some omitted variables that affect both the appointment of managers with foreign experience and corporate innovation drive our results. Furthermore, there is a reverse causality concern that firms with high innovation potential attract managers with foreign experience.

In addition to using lagged values of managers with foreign experience in the main model, in this section, we further address the potential endogeneity issue in several alternative ways, including firm fixed effects model, Heckman two-step sample selection model, PSM procedure, and the market reaction to the appointing announcements of managers with foreign experience.[5]

[5] We also conduct two other tests to check the robustness of our results. First, we divide the sample into innovative firms and non-innovative firms, and the regressions with the two sub-samples produce similar results. Second, we exclude managers who obtain their foreign experience from Hong Kong, Macau, and Taiwan from our full sample, due to the relatively similar cultural and linguistic similarities with mainland China, our findings still hold. These results are available upon request.

Table 8
PSM procedure.
This table reports the regression results using PSM procedure. Panel A reports the results of covariate balance checks (*pstest*) on the mean difference in the covariates used in the probit model between the treatment firms and the control firms, matched on PSM approach. The probit model is the same as model (2), excluding the exogenous variable (*Mean_percentage_foreign experience*). Panel B reports the results from the OLS regressions. The specification of the model is the same as model (1) described in Section 3.2. The dependent variables include *Patent_invention* and *Patents_total* and the test variable is *Number_foreign experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

Panel A The results of covariate balance checks

	Means		*P* values
	Firms having managers with foreign experience	Matched firms having no managers with foreign experience	
$State\ control_{i,t-1}$	0.125	0.114	0.319
$Top\ 1_{i,t-1}$	0.375	0.370	0.268
$Board\ size_{i,t-1}$	9.297	9.209	0.178
$Board\ independence_{i,t-1}$	0.341	0.344	0.325
$Firm\_age_{i,t-1}$	10.959	11.161	0.199
$Size_{i,t-1}$	21.612	21.615	0.933
$Leverage_{i,t-1}$	0.201	0.196	0.353
$ROA_{i,t-1}$	0.037	0.037	0.949
$MB_{i,t-1}$	3.604	3.567	0.748
$Sales\ growth_{i,t-1}$	0.222	0.241	0.277

Panel B The regression results using PSM procedure

	$Patent\_invention_{i,t}$	$Patents\_total_{i,t}$
	(1)	(2)
$Number\_foreign\ experience_{i,t-1}$	0.104***	0.128***
	(2.78)	(3.06)
$Institutional\ ownership_{i,t-1}$	0.393***	0.509***
	(3.93)	(3.98)
$Managerial\ ownership_{i,t-1}$	0.985***	1.162***
	(3.38)	(3.36)
$Firm\ age_{i,t-1}$	−0.025***	−0.037***
	(−4.64)	(−5.17)
$Firm\ size_{i,t-1}$	0.213***	0.275***
	(8.92)	(9.01)
$ROA_{i,t-1}$	0.497***	0.542**
	(3.04)	(2.52)
$Leverage_{i,t-1}$	−0.288***	−0.549***
	(−2.65)	(−3.70)
$Cash\ ratio_{i,t-1}$	0.012	0.017
	(0.13)	(0.15)
$Asset\ turnover_{i,t-1}$	0.051	0.113**
	(1.45)	(2.26)
$Sales\ growth_{i,t-1}$	−0.052***	−0.080***
	(−4.16)	(−4.69)
Constant	−3.648***	−4.468***
	(−6.91)	(−6.60)
Year fixed effect	YES	YES
Industry fixed effect	YES	YES
Observations	12,673	12,673
Adjusted R^2	0.30	0.33

5.1. Firm fixed effects model

To mitigate potential problems that may arise from omitting time-invariant firm-specific characteristics, we re-estimate the regressions of model (1) using the firm fixed effects model, when *Patent_invention* is adopted as the dependent variable. The results, shown in Table 6, suggest that the estimated coefficient on the variable *Number_foreign experience* is significantly positive at the 5% level in Column (3). This implies that our results are not driven by time-invariant firm-specific characteristics.

5.2. Heckman two-step sample selection model

A firm's decision to appoint a manager with foreign experience may be non-random and this may cause a self-selection bias. To mitigate this concern, we adopt the Heckman two-step sample selection model as a robustness check. In the first step, we estimate a probit model with a binary dummy (*Dummy_foreign experience*) as the dependent variable, which equals 1 if a firm has at least one manager with foreign experience, 0 otherwise.

Table 9
Market reaction to the announcements of appointing managers with foreign experience.
This table reports the results of market reaction to the appointing announcements of managers with foreign experience in innovative firms vs. non-innovative firms. CAR_1 is value-weighted average market return adjusted and CAR_2 is equal-weighted average market return adjusted. Innovative and non-innovative industries are defined in Appendix B. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively.

Panel A: Full sample (159)						
	CAR_1			CAR_2		
Event window	Mean	Median	*P*-value	Mean	Median	*P*-value
[−1,0]	0.0113	0.0031	0.0070***	0.0116	0.0029	0.0058***
[−1,1]	0.0128	0.0037	0.0128**	0.0129	0.0045	0.0119**
[−2,2]	0.0132	0.0064	0.0306**	0.0139	0.0051	0.0236**
Panel B: Innovative industry (105)						
	CAR_1			CAR_2		
Event window	Mean	Median	*P*-value	Mean	Median	*P*-value
[−1,0]	0.0094	0.0039	0.0459**	0.0098	0.0047	0.0373**
[−1,1]	0.0099	0.0051	0.0829*	0.0101	0.0047	0.0743*
[−2,2]	0.0094	0.0066	0.187	0.0106	0.0051	0.1400
Panel C: Non-innovative industry (54)						
	CAR_1			CAR_2		
Event window	Mean	Median	P-value	Mean	Median	P-value
[−1,0]	0.0149	0.0041	0.0560*	0.0148	0.0029	0.0579*
[−1,1]	0.0137	0.0026	0.1397	0.0137	0.0002	0.1441
[−2,2]	0.0093	0.0016	0.3756	0.009	0.0006	0.3882

We add the following determinants of appointing managers with foreign experience: *State control* (a dummy variable which equals 1 if firm *i* is a state owned entity and 0 otherwise), *Top* 1 (the percentage of shares owned by the largest shareholder), *Board size* (the number of directors on a firm's board), *Board independence* (the proportion of independent directors in a board), *Firm age* (fiscal year *t* minus the year when firm *i* was established), *Firm size* (the natural logarithm of the book value of total assets), *Leverage* (the book value of total debts divided by the book value of total assets), *ROA* (return on assets), *Market-to-book ratio* (the ratio of market value divided by book value of firm), *Sales growth* (the increased percentage of sales), and *Mean_percentage_foreign experience* (the mean percentage of appointing managers with foreign experience appointed by firms in the same industry in the same year, excluding the firm concerned). Heckman's estimator requires exogenous variables that are correlated with a firm's propensity to appoint managers with foreign experience, but not with corporate innovation. Note that *Mean_percentage_foreign experience* is likely to be an important factor for a firm when deciding whether to appoint managers with foreign experience, but less likely to be closely correlated with corporate innovation. The variables are defined in Appendix A. The specification of the probit model is as follows.

$$\begin{aligned} Dummy\_foreign\ experience_t = {} & \beta_0 + \beta_1 State\ control_{t-1} + \beta_2 Top\ 1_{t-1} + \beta_3 Board\ size_{t-1} + \beta_4 Board\ independence_{t-1} \\ & + \beta_5 Firm\ age_{t-1} + \beta_6 Firm\ size_{t-1} + \beta_7 Leverage_{t-1} + \beta_8 ROA_{t-1} \\ & + \beta_9 Market-to-book\ ratio_{t-1} + \beta_{10} Sales\ growth_{t-1} \\ & + \beta_{11} Mean\_percentage\_foreign\ experience_{t-1} + Year + Industry + \varepsilon \end{aligned} \quad (2)$$

The inverse Mills ratio (IMR) is generated from the first step and then included in the second-step model to control for the potential sample selection bias. The specification of the second-step model is the same as model (1) described in Section 3.2. Table 7 reports the regression results of Heckman model.

The results of the first-step regression show that *Firm size*, *Market-to-book ratio*, and *Mean_percentage_foreign experience* have significant and positive impacts on a firm's decision to appoint managers with foreign experience, whereas *State control*, *Top* 1, and *Firm age* have significantly negative impacts.

The results of the second-step regressions show that the coefficients on *Number_foreign experience* in Columns (1) and (2) remain significantly positive. The coefficients on IMR in two columns are both significant and positive, implying that the unobserved factors that motivate firms to appoint managers with foreign experience are positively related to corporate innovation.

5.3. PSM procedure

To mitigate the potential endogeneity arising from reverse causality, we compare firms having managers with foreign experience (i.e., treatment firms) to a sample of control firms having no managers with foreign experience (i.e., control firms) matched on the propensity for a firm to appoint managers with foreign experience. The primary benefit of using a control sample matched on propensity scores is that it allows us to more clearly attribute any observed effects to the appointment of managers with foreign experience itself, rather than to the firm characteristics associated with the appointment of managers with foreign experience (Bowen et al., 2010).

To identify the propensity-score matched control sample, we estimate a probit model using the full sample. The specification of the probit model is the same as model (2) described in Section 5.1, excluding the exogenous variable (*Mean_percentage_foreign experience*). We then calculate a propensity score for each firm. For each treatment firm, we select one control firm with the

Table 10
The regression results controlling for managerial ability.
This table reports the results of the impact of managerial foreign experience on corporate innovation controlling for managerial ability (*Managerial Ability*). *Managerial Ability* is calculated following Demerjian et al. (2012). The dependent variables include *Patent_invention* and *Patents_total* and the test variables are *Dummy_foreign experience* and *Number_foreign experience*. *t*-statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	(1)	(2)	(3)	(4)
$Dummy\_foreign\ experience_{i,t-1}$	0.099*		0.133**	
	(1.76)		(1.97)	
$Number\_foreign\ experience_{i,t-1}$		0.077**		0.096**
		(2.13)		(2.35)
$Institutional\ ownership_{i,t-1}$	0.314***	0.317***	0.393***	0.396***
	(3.88)	(3.92)	(3.85)	(3.89)
$Managerial\ ownership_{i,t-1}$	0.624***	0.626***	0.990***	0.992***
	(3.54)	(3.55)	(4.58)	(4.59)
$Firm\ age_{i,t-1}$	−0.024***	−0.024***	−0.038***	−0.038***
	(−5.51)	(−5.52)	(−6.89)	(−6.90)
$Firm\ size_{i,t-1}$	0.244***	0.242***	0.303***	0.300***
	(11.08)	(10.95)	(11.06)	(10.93)
$ROA_{i,t-1}$	0.800***	0.803***	0.980***	0.983***
	(4.26)	(4.27)	(4.08)	(4.09)
$Leverage_{i,t-1}$	−0.393***	−0.391***	−0.739***	−0.737***
	(−3.50)	(−3.49)	(−5.03)	(−5.01)
$Cash\ ratio_{i,t-1}$	0.060	0.059	0.104	0.104
	(0.78)	(0.77)	(1.06)	(1.06)
$Asset\ turnover_{i,t-1}$	0.027	0.026	0.060	0.058
	(0.84)	(0.80)	(1.38)	(1.35)
$Sales\ growth_{i,t-1}$	−0.063***	−0.062***	−0.094***	−0.093***
	(−4.36)	(−4.31)	(−4.88)	(−4.83)
$Managerial\ ability_{i,t-1}$	−0.064	−0.064	−0.041	−0.041
	(−1.46)	(−1.46)	(−0.68)	(−0.68)
Constant	−4.258***	−4.204***	−4.828***	−4.763***
	(−7.80)	(−7.70)	(−6.86)	(−6.76)
Year fixed effect	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES
Observations	12,599	12,599	12,599	12,599
Adjusted R^2	0.28	0.28	0.34	0.34

closest propensity score, and these firms constitute the propensity-score matched control sample. To ensure that the matching is satisfactory, we assess covariate balance by testing whether the means and medians of the covariates used in model (2) differ between the treatment firms and matched control firms and report the results in Panel A of Table 8.

As Panel A shows, there are no significant differences in the means of any covariates, indicating that the propensity-score matched control sample resembles the treatment firms along virtually all dimensions. The untabulated results of the probit regression indicate that the determinants of appointing managers with foreign experience are broadly similar to the results of the first-step regression in Table 7.

We then re-estimate model (1) using the treatment and matched control sample, and report the results in Panel B of Table 8. The results show that the coefficients on *Number_foreign experience* in Columns (1) and (2) are both significantly positive at the at the 1% level, suggesting a positive association between managerial foreign experience and corporate innovation.

5.4. Market reaction to the appointing announcements of managers with foreign experience in innovative firms vs. non-innovative firms

Following Chen et al. (2016), we adopt the event study to address the potential endogeneity. Specifically, we investigate the market reaction to firms' announcements of appointing managers with foreign experience. Since managers with foreign experience are scarce and valuable resources and they are believed to create value for companies, the stock market should react positively to these announcements.

We manually collect the appointing announcements of managers with foreign experience. When selecting sample, we also check whether a firm's appointing announcements are associated with potentially confounding events (including earnings announcements, profit distributions, mergers and acquisitions, share issues, related party transactions, asset write-downs), as they make it difficult to observe a clean market reaction to an appointing announcement. Removing the potential noises, we get 159 appointing announcements.

We follow Brown and Warner (1985)'s market-adjusted model to define cumulative abnormal return (CAR) as follows:

$$\mathrm{CAR}_i[t_1, t_2] = \sum_{t=t_1}^{t_2} (R_{it} - R_{Mt})$$

Table 11
The alternative innovation measure of *R&D* and *R&D* as a control variable.
This table reports the results of the impact of managerial foreign experience using R&D investment (*R&D*) as the dependent variable in Columns (1) and (2). Columns (3)–(6) present the results of this impact using *Patent_invention* and *Patents_total* as the dependent variables while controlling for R&D investment (*R&D*). Since the data R&D expenditure are publicly available from 2007 in China, the number of observations in this table is reduced from 18,236 in Table 5 to 10,527. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$R\&D_{i,t}$		$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$Dummy\_foreign\ experience_{i,t-1}$	0.784**		0.088		0.116*	
	(2.24)		(1.50)		(1.65)	
$Number\_foreign\ experience_{i,t-1}$		0.193*		0.073*		0.093**
		(1.73)		(1.92)		(2.10)
$R\&D_{i,t-1}$			0.011***	0.011***	0.007*	0.007*
			(3.35)	(3.37)	(1.71)	(1.73)
$Institutional\ ownership_{i,t-1}$	0.290	0.289	0.276***	0.278***	0.327***	0.330***
	(0.56)	(0.89)	(3.51)	(3.55)	(3.33)	(3.36)
$Managerial\ ownership_{i,t-1}$	0.717	0.706	0.459***	0.460***	0.770***	0.772***
	(0.67)	(1.09)	(2.72)	(2.73)	(3.67)	(3.68)
$Firm\ age_{i,t-1}$	−0.065**	−0.067***	−0.024***	−0.024***	−0.038***	−0.038***
	(−2.37)	(−4.60)	(−5.66)	(−5.67)	(−7.17)	(−7.18)
$Firm\ size_{i,t-1}$	0.464***	0.470***	0.251***	0.249***	0.307***	0.304***
	(4.07)	(7.44)	(11.76)	(11.64)	(11.51)	(11.38)
$ROA_{i,t-1}$	0.614	0.671	0.971***	0.974***	1.202***	1.206***
	(0.51)	(0.67)	(4.93)	(4.94)	(4.79)	(4.80)
$Leverage_{i,t-1}$	−0.086	−0.090	−0.375***	−0.372***	−0.680***	−0.677***
	(−0.12)	(−0.18)	(−3.20)	(−3.18)	(−4.52)	(−4.50)
$Cash\ ratio_{i,t-1}$	1.500***	1.521***	0.048	0.048	0.080	0.080
	(2.94)	(4.02)	(0.61)	(0.60)	(0.81)	(0.81)
$Asset\ turnover_{i,t-1}$	−0.000	−0.006	0.006	0.004	0.019	0.017
	(−0.00)	(−0.05)	(0.18)	(0.14)	(0.44)	(0.40)
$Sales\ growth_{i,t-1}$	0.022	0.022	−0.073***	−0.072***	−0.100***	−0.099***
	(0.21)	(0.19)	(−4.90)	(−4.89)	(−4.99)	(−4.98)
Constant	−5.450**	−7.131***	−4.371***	−4.319***	−4.888***	−4.822***
	(−2.18)	(−5.32)	(−9.44)	(−9.32)	(−8.48)	(−8.36)
Year fixed effect	YES	YES	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES	YES	YES
Observations	10,527	10,527	10,527	10,527	10,527	10,527
Adjusted R-squared	0.14	0.14	0.29	0.29	0.35	0.35

where R_{it} is stock *i*'s return on day *t*, and R_{Mt} is the value-weighted or equal-weighted average return of all the stocks traded on both Shanghai and Shenzhen Stock Exchanges on date *t*. CAR_i $[t_1,t_2]$ is the cumulative abnormal return during event window $[t_1,t_2]$. Our study adopts three event windows, [−1,0], [−1,+1] and [−2,+2], to calculate CARs. The daily stock returns for our sample firms are retrieved from the CSMAR database.

Panel A of Table 9 presents the cross-sectional means and medians of CARs (both value-weighted average market return adjusted and equal-weighted average market return adjusted) for three event windows surrounding appointing announcement dates. The results show that the CARs of the full sample for the three event windows are on average significantly positive. Specifically, CARs in [−1,0] are significant at 1% level, and in [−1,+1] and [−2,+2] are significant at 5% level.

We then examine whether market reaction differs to the appointing announcements in innovative and non-innovative firms. We define an industry as being innovative if the number of firms with patents accounts for more than 50% of the total number of firms in this industry, otherwise, it is not innovative. Based on this criterion, the industries of mining, manufacturing, construction, and information and technology are regarded as innovative industries (see Appendix B).[6] Consequently, we divide 159 sample firms into 105 innovative firms and 54 non-innovative firms.

Panels B and C of Table 9 report the cross-sectional means and medians of CARs in three event windows in innovative and non-innovative firms. For the innovative firms, all CARs are positive. Specifically, CARs in [−1,0] and [−1,+1] windows are significant at the 5% and 10% level, respectively. However, for the non-innovative firms, not all CARs are positive. Only in [−1,0] window are CARs significant at the 10% level. In summary, appointing managers with foreign experience win investors and investors seem optimistic to the appointments in innovative firms.

It is important to note a limitation of the event study in our paper. In general, an event study is less likely to suffer from omitted variable bias. However, in this study, foreign experience may simply be a proxy for managerial ability and the market may be reacting to that. To address this concern, we undertake an additional test controlling for managerial ability in Section 5.5.

[6] We also use an alternative criterion of "above/below industry-year median growth opportunity" to split innovative firms and non-innovative firms and get similar results. The results are available upon request.

Table 12
Foreign study experience vs. foreign work experience.
This table reports the results the impact of foreign study experience and foreign work experience on corporate innovation. The dependent variables include *Patent_invention* and *Patents_total* and the test variables are *Study_foreign experience* and *Work_foreign experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	(1)	(2)	(3)	(4)
$Study\_foreign\ experience_{i,t-1}$	0.186***		0.215***	
	(2.91)		(3.00)	
$Work\_foreign\ experience_{i,t-1}$		0.197**		0.243**
		(2.02)		(2.27)
$Institutional\ ownership_{i,t-1}$	0.430***	0.434***	0.497***	0.502***
	(4.75)	(4.78)	(4.45)	(4.49)
$Managerial\ ownership_{i,t-1}$	1.438***	1.437***	2.142***	2.140***
	(5.36)	(5.37)	(6.79)	(6.81)
$Firm\ age_{i,t-1}$	−0.021***	−0.021***	−0.031***	−0.031***
	(−4.85)	(−4.87)	(−5.62)	(−5.63)
$Firm\ size_{i,t-1}$	0.228***	0.230***	0.294***	0.296***
	(9.91)	(9.98)	(10.55)	(10.64)
$ROA_{i,t-1}$	0.497***	0.492***	0.550***	0.544***
	(3.43)	(3.38)	(2.92)	(2.88)
$Leverage_{i,t-1}$	−0.343***	−0.341***	−0.667***	−0.665***
	(−3.27)	(−3.24)	(−4.76)	(−4.73)
$Cash\ ratio_{i,t-1}$	0.073	0.083	0.206*	0.217*
	(0.77)	(0.88)	(1.76)	(1.87)
$Asset\ turnover_{i,t-1}$	0.140***	0.140***	0.245***	0.244***
	(3.22)	(3.20)	(4.28)	(4.27)
$Sales\ growth_{i,t-1}$	−0.076***	−0.073***	−0.113***	−0.110***
	(−3.32)	(−3.17)	(−3.85)	(−3.70)
Constant	−4.465***	−4.508***	−5.553***	−5.599***
	(−9.39)	(−9.47)	(−9.65)	(−9.74)
Year fixed effect	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES
Observations	18,236	18,236	18,236	18,236
Adjusted R^2	0.29	0.29	0.35	0.35

5.5. Controlling for managerial ability

As we discussed above, managers with foreign experience have gained advanced knowledge, superior management practice, and highly specialized skills when they studies/worked abroad. Hence, foreign experience may be a proxy for managerial ability and this may be driving the results, causing unobservable heterogeneity.

We employ a two-step procedure developed by Demerjian et al. (2012) to estimate managerial ability (*Managerial ability*). In the first step, we use data envelopment analysis (DEA) to evaluate the relative firm efficiency of peer decision-making units. In the second step, we separate the managers' contributions from firm efficiency since the latter includes both the firm-level efficiency and manager-specific efficiency. This measure has been widely used in accounting, finance, and management research (e.g., Krishnan and Wang, 2014; Wang et al., 2017). We add *Managerial ability* to model (1) and re-run the regressions. The results are tabulated in Table 10.

We find that the coefficients on *Managerial ability* are insignificant, while the test variables *Dummy_foreign experience* and *Number_foreign experience* are both positively and significantly associated with corporate innovation measures. The result indicates that the managerial ability is unlikely to drive our findings.

6. Further analyses

6.1. The alternative innovation measure of R&D and R&D as a control variable

As we discuss in the hypotheses development section, managerial foreign experience may affect innovation via two channels. In this section, we examine whether managers with foreign experience increase the amount of R&D. We use *R&D* as a dependent variable. The results reported in Columns (1) and (2) of Table 11, suggest that managerial foreign experience increases R&D investment.

In addition, the amount of R&D investment (input) is likely to be related to the number of patents (output) and it is possible that managers with foreign experience may be more attracted to firms with high R&D investment. Hence, including R&D may help to address some of the endogeneity issue. We re-run the regressions of model (1) controlling for R&D and tabulate the results in Columns (3)–(6). Consistent with the main finding in Table 5, the results show that controlling for the amount of R&D as input, foreign experience helps produce more patents, suggesting an efficiency channel. In sum, our evidence explains the channels (both R&D investment and patents) through which managerial foreign experience may affect corporate innovation.

Table 13
Senior managers vs. junior managers.
This table reports the impact of foreign experience of senior and junior managers on corporate innovation. The dependent variables include *Patent_invention* and *Patents_total* and the test variables are *Senior_foreign experience* and *Junior_foreign experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	(1)	(2)	(3)	(4)
$Senior\_foreign\ experience_{i,t-1}$	0.182***		0.211***	
	(2.84)		(2.91)	
$Junior\_foreign\ experience_{i,t-1}$		−0.022		−0.040
		(−0.26)		(−0.39)
$Institutional\ ownership_{i,t-1}$	0.431***	0.431***	0.498***	0.497***
	(4.76)	(4.75)	(4.46)	(4.44)
$Managerial\ ownership_{i,t-1}$	1.435***	1.431***	2.138***	2.133***
	(5.35)	(5.33)	(6.78)	(6.75)
$Firm\ age_{i,t-1}$	−0.021***	−0.021***	−0.031***	−0.032***
	(−4.86)	(−4.98)	(−5.63)	(−5.73)
$Firm\ size_{i,t-1}$	0.229***	0.233***	0.295***	0.300***
	(9.91)	(9.91)	(10.57)	(10.65)
$ROA_{i,t-1}$	0.493***	0.495***	0.546***	0.547***
	(3.41)	(3.39)	(2.91)	(2.90)
$Leverage_{i,t-1}$	−0.343***	−0.343***	−0.667***	−0.667***
	(−3.27)	(−3.24)	(−4.76)	(−4.73)
$Cash\ ratio_{i,t-1}$	0.077	0.084	0.209*	0.219*
	(0.81)	(0.89)	(1.80)	(1.88)
$Asset\ turnover_{i,t-1}$	0.140***	0.140***	0.244***	0.244***
	(3.20)	(3.19)	(4.26)	(4.25)
$Sales\ growth_{i,t-1}$	−0.075***	−0.077***	−0.113***	−0.115***
	(−3.31)	(−3.38)	(−3.84)	(−3.91)
Constant	−4.485***	−4.560***	−5.575***	−5.664***
	(−9.41)	(−9.42)	(−9.68)	(−9.75)
Year fixed effect	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES
Observations	18,236	18,236	18,236	18,236
Adjusted R^2	0.29	0.28	0.35	0.34

It is important to note that Chinese listed companies are not required to disclose R&D expenditure until 2007. Therefore, when we use R&D as a dependent variable or a control variable, the number of observations reduces from 18,236 in Table 11 to 10,527 in Table 5.

6.2. Foreign study experience vs. foreign work experience

Education indicates a person's knowledge and skill base. Hambrick and Mason (1984) argue that the amount of formal education in a management team will be positively associated with innovation. Thus, we predict that managers with foreign study experience may have more significant impacts on innovation than those with work experience. We construct the following models to test our prediction:

$$Patent\_invention(Patents\_total)_{i,t} = \eta_0 + \eta_1 Work\_foreign\ experience_{i,t-1}\left(Study\_foreign\ experience_{i,t-1}\right) + Control\ variables_{i,t-1} + \varepsilon \quad (3)$$

where, *Study_foreign experience* is a dummy variable, which equals 1 if firm *i* has at least one manager with foreign study experience in year *t*, and 0 otherwise. Foreign study experience includes the experience of earning academic degrees (i.e., bachelor, master, and doctoral degrees), being visiting scholars, taking training programs, and having post-doctoral experience. *Work_foreign experience* is also a dummy variable, which equals 1 if firm *i* has at least one manager with foreign working experience in year *t*, and 0 otherwise. Control variables are the same as those used in model (1).

Table 12 reports the regression results. The coefficients on *Study_foreign experience* in Columns (1) and (3) are positively significant at the 1% level, and those of *Work_foreign experience* in Columns (2) and (4) are positively significant at the 5% level. The results indicate that foreign experience, both study experience and foreign work experience, has important impacts on innovation.

6.3. Senior managers vs. junior managers

Generally, senior managers have more influence on decision-making than junior ones. Since CEOs and vice-CEOs are the principal corporate decision-makers, we predict that they have more significant impacts on innovation than non-CEOs. The following

Table 14
SOEs vs. non-SOEs.
This table reports the results of the impact of managerial foreign experience on corporate innovation in SOEs and non-SOEs. The dependent variables include *Patent_invention* and *Patents_total* and the test variable is *Number_foreign experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	SOE	Non-SOE	SOE	Non-SOE
	(1)	(2)	(3)	(4)
$Number\ foreign\ experience_{i,t-1}$	0.148	0.086**	0.098	0.100**
	(1.63)	(2.36)	(1.04)	(2.42)
$Institutional\ ownership_{i,t-1}$	0.388	0.345***	0.591	0.417***
	(1.04)	(4.31)	(1.39)	(4.13)
$Managerial\ ownership_{i,t-1}$	1.274	0.742***	1.849	1.128***
	(0.73)	(4.32)	(0.82)	(5.32)
$Firm\_age_{i,t-1}$	−0.008	−0.023***	−0.002	−0.036***
	(−0.76)	(−5.85)	(−0.18)	(−6.89)
$Firm\ size_{i,t-1}$	0.170***	0.211***	0.249***	0.270***
	(3.91)	(10.58)	(4.55)	(10.74)
$ROA_{i,t-1}$	0.558**	0.537***	0.377	0.641***
	(2.48)	(3.66)	(1.09)	(3.37)
$Leverage_{i,t-1}$	−0.161	−0.364***	−0.455**	−0.687***
	(−1.12)	(−3.82)	(−2.18)	(−5.39)
$Cash_{i,t-1}$	0.002	0.026	0.138	0.080
	(0.01)	(0.38)	(0.62)	(0.91)
$Turn_{i,t-1}$	0.082	0.032	0.223***	0.076*
	(1.42)	(1.11)	(2.72)	(1.83)
$Sales\ growth_{i,t-1}$	−0.034**	−0.055***	−0.060**	−0.088***
	(−1.97)	(−5.03)	(−2.28)	(−5.92)
Constant	−2.905***	−3.519***	−4.561***	−4.206***
	(−2.98)	(−8.05)	(−3.75)	(−7.60)
Year fixed effect	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES
Observations	2744	15,418	2744	15,418
Adjusted *R*-squared	0.26	0.29	0.26	0.36

models are employed to test our prediction:

$$Patent\_invention(Patents\_total)_{i,t} = \lambda_0 + \lambda_1 Senior\_foreign\ experience_{i,t-1}\left(Junior\_foreign\ experience_{i,t-1}\right) + Control\ variables_{i,t-1} + \varepsilon \quad (4)$$

where, *Senior_foreign experience* is a dummy variable, which equals 1 if firm *i*'s senior managers (including CEOs and vice-CEOs) have foreign experience in year *t*, and 0 otherwise. *Junior_foreign experience* is also a dummy variable, which equals 1 if firm *i*'s junior managers (non-CEOs) have foreign experience in year *t*, and 0 otherwise.

Table 13 reports the regression results. The coefficients on *Senior_foreign experience* in Columns (1) and (3) are positively significant at the 1% level, while those of *Junior_foreign experience* in Columns (2) and (4) are not significant. Therefore, consistent with the findings of Lin et al. (2011), senior managers with foreign experience seem to have more significant impact on innovation than junior managers with foreign experience.

6.4. SOEs vs. non-SOEs

Compared with non-SOEs, SOEs may lack initiatives to implement innovation strategies in three ways. First, SOEs are dominant in industries related to people's livelihood, such as water utilities, postal delivery, and power generation and distribution. Hence, their performance criteria are more social-based than economical-based. Moreover, SOEs get protection from the government, and they enjoy implicit or explicit loan guarantees, which enable them to borrow money at favorable rates (Dewenter and Malatesta, 2001). Thus, they lack incentives to compete with private firms in the market and regulatory influences may seem to provide an easier path to reap excessive profits than innovating new products and services. In addition, a number of studies have documented that SOEs are less efficient than private firms (e.g., Megginson et al., 1994; Dewenter and Malatesta, 2001). Even if SOEs have incentives to innovate, lack of efficiency may hinder the process. Consequently, we argue that managers with foreign experience in SOEs are less likely to promote innovation than those in private firms.

Table 15
Managers gaining experience in the U.S. vs. in non-U.S. countries or regions.
This table reports the results the impact of managerial foreign experience gained in the U.S. and in non-U.S. countries or regions on corporate innovation. The dependent variables include *Patent_invention* and *Patents_total* and the test variables are *Dummy_U.S. experience* and *Number U.S. experience*. *t*-Statistics in the brackets are based on standard errors adjusted for clustering at the firm level. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in Appendix A.

	$Patent\_invention_{i,t}$		$Patents\_total_{i,t}$	
	(1)	(2)	(3)	(4)
$Dummy\_U.S.\ experience_{i,t-1}$	0.246**		0.264**	
	(2.57)		(2.29)	
$Number\_U.S.\ experience_{i,t-1}$		0.261***		0.260***
		(3.65)		(3.31)
$Dummy\_foreign\ experience_{i,t-1}$	0.046	−0.020	0.063	0.003
	(0.82)	(−0.36)	(0.95)	(0.04)
$Institutional\ ownership_{i,t-1}$	0.336***	0.338***	0.398***	0.400***
	(4.28)	(4.33)	(3.99)	(4.03)
$Managerial\ ownership_{i,t-1}$	0.809***	0.811***	1.247***	1.249***
	(4.71)	(4.71)	(5.88)	(5.87)
$Firm\ age_{i,t-1}$	−0.022***	−0.022***	−0.033***	−0.033***
	(−5.50)	(−5.46)	(−6.23)	(−6.20)
$Firm\ size_{i,t-1}$	0.206***	0.203***	0.268***	0.265***
	(10.43)	(10.34)	(10.70)	(10.63)
$ROA_{i,t-1}$	0.552***	0.557***	0.623***	0.627***
	(4.12)	(4.16)	(3.53)	(3.55)
$Leverage_{i,t-1}$	−0.316***	−0.316***	−0.632***	−0.632***
	(−3.58)	(−3.60)	(−5.25)	(−5.26)
$Cash\ ratio_{i,t-1}$	0.035	0.033	0.093	0.092
	(0.53)	(0.50)	(1.09)	(1.07)
$Asset\ turnover_{i,t-1}$	0.047*	0.045	0.104***	0.102**
	(1.66)	(1.59)	(2.58)	(2.53)
$Sales\ growth_{i,t-1}$	−0.054***	−0.053***	−0.088***	−0.087***
	(−5.57)	(−5.46)	(−6.46)	(−6.39)
Constant	−3.475***	−3.415***	−4.257***	−4.197***
	(−7.97)	(−7.87)	(−7.69)	(−7.61)
Year fixed effect	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES
Observations	18,236	18,236	18,236	18,236
Adjusted R^2	0.30	0.30	0.35	0.35

We divide the sample into two subsets, SOEs and non-SOEs, and run the regressions of model (1) on the two subsets respectively. We report the results in Table 14. The coefficients on *Number_foreign experience* in non-SOE subsets are positive and significant at the 5% level, while those are not significant in SOE subsets. The result indicates that managers with foreign experience in private enterprises have more incentives to implement innovation activities than those in SOEs.

6.5. Foreign experience gained in the U.S. vs. in non-U.S. countries or regions

The U.S. is the most developed economy in the world with quality legal institutions and a high level of capital market development. It has gained and maintained world leadership in innovation and technology, due to higher mobility of capital, population and knowledge in the U.S. promotes agglomeration of R&D (Crescenzi et al., 2007). Thus, we predict that managerial study or work experience gained in the U.S. may have a more pronounced impact on corporate innovation than it gained in countries or regions other than the U.S. We adopt the following models to examine our prediction.

$$Patent\_invention(Patents\_total)_{i,t} = \zeta_0 + \zeta_1 Dummy\_U.S.experience(Number\_U.S.experience)_{i,t-1} + \zeta_2 Dummy\_foreign\ experience + Control\ variables_{i,t-1} + \varepsilon \quad (5)$$

where, *Dummy_U.S. experience* is a dummy variable which equals 1 if firm *i*'s managers gain experience from the U.S., and 0 otherwise. *Number_U.S. experience* is the number of managers who gain experience from the U.S. in year *t*. To examine how much more U.S. experience contributes to innovation, we control for managerial foreign experience in general (*Dummy_foreign experience*) in model (5).

Table 15 reports the regression results. The coefficients on *Dummy_U.S. experience* and *Number_U.S. experience* are positive and statistically significant at the 5% and 1% level, respectively, suggesting that managers gaining experience in the U.S. have more impacts on innovation. In terms of economical significance, the coefficients on *Dummy_U.S. experience* in Columns (1) and (3) suggest

that one standard deviation increase in *Dummy_U.S. experience* is associated with 7.41% increase in invention patents and 5.04% increase in total patents, respectively. Similarly, one standard deviation increase in the number of managers who gain experience in the U.S. leads to 12.48% increase in invention patents and 7.89% increase in total patents, respectively.

7. Conclusions

In this paper, we examine the effect of managerial foreign experience on corporate innovation using a sample of Chinese listed firms over the period 2001–2013. In line with theoretical predictions, we find managerial foreign experience to be a significant determinant of corporate innovation. This study extends the prior literature (e.g., Cho et al., 2016; Giannetti et al., 2015) by providing new evidence that managerial characteristics matter for corporate innovation.

Our results are beneficial to firms and governments that are interested in promoting innovation. When firms appoint individuals with foreign experience as members of their management teams, their innovation activities tend to be increased. If they gain foreign experience in the developed markets, their impacts on innovation are more significant. In addition, our findings suggest that Chinese governments' efforts in attracting talents with foreign experience seem to have generated positive impact on corporate innovation and thus should continue.

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Appendix A. Variable definitions

Variables	Definitions
Panel A: patent variables	
Patent_invention	The natural logarithm of one plus firm *i*'s invention patents
Patents_total	The natural logarithm of one plus firm *i*'s total patents, including invention patents, design patents, and utility model patents
Panel B: foreign experience variables	
Dummy_foreign experience	A dummy variable which equals 1 if firm *i* has at least one manager with foreign experience in year *t* and 0 otherwise
Number_foreign experience	The number of managers who have foreign experience in year *t*
Study_foreign experience	The number of managers with foreign study experience in year *t*
Work_foreign experience	The number of managers with foreign work experience in year *t*
Senior_foreign experience	The number of senior manager (CEO or vice CEOs) with foreign experience in year *t*
Junior_foreign experience	The number of junior manager (except for CEO and vice CEOs) with foreign experience in year *t*
Dummy_U.S. experience	A dummy variable which equals 1 if firm *i* has at least one manager with U.S. experience in year *t* and 0 otherwise
Number_U.S. experience	The number of managers who gain experience in the U.S. in year *t*
Panel C: other variables	
Institutional ownership	The number of shares held by institutional investors divided by the total shares in issue
Managerial ownership	The number of the shares held by management divided by the total shares in issue
Firm age	Firm *i*'s age, which equals to the difference of fiscal year *t* minus the year the firm was established
Firm size	The natural logarithm of the book value of total assets plus one
ROA	Return on assets, which equals to net income divided by total assets
Leverage	The book value of total debts divided by the book value of total assets
Cash ratio	The book value of cash holdings divided by the book value of total assets
Asset turnover	The book value of total revenues divided by the book value of total assets
Sales growth	The increased percentage of sales in year *t*
State control	A dummy variable which equals 1 if firm *i* is a state-owned entity and 0 otherwise
Top 1	The percentage of shares owned by the largest shareholder in year *t*
Board size	The number of directors on a firm's board in year *t*
Board independence	The proportion of independent directors in a board in year *t*
Market-to-book ratio	The ratio of market value divided by the book value of firm *i* in year *t*
Mean_percentage_foreign experience	The mean percentage of managers with foreign experience appointed by firms in the same industry in the same year, excluding the firm concerned
R&D	The natural logarithm of R&D expenditures plus one
Managerial ability	Following Demerjian et al. (2012), we calculate managerial ability using a two-step procedure. In the first step, we use data envelopment analysis (DEA) to evaluate the relative firm efficiency of peer decision-making units with a nonlinear optimization model. In the second step, we separate the managers' contribution from firm efficiency and get the data of managerial ability.

Appendix B. The number and percentage of firms with and without patents by industry

This appendix presents the number and percentage of firms with and without patents by industry. The industry classification is issued by the China Securities Regulatory Commission (CSRC) in 2001. Industries with asterisks (*) are regarded as innovative, because the percentage of firms with patents accounts for more than 50% of the total number of firms in these industries.

Industry	Firms with patents	Firms without patents	Total no. of firms
Agriculture (A)	17 (38.6%)	27 (61.4%)	44
Mining (B)*	37 (59.7%)	25 (40.3%)	62
Manufacturing (C)*	1195 (80.9%)	283 (19.1%)	1478
Electronic and gas (D)	11 (14.7%)	64 (85.3%)	75
Construction (E)*	42 (79.2%)	11 (20.8%)	53
Transportation (F)	9 (11.4%)	70 (88.6%)	79
Information and technology (G)*	145 (71.8%)	57 (28.2%)	202
Wholesale and retail (H)	6 (4.7%)	122 (95.3%)	128
Real estate (J)	9 (6.9%)	121 (95.3%)	130
Social service (K)	24 (30.0%)	56 (70.0%)	80
Communication and cultural (L)	8 (21.1%)	30 (78.9%)	38
Comprehensive (M)	5 (9.8%)	46 (90.2%)	51

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