Executives Overseas Work Experience and the International Knowledge Spillovers: Evidences from China

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Abstract

This paper examines whether managers' overseas work experience promotes international knowledge spillovers via international labor mobility. Using more precise foreign patent citations data and the overseas work experience of all the managers in Chinese listing firms, we find a positive correlation between the foreign patent citations number and the number of managers with overseas work experience in the firms. Moreover, we find that managers tend to cite patents from the exact country where they have worked, and the positive correlation is more obvious for managers who returned from more innovation-oriented countries and those had abroad research and development (R&D), marketing, and management work experience. We propose an instrumental variable strategy and lagged explanatory variables to show that the results are not driven by omitted variables or reversed causality.

1 Introduction

It has been proved that several channels that can cause international knowledge spillovers across countries, including global challenges, global knowledge sourcing, international collaborative networks, and social ties. Among the above channels, labor mobility has been recognized as one of the important channels for international knowledge spillovers (Almeida and Kogut, 1999, Oettl and Agrawal, 2008, Singh and Agrawal, 2011). As knowledge is embedded in the human capital of a firm's employees, labor mobility can cause the spread of knowledge and, thus, managers' overseas work experiences can cause the knowledge spillovers in an international scope.

In this paper, we study the effects of managers' overseas work experiences on international knowledge spillovers. In other words, we check whether managers' overseas work experience causes the international labor mobility and then accelerates knowledge spillovers globally. To answer the above questions, we examine the relationship between the number of managers with overseas work experience and the number of foreign patent citations in 2,987 Chinese listing companies from 2008 to 2017. Here, we use the foreign patent citations as the proxy for the intensity of international knowledge spillovers (Dang and Motohashi, 2015).

Our empirical results show that the number of managers with overseas experience within a firm positively correlates with the firms' foreign patent citations number, which supports the hypothesis that managers' overseas work experience contributes to international knowledge spillovers by generating labor mobility in the international scope. Besides, by separating overseas work experiences and foreign patent citations into the corresponding countries, we find that the positive correlation between the patent citations and managers' overseas work experience demonstrates a clear country-level pattern, which implies that managers tend to cite patents from the exact country where they have worked , which therefore provides even stronger evidences for international knowledge spillovers being caused by managers' labor mobility.

In a further analysis, we separate the countries into two subsamples: innovation-oriented countries and noninnovation-oriented countries according to their Innovation Capability (IC) Index. We found that the positive correlation between foreign patent citations and managers' overseas work experiences is more significant for managers who returned from innovation-oriented countries, which indicates that managers who worked in countries with stronger innovation capabilities demonstrate a greater ability to carry international knowledge flows. Finally, we find that the international knowledge spillover effects are more obvious for managers who have abroad research and development (R&D), marketing,

and management work experiences.

We collect the number of each firm's foreign patent citations from the PatSnap database, a comprehensive global patent database. Differing from the previous literature, which mainly uses the aggregate level of patent or R&D data to measure a firm's innovation or knowledge spillover level, we separate the foreign patent citations from the domestic patent citations to capture only the international knowledge spillovers. Simultaneously, we draw the firm managers' overseas work experience from their resumes using the text-mining technique. The managers' resume data are downloaded from the Chinese Stock Market and Accounting Research (CSMAR) database, which covers each managers' personal information, education, and work experience in detail.

Based on the above data, we first regress the log number of each firm's foreign patent citations on the log number of managers with overseas work experience. We find a positive relationship between the extent of the international knowledge flows and the return of managers with overseas experience in the test. However, the endogeneity issue in this empirical result, including the omitted variable and the reverse causality problems , should be discussed .

To address the omitted variable problem, we provide further empirical evidences by separating the managers' overseas work experiences and the foreign patent citations by country and examining whether there is a country-level pattern between the managers' labor mobility and the foreign patent citations. We found that the positive correlation between managers' overseas work experiences and patent citations demonstrates a clear country-level pattern, which implies that the firms are citing more patents from the countries where the managers gained their overseas work experiences. This finding provides strong evidences for addressing the omitted variable problem and further supports the channel of international knowledge spillovers via managers' labor mobility.

In terms of reverse causality, we address the problem by using both the lagged explanatory variables and the Instrument Variable Estimation . Using both the lagged explanatory variable and exploiting the managers' average salary level as a plausible exogenous instrumental variable to undertake a two-stage least square (2SLS) analysis, we show that our previous findings are robust. Finally, we revised the log-level data of the patent citations and number of managers into ratios to provide a robustness check. The regression results illustrate that our empirical findings are robust for alternative definitions of international knowledge flows and managers' overseas work experiences.

A set of further analyses is presented in this paper. One assumption is that if the managers' international labor mobility promotes the international knowledge spillovers, then the managers' effects

on promoting the knowledge spillovers should be heterogeneous in terms of the country where they gained their overseas work experience and background s. Therefore, we separate the managers' overseas experience by country and work position and then find that the positive correlation between the firms' foreign patent citations and the number of managers with overseas work experience is more obvious for the managers who returned from innovation-oriented countries and for those who have R&D, marketing, and overseas management backgrounds.

Related Literatures

Our paper contributes to several literature trends. First, our research is related to the literatures on international knowledge flows and labor mobility. Oettl and Agrawal [2008] examine knowledge flows resulting from cross-border movement. Liu et al. [2010] investigate the impact of returnee entrepreneurs on innovation and show that there are significant knowledge spillover effects associated with returnees. Trippl [2013] study the knowledge flows resulting from elite scientists' international mobility. He shows that elite scientists establish manifold interregional knowledge links between sending and receiving areas. However, existing studies ignore the important roles played by company managers, as their labor mobility brings international knowledge flows via their past overseas working experiences. Compared with other employees, firm managers hold greater power for manipulating firms' innovation strategies, and their overseas work experiences will have more influences on firms' knowledge inflows. Our paper contributes to this gap.

Second, our paper also builds on the empirical literature studying managerial characteristics and firm innovation. Previous literatures show that CEO characteristics, including CEOs' incentives (Lin et al., 2011), overconfidence (Hirshleifer et al., 2012), turnovers (Bereskin and Hsu, 2014), and general managerial skills are confirmed to be associated with firms' innovative success. However, few literatures examine the impact of managerial overseas work experience on corporate innovation activities. Yuan and Wen [2018] provide evidences for the positive effects of managerial international experience on firms' innovation output, but the transmission mechanism between the two factors is unclear. In our results, we confirm previous findings that managerial international experience can be positively correlated to firms' innovation activity, and our empirical results also further empirically show that the international knowledge flows held by managers is a channel for promoting their firms' innovation externalities.

Finally, this paper adds to the literature investigating how labor mobility affects long-run economic growth. There are vast literatures that show that the accumulation of human capital and inventor mo-

bility is related to long-run economic growth. For example, Wollner [1994] characterize the relationship between recruiting and the access to ideas as central to explaining Northern California's exceptional economic growth. However, due to the lack of empirical data, the previous studies failed to empirically investigate international knowledge spillovers as a channel for the relationship between labor mobility and long-run economic growth.

The rest of the paper is organized as follows: Section 2 develops the hypothesis. Section 3 describes the data. Section 4 reports the empirical results and robustness checks, and section 5 concludes the paper.

2 Theoretical Background

Contemporary economic theory considers knowledge flows that occur outside market mechanisms as an important source of innovation and economic growth, and the knowledge inflows and innovation have been introduced into the production function under the endogenous growth model (Romer, 1986, 1990). However, the clusters of innovation are geographically localized (Jaffe et al., 1993, Thompson and Fox-Kean, 2005). Therefore, the knowledge that flows across different locations can promote the development of innovation networks and extend the scope of innovation clusters by increasing the frequency with which enterprises exchange ideas, thus accelerating the innovation output growth in the areas where the knowledge flows (Audretsch and Feldman, 1996, Jaffe et al., 1993).

Meanwhile, labor mobility has been recognized as a possible channel of improving firm innovation (Almeida and Kogut, 1999, Rosenkopf and Almeida, 2003, Song et al., 2003). Previous studies show that intellectual talents have a set of skills or capabilities for formulating corporate strategies (Boeker, 1997), increasing productivity, and accelerating productive innovation (Görg and Strobl, 2005, Rao and Drazin, 2002). Since skills and knowledge capability is embedded in the human capital of the firm's employees, labor mobility is one kind of knowledge flow. During the labor mobility process, employees will interact and communicate with surrounding groups and therefore accelerate the diffusion of knowledge between these different groups (Almeida and Kogut, 1999).

The mobility of labor across different enterprises and regions can promote the spread of knowledge (Almeida and Kogut, 1999) and is crucial for a firm's innovation activities. According to the upper echelon theory first developed by Hambrick and Mason [1984], the top management team's (TMT) characteristics are important factors that affect a firm's performance as well as its innovation strategy (Acedo and Galán, 2011, Delmar and Wiklund, 2008). Compared with R&D researchers, inventors,

and engineers, firm executives have greater power to improve firm innovation activities. Therefore, firm executives' mobility is important for the knowledge flows across regions.

Managers' overseas work experience creates labor mobility in the international scope. When firm managers move from one country to another, they can also introduce advanced technology from foreign countries to domestic firms. In particular, by comparing the differences in innovation strategies between domestic and foreign enterprises, managers with overseas work experiences can share innovation patents or ideas from abroad and help their firms close the technology gap. These effects are more crucial for firms in emerging markets, which rarely have a sense of the current international industry development and the harsh competitiveness. In this sense, firm managers with overseas work experiences will act as professional monitors and advisors who encourage the firm's access to advanced knowledge and skills, which were not previously recognized as open sourced (Aguilera et al., 2008). Based on the above analysis, we postulate hypothesis 1:

H1: managerial overseas work experience has positive effects on the international knowledge spillovers.

Based on this hypothesis, one inference is that if managers facilitate the knowledge flows via labor mobility, then they will rely on the innovative knowledge they gained from their former overseas working experiences to contribute to domestic firms, since their innovation performance–related knowledge and work experience are embedded in the human capital. Then, a corresponding relationship should exist between the countries where the returnee managers worked and those countries' knowledge outflows. Therefore, we assume that:

H2: Managers from more innovation-oriented countries tend to bring international knowledge inflows exactly from their source countries.

Although we assume in hypothesis 1 that the return of managers with foreign experience should be closely related to the intensity of knowledge flows, this does not necessarily mean that each manager should perform uniformly in the ability to promote knowledge flows. Although the managers with overseas work experiences all facilitate knowledge flows to their domestic firms, they definitely hold different perceptions in terms of innovation and show various intrinsic strengths in promoting firms' innovation performances due to certain potential reasons. In other words, heterogeneity exists in the correlation between managers' abroad work experiences and the knowledge inflows. Several factors influence the heterogeneity, including the innovation level of the countries where the managers worked

and the abroad work positions they held. For example, the managers who returned from innovation-oriented countries can access more innovative patents and professional training on innovation strategy and are, therefore, more valuable to their firms in terms of their ability to introduce knowledge inflows compared to managers from other countries. Therefore, we propose hypothesis 3:

H3: Managers from more innovation-oriented countries bring more international knowledge inflows than managers from other countries.

Furthermore, we assume that the managers' abroad work positions are also a determining factor for the heterogeneity of their ability to facilitate knowledge flows. Executives with specific abroad working backgrounds gain different working experiences. For instance, managers who hold positions in finance or human resource departments rarely have access to their firms' innovation strategies, while managers who hold positions in R&D or marketing departments [1] will gain more work experiences related to firm innovation. Thus, we develop hypothesis 4:

H4: Managers with overseas R&D, marketing and management working background bring more international knowledge inflows to firms.

3 Data

In this section, we collect empirical data to test the aforementioned hypotheses in section 2. Our data comes from several sources: the patent data are collected from the PatSnap database, the managers' overseas work experience data are collected from the CSMAR resumes database, and the managers' average salary data used in the Instrument Variable Estimation and all the control variables are collected from the RESSET database.

3.1 Measurement & Variables

International knowledge spillovers

Following the previous studies, we use patent citation data as the proxy for the knowledge flows Oettl and Agrawal, 2008, Song et al., 2003, Trajtenberg and Jaffe, 2005). In contrast to the previous literatures, which use a patent's cited time to measure its importance as an innovation output, our paper uses the foreign patent numbers cited by Chinese firms to measure the intensity of international knowledge flows to each Chinese listing firm. Also, to capture only the overseas' innovation knowledge

[1] recent studies indicate that the managers of marketing department is highly related with the innovation performance of the firms, since effective innovation needs to serve the market (Pamela et al., 2019).

inflows to the firms, we separate the foreign patent citations from all the patent citations.

We collect all the patent information from the PatSnap database, which is a database records the comprehensive information for global patents . For each patent record, the database discloses the patent's title, abstract, ownership country, claims, description, application date, citations, and assignee information. To measure each firm's foreign patent citing in every year, we first search the entire database to obtain each Chinese listing firm's granted patent application records in each year, then we search the patents cited by each Chinese firm's patent application records and then identify the foreign patents from the cited patent's current first assignee address [2].

We count the number of foreign patent numbers cited by Chinese firms and use the log of one plus the number of foreign patent numbers to measure the intensity of international knowledge flows to each Chinese listing firm in each application year. Following the previous studies, we set the citation counts to zero for firms without applied patents and without citing information in PatSnap. For further analysis, we also separate the foreign patents into different ownership country catalogs. The countries included in our analysis are: the United States, United Kingdom, Canada , Japan, Germany, France, and South Korea.

Overseas work experience of managers

Following previous literatures (Cheng-HuaTzeng, 2018, Wei and Ling, 2015, Yuan and Wen, 2018), we use the natural log of one plus the number of managers who had overseas work experience to measure the extent the firm is affected by overseas work experiences. To apply this definition, we define managers with overseas work experience as those who ever worked in a foreign country. The employees we consider managers in our analysis include the chairman, vice chairman and secretary of the board , CEO, CFO, and other personnel prescribed by the firm's articles of association, such as the deputy general manager, chief engineer, and CTO.

The managers' past working experience information is collected from the CSMAR executives resume database, the biggest database that records detailed resume information of the executives in all the Chinese listing firms. The database reports each executive's personal information, education background, and working experiences in text form.

One contribution of our paper is that we conduct a deep analysis of the executives' resume information using the text-mining method. We extract each executive's work position, workplace, and working duration from their resumes' text, and the rich information of manager's foreign experiences

[2]we use the text mining method to analyze the cited patent's current first assignee address to define the patent's ownership country

enables us to more deeply analyze how the returnee managers' different work positions and overseas countries affect the international knowledge inflows. These analysis results can give us a better understanding in terms of the channel's heterogeneity. Consistent with the patent ownership, we also separate managers' overseas work experience countries into different catalogs. The countries include in our analysis are: United States of America ($LnUSWork$), United Kingdom ($LnUKWork$), Canada ($LnCAWork$), Japan ($LnJPWork$), Germany ($LnDEWork$), France ($LnFRWork$) and South Korea ($LnKRWork$).

Country Innovation-level Index

In our hypothesis 3, we test whether managers from more innovation-oriented countries bring more international knowledge inflows than managers from other countries. To define the innovation-oriented countries, we use the Global Innovation Index, a country-level index that ranks the IC of different countries around the world. The index is derived from the annual report published by the World Intellectual Property Organization (WIPO), a very authoritative index to measure IC at the country level. The ranking of our sample countries according to the Global Innovation Index is shown in Appendix B.

Other control variables

We collect a matrix of control variables from the RESSET database, which contains adequate financial data of Chinese listing firms. Following He and Tian [2013], we select our control variables as follows: R&D expenditures, firm size, firm age, firm ownership, firm's equity multiplier, ROE, revenue growth rate, asset turnover ratio, and board independent ratio. The definitions of the variables in our regressions are described in Appendix A. All the variables were winsorized at 1% in both tails to prevent outliers influencing the results with bias; we also exclude financial firms from our firm sample. After basic data cleaning, we obtain a sample with 22,888 observations, which covers all the Chinese listed firms from 2008 to 2017.

3.2 Summary Statistics

In this section, we present a set of descriptive statistics on the measurement of international knowledge flows and managers' overseas work experiences. It is obvious to recognize from Figure 1 that the proportion of foreign patent citations in Chinese listed companies has increased steadly from 2008 to 2017. To check the patent citing distribution in our sample, we show the structure of the different countries' total foreign citations in Figure 2. From Figure 2, we can recognize that the number of

citations contributed by the selected countries varies.

[Insert Figure 1 Here]

Figure 2 shows that, among all the countries we account for in our country-level analysis, the United States is the country with most patent citations from China, with 144,654 patent citations from Chinese listing firms. This number is 27.47% larger than that of Japan , which is ranked in second place with 113,482 patent citations. The third to seventh positions belong to South Korea (75,284), Germany (27,984), France (10,952), Canada (6,409), and the United Kingdom (6,363), respectively.

It is interesting to note that, aside from the US, which is recognized as the most technologically developed country in the world, Chinese companies also cite more patents from neighboring countries (e.g., Japan and South Korea). This finding is consistent with previous findings that firms' innovation activities are geographically clustered (Almeida and Kogut, 1999, Audretsch and Feldman, 1996, Bottazzi and Peri, 2003, Jaffe et al., 1993, Thompson and Fox-Kean, 2005). The total citation number from the above 7 foreign countries in our country-level pattern analysis accounts for 54.78% of the total foreign citations.

[Insert Figure 2 Here]

The summary statistics of the main variables in our regression are presented in Table 1. On average, the sample firms in our data cite foreign patents 32.816 times in each year, and 27.1% of the managers have foreign experience, suggesting that over one-third of the managers in today's Chinese listing firms have foreign work experiences. Meanwhile, Table 2 shows the Pearson correlation matrix of all the regressors. From Table 2, we observe that no abnormally high correlation coefficient exists between any pair of variables; therefore, we can rule out the multicollinearity problem in our regressions.

[Insert Table 1 and Table 2 Here]

4 Empirical Results

The objective of this section is to test the theoretical framework's main hypothesis, described in section 2. To this end, we proceed in several steps. First, we study the effect of employing managers with foreign experiences on the knowledge inflows to firms. Our hypothesis is that, once firms employ more returnees as executives, they will start to cite more foreign patents, since the returnee managers bring

international knowledge inflows to the firms and promote the firms' innovation performance. Then, in a second step, we provide further evidences for the international knowledge inflows brought by managers with foreign work experiences. We study whether there is a consistency between a certain country's citing patent and which country the managers are returning from. Last, we study the heterogeneous effects of the channel across managers who returned from different countries and hold different work positions abroad. Here, we are particularly interested in whether returnee managers who ever worked in countries with stronger innovation capabilities and hold R&D-related work positions brought more international knowledge flows to their domestic firms.

4.1 Returnee managers and the international knowledge inflows

The objective of this section is to document the main effect of how managerial foreign work experience influences international knowledge inflows to domestic firms. To this end, we estimate the following baseline regression equation:

$$Ln(FPCiting_{i,t}) = \alpha + \beta Ln(ReturneeManagers_{i,t}) + \lambda X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where i index firms, t index time - which is expressed in years. Our dependent variable $Ln(FPCiting_{i,t})$ is the logarithm of one plus the citing time of foreign patent of firm i at year t, which is the proxy for the international knowledge inflows to firm i. Our main interest variable is $Ln(ReturneeManagers_{i,t})$, which is the logarithum of one plus the number of managers who ever worked overseas and now works in firm i at year t. To control for other vairales' effects on firm cites foreign patents, we add a matrix of control variables $X_{i,t}$ into our regression. [3] To the end, we also add to our specification a set of fixed effects.

The results of the estimating equation (1) are reported in Table 3, where we present four different econometric models in columns 1 to 4, with different fixed effects to prevent potential endogenous problems caused by omitted variables. For all four econometric modules, we find that the number of cited foreign patents is positively correlated with the number of managers with overseas work experiences in the corresponding firm. The regression coefficient β is 0.080 and positively significant at the 0.1 level in column 4 when we control for the firm and year fixed effects. This result suggests that a positive correlation exists between the total number of managers with foreign work experience

[3] the control variables we include in our regression are: R&D expenditures, firm size, firm age, firm ownership, firm's equity multiplier, ROE, revenue growth rate, asset turnover ratio and board independent ratio.

and the intensity of knowledge inflows from foreign countries to the domestic firm. This finding is also consistent with our hypothesis 1 that managerial overseas work experiences bring international knowledge spillovers to domestic firms.

Among all the other control variables, both the R&D ratio and firm size coefficients are positive and significant at the 0.1 level, which supports that the knowledge flows' intensity is highly associated with the firm's scale and R&D expenditure. This finding is consistent with those of the previous literatures (He 2013; Chen 2015; Yuan 2018; Yang 2019). We also observed that the equity multiplier is negatively associated with the foreign patent's citing number, which implies that a firm with a higher liability level has more financial pressure to improve knowledge flows and innovation. Two profitability measurements, ROE and the asset turnover ratio, are positively related to foreign patent citations, which supports that firms with higher profitability can absorb more international knowledge inflows (Yuan 2018). Finally, we also find that the firm ownership is negatively correlated with the foreign patent citations, which implies that private firms may have less resources and channel access to foreign innovation.

[Insert Table 3 Here]

Although the baseline regression result already discovered a positive relationship between the number of returnee managers and foreign knowledge inflows, this result still suffered from the omitted variables problem. To provide stronger evidences for the international knowledge inflows derived by managers' labor mobility, we further investigate whether a consistency exists between the foreign countries where the managers worked and the domestic firms' cited foreign patents. Our assumption behind this estimation is that if the returnee managers' labor mobility brought the international knowledge inflows into the domestic country, then the managers will tend to cite the foreign patents from the countries where they worked. Based on the above assumption, we separate the foreign patents and countries where the managers worked into different country catalogs. After eliminating the countries with too few citing numbers to produce a meaningful statistic regression result, we finally selected 7 countries to conduct this estimation in our sample: the United States, the United Kingdom, Canada, Japan, Germany, France, and South Korea. Based on our sample, we estimate the following specification:

$$Ln(FPCiting_{i,j,t}) = \alpha + \beta Ln(ReturneeManagers_{i,j,t}) + \lambda X_{i,t} + \varepsilon_{i,j,t} \quad (2)$$

In the above specification, i stands for the index firms, j for the index country catalog, and t for the index time . The dependent variable in equation (2), $Ln(FPCiting_{i,j,t})$, stands for the natural log of one plus the citing number of foreign patents owned by the country j, and $Ln(ReturneeManagers_{i,j,t})$, stands for the natural log of one plus number of managers in firm i in year t who ever worked in foreign country j. As in equation (1), $X_{i,t}$ stands for a matrix of control variables we add into our regression. We also control for a set of fixed effects on the above estimation.

The estimation results of equation (2) are shown on Table 4. Columns 1 to 3 in Table 4 demonstrate that after separating the sample into subsamples according to the foreign patents' catalog, a significant positive linkage exists between the number of returnee managers who worked in a country and the citing number of the foreign patents in that corresponding country. Remarkably, the coefficients show that the magnitudes of the subsample coefficients are greater than the baseline level estimation coefficient (0.80) and significant at the 0.01 level. This finding implies that the returnee managers especially from the United States, the United Kingdom and Canada tend to cite or access patents from the foreign county where they worked, a finding consistent with our hypothesis that returnee managers bring international knowledge inflows to domestic firms via their labor mobility. Among all the control variables, the R&D ratio and firm size still present significant positive relations to the foreign patent citing numbers, which reinforced the R&D expenditures' important role in generating knowledge inflows. Another finding is that the firm age is significantly negative when associated with dependent variables, which also implies that compared with young firms, the mature firms lack the incentives to improve their innovation performance.

[Insert Table 4 Here]

4.2 Heterogenous effects of returnee managers on the international knowledge inflows

Though the above findings support that the returnee managers can bring international knowledge inflows into domestic firms via labor mobility, we still need a deeper understanding of how this mechanism works. Therefore, we further check how the managers' IC varies with the foreign country where they worked and the different abroad work backgrounds they obtained. To do this, we first construct a weighted innovation capacity index for all returnee managers in each firm for every year as follows:

$$WeightInnov_{i,t} = \sum GII_j \times LnInnovOriented_{i,j,t} \tag{3}$$

In the above equation, GII_j is the Global Innovation-level (GII) Index[4] of each country j, and $LnInnovOriented_{i,j,t}$ is the log number of managers returning from the country abroad j who now work in firm i in year t. Therefore, the $WeightInnov_{i,t}$ is the sum of the number of returnee managers weighted with each manager's return country's Global Innovation-level Index. The weighting information can also be found in Appendix B; the higher a country's innovation index ranking, the greater the country's weight. After we construct the weighted innovation capacity index, we then use the weighted index in our regression model to check the assumption that the managers returning from countries with higher innovative capacities will bring more knowledge inflows to the domestic firms. We then use the following specification to reinforce our argument:

$$Ln(FPCiting_{i,t}) = \alpha + \beta WeightInnov_{i,t} + \lambda X_{i,t} + \varepsilon_{i,t} \tag{4}$$

In specification (4), variable $Ln(FPCiting_{i,t})$ demonstrates the citing number of the total foreign patents of firm i in year t, and $WeightInnov_{i,t}$ is the weighted innovation capacity index . Then, the coefficient β captures our estimation result. We show the regression results in Table 5. From Table 5, we see that there is a significant positive coefficient of $WeightInnov_{i,t}$, which supports that a positive correlation exists between the foreign patent citing numbers and the weighted innovation capacity index. This finding suggest that, if the returnee managers come back from countries with higher innovative capacities, then they bring more international knowledge inflows.

[Insert Table 5 Here]

Finally, we check the foreign working backgrounds' impacts on the managers' capacity to bring knowledge inflows. Although the baseline regression results show that more managers with overseas backgrounds can bring more knowledge inflows, one question is whether the managers with certain specific work experiences can be more powerful in carrying foreign knowledge inflows to the domestic firms. Here, we proved this by running an additional regression, separating our concewhere i stands for the index firms, and t for the index time expressed in years. Our dependent variable $Ln(FPCiting_{i,t})$ is the logarithm of one plus the citing time of the foreign patent of firm i in year t, which is the proxy for the international knowledge inflows to firm i. Our main interest variable is $ReturneeManagers_{i,t}$, which is the logarithm of one plus the number of managers who ever worked overseas and now work in firm i in year t. To control for other variables' effects on firm cites' foreign patents, we add a matrix

[4]The Global Innovation-level (GII) Index is an index that ranges from 0 to 100, published by the WIPO, and is an authoritative index to rank the IC of countries around the world.

of control variables $X_{i,t}$ into our regression. rned independent variables by the number of managers with different overseas working experiences as follows:

$$Ln(FPCiting_{i,t}) = \alpha + \beta Ln(ReturneeManagers_{i,s,t}) + \lambda X_{i,t} + \varepsilon_{i,t} \tag{5}$$

In the above equation, our concerned variable $Ln(ReturneeManagers_{i,s,t}$ demonstrates the log of the number of returnee managers with specific work background s at firm i in year t. The work background variable includes the following: R&D, marketing, management, manufacture, designing, law, accounting, and human resources. $X_{i,t}$ is the control variables matrix; here, we keep the dependent variables fixed. The estimation results of equation (5) are shown on Table 6. From Table 6, we observe that the coefficients of the returnee managers' work backgrounds on the foreign patent citing numbers are different. The coefficients of managers with R&D, marketing, and management experience are positive and significant at the 1% level. However , we fail to find a similar result for the managers with other work experience, such as manufacture, design, accounting, law, and human resources (Appendix C). The heterogeneity of the regression coefficients in Table 6 supports our hypothesis 3 and implies that the managers with different working experiences bring different extents of knowledge flows to the domestic firms.

From Table 6, we observe that the firms' foreign patent citing numbers are significantly positively correlated with the number of managers who have R&D, marketing, and management work backgrounds. These findings are consistent with those of the previous literatures, which suggest that the employees who worked in R&D departments hold more research-related work experiences and have access to more of the source company's key technology. Therefore, the returnee managers who ever worked in R&D departments could bring more knowledge inflows back to China. At the same time, the managers who have marketing and management work experiences, in general, have considerable insights on the industry's future development because they have close access to the technology and patents through dealing with real issues happening in the market. Thus, marketing and management work experience is also an advantage for bringing more knowledge inflows to the domestic firms.

[Insert Table 6 Here]

4.3 Robustness Tests and Further Explorations

4.3.1 Instrumental Variable Analysis

In this section, we present a set of robustness checks for our empirical results. Though we find that the firms' international knowledge inflow is positively related with the log numbers of returnee managers in the firm, this result still suffers from the endogeneity problems. The country subsample regression results presented in Table 4 already yielded strong evidences that the baseline regression result is not derived by the unobservable firm characteristics variables correlated with both the international knowledge inflow and management international working experience. However, we still must address the reverse causality problem.

The baseline regression result shows a positive correaltion between the number of returnee managers and the foreign patent citing numbers, which is a proxy for the international knowledge inflows. However, the causality between the two factors has not been proved. Our hypothesis is that more returnee managers bring more international knowledge inflows to the firm and, therefore, the firm will start to cite more foreign patents, especially those from countries where the returnee managers worked. Nevertheless, one reverse causality concern is that it is the growth of foreign patent citations that stimulates a firm to hire more returnee managers. To address the reverse causality problem, we exploit an Instrument Variable (IV) Estimation in this section.

We use the managers' average salary level in the firm as the plausible exogenous instrumental variable (IV) to undertake a two-stage least square (2SLS) analysis. Given that the managers' average salary level is an important determinant factor for attracting returnee managers to work at the firm, it is not necessarily correlated with the firm's foreign patent citation numbers. When determining the number of overseas patent citations, firms make their decisions based on the firm's operation situation and technology development strategy instead of on the managers' salaries. Therefore, the managers' average salary level is an ideal plausible exogenous instrumental variable. We calculate this as the total salary amount offered to all managers in the firm divided by the total number of managers. The managers' salary information for each firm is collected from the RESSET database, while the manager number information is collected from the CSMAR database.

Before running the Instrument Variable (IV) Estimation, we check the validity of our instrument variable. Table 7 shows that the LM statistic test is 160.580, which is high enough to reject the null hypothesis that the model is underidentified. Then the F-statistic of weak identification test is 139.787, which demonstrates that the instrument variable is relevant and correlated with the endogenous re-

gressors. Since the number of our instrumental variable is just one, there is no need to perform an overidentification test. The above test results show that our instrument variable is valid. After, we run the baseline regression in the 2SLS analysis. The estimation result is shown on Table 7. From Table 7, we observe that a positive correlation between the number of returnee managers and the international knowledge inflow still exists and is significant at the 1% level. This result confirms that more returnee managers drive the firm to cite more foreign patents, and we can rule out the reverse causality problem in our estimation results.

[Insert Table 7 Here]

4.3.2 Regression with Lagged Explanatory Variables

Despite the instrumental variable method, we also use the lagged explanatory variable to further check the causality between the number of returnee managers and the foreign patent citing numbers in the firm. The assumption behind the lagged explanatory variables estimation is that if the returnee managers bring more international knowledge inflows and increase the foreign patent citing numbers in the corresponding firm, then the phenomena that firms cite more foreign patents should happen after they hire more returnee managers. Based on this assumption, we revise the dependent variables in the regression equation (2) from t to$t+1$ and $t+2$ and run the following regression:

$$Ln(FPCiting_{i,t+j}) = \alpha + \beta Ln(ReturneeManagers_{i,t}) + \lambda X_{i,t} + \varepsilon_{i,t} \text{ for } j = 1, 2 \tag{6}$$

The estimation results of equation 6 are shown in Table 7, columns 2 and 3. From column 2 and column 3, we see that the estimated coefficients on the variable $LnOverseas_{i,t+j}$ are significantly positive at the 5% level. This finding sheds light on the causality direction between the number of returnee managers and the citing number of the foreign patents, which proves that it is the returnee managers who increased the firm's foreign patent citing numbers.

4.3.3 Alternative definition of dependent variable

Finally, we check the firm size's effects on our estimation results. The previous literature suggests that a larger firm will cite more patents and have a greater demand for R&D expenditures (Chen et al., 2015; Yang et al., 2019). Although we have controlled the firm size in our baseline model, to rule out the firm size's effects on our estimation results and reinforce our inference, we re-estimated our baseline

regression by revising both $LnOverseas_{i,t}$ and $LnForeignCite_{i,t}$ into ratios, namely, $OverseasRatio_{i,t}$ and $ForeignCiteRatio_{i,t}$. The explanatory variable $OverseasRatio_{i,t}$ is equal to the proportion of returnee managers to total managers, and the dependent variable$ForeignCiteRatio_{i,t}$ is equal to the foreign patent citing numbers to the total patent citing numbers of the firm i in year t. Table 8 presents the estimation results with alternative dependent variables. From Table 8, we observe that there is still a significantly positive coefficient under the 5% or 10% level between the returnee managers ratio and the foreign patent citing number ratio. Thus, we could rule out the firm size's effects on our empirical results.

[Insert Table 8 Here]

5 Conclusion

This paper used panel data of Chinese listed firms from 2008 to 2017 to prove that the managers' labor mobility can promote knowledge spillovers in the international scope. Returnee managers can bring international knowledge inflows from the countries where they worked to the domestic firms. Using the number of foreign patent citations to measure international knowledge flows, we show that the scale of managers with overseas working experience do intensify the knowledge inflows from foreign countries and drive the firm to cite more foreign patents. This result is robust to various robustness checks.

Furthermore, we also find that this mechanism exists heterogeneously. The above finding is stronger for managers returning from countries with stronger innovation capacities and who worked in R&D, marketing, and management departments, which suggests that the managers who returned from innovation-oriented countries or held a position with close access to research development have a greater ability to carry knowledge inflows. They also tend to bring international knowledge inflows from the exact country where they worked.

Our paper indicates that managers who have international working experience can act as an important linkage of the knowledge spillovers between countries. Under the tide of deeper globalization as well as a harsher competitive environment, we suggest governments and firms draw more attention to attracting overseas talents and take advantage of the knowledge spillovers on the world.

Appendix

Appendix A. Variable definitions

Variable	Definition
Panel A: citation variables	
$LnForeignCite$	The natural log of one plus the number of foreign patent citations.
$LnUSCite$	The natural log of one plus the number of patent citations from the United States.
$LnUKCite$	The natural log of one plus the number of patent citations from the United Kingdom.
$LnCACite$	The natural log of one plus the number of patent citations from Canada.
$LnJPCite$	The natural log of one plus the number of patent citations from Japan.
$LnDECite$	The natural log of one plus the number of patent citations from Germany.
$LnFRCite$	The natural log of one plus the number of patent citations from France.
$LnKRCite$	The natural log of one plus the number of patent citations from South Korea.
Panel B: overseas experience variables	
$LnForeignWork$	The natural log of one plus the number of managers with foreign experience.
$LnUSWork$	The natural log of one plus the number of managers with the United States working experience.
$LnUKWork$	The natural log of one plus the number of managers with the United Kingdom working experience.
$LnCAWork$	The natural log of one plus the number of managers with Canada working experience.
$LnJPWork$	The natural log of one plus the number of managers with Japan working experience.
$LnDEWork$	The natural log of one plus the number of managers with the Germany working experience.
$LnFRWork$	The natural log of one plus the number of managers with France working experience.
$LnKRWork$	The natural log of one plus the number of managers with South Korea working experience.
$LnRDWork$	The natural log of one plus the number of managers with foreign R&D experience.
$LnMarketWork$	The natural log of one plus the number of managers with foreign marketing experience..
$LnManageWork$	The natural log of one plus the number of managers with foreign management experience.

Variable definitions (continued)

Variable	Definition
Panel C: other variable	
$RDRatio$	The ratio of total R&D expenditure divided by total revenue.
$FirmSize$	The natural log of total assets.
$EquityMultiplier$	The ratio of total assets divided by total equity.
ROE	Return on equity: The percentage of a company's after-tax income divided by its net assets.
$AssetTurnover$	The ratio of total revenue divided by average assets.
$RevenueGrowth$	The annual growth rate of total revenue.
$Ownership$	A dummy variable which equals 0 if firm is state-owned and equals to 1 if firm is private.
$FirmAge$	The year duration of firm since its establishment till now.
$Indepratio$	The ratio of independent directors number to the number of total directors in the board.

Appendix B. Country rankings: Global Innovation Index

This appendix presents the country rankings based on Global Innovation Index, published by World Intellectual Property Organization (WIPO) and the country weights we use to test hypothesis H2.

Weight	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
7	US (1)	US (11)	US (7)	UK (5)	UK (3)	UK (2)	UK (2)	UK (3)	US (4)	UK (4)
6	DE (2)	CA (12)	CA (8)	US (10)	US (5)	US (6)	US (5)	US (4)	UK (5)	US (6)
5	UK (4)	JP (13)	UK (10)	CA (12)	CA (11)	CA (12)	DE (12)	DE (10)	DE (9)	DE (9)
4	KR (6)	UK (14)	DE (12)	DE (15)	DE (15)	DE (13)	KR (14)	KR (11)	KR (11)	KR (12)
3	JP (9)	DE (16)	KR (16)	KR (21)	KR (18)	KR (16)	CA (16)	CA (15)	JP (14)	JP (13)
2	CA (11)	KR (20)	JP (20)	FR (24)	FR (20)	JP (21)	JP (19)	JP (16)	FR (15)	FR (16)
1	FR (19)	FR (22)	FR (22)	JP (25)	JP (22)	FR (22)	FR (21)	FR (18)	CA (18)	CA (18)
	CN (37)	CN (43)	CN (29)	CN (34)	CN (35)	CN (29)	CN (29)	CN (25)	CN (22)	CN (17)

Appendix C. Management professional background and international knowledge spillovers

This appendix presents the impact of management working background on international knowledge spillovers. The test variables include the log number of the number of managers with working background in manufacturing ($LnManuf_{i,t}$), design ($LnDesign_{i,t}$), accounting ($LnAcct_{i,t}$), law ($LnLaw_{i,t}$) and human resource ($LnHR_{i,t}$). 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.

	(1)	(2)	(3)	(4)	(5)
	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$
$LnManuf_{i,t}$	-0.035				
	(0.082)				
$LnDesign_{i,t}$		0.045			
		(0.099)			
$LnAcct_{i,t}$			-0.030		
			(0.019)		
$LnLaw_{i,t}$				-0.168	
				(0.121)	
$LnHR_{i,t}$					0.046
					(0.037)
$RDRatio$	2.350***	2.349***	2.331***	2.335***	2.347***
	(0.315)	(0.315)	(0.518)	(0.518)	(0.518)
$lnAsset$	0.089***	0.089***	0.089***	0.089***	0.089***
	(0.014)	(0.014)	(0.020)	(0.020)	(0.020)
$EquityMultiplier$	0.006	0.006	0.006	0.006	0.006
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
ROE	0.041	0.041	0.040	0.043	0.042
	(0.055)	(0.055)	(0.056)	(0.056)	(0.056)
$AssetTurnover$	-0.004	-0.005	-0.003	-0.003	-0.004
	(0.030)	(0.030)	(0.043)	(0.043)	(0.043)

	(1)	(2)	(3)	(4)	(5)
	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$
Ownership	-0.093**	-0.093**	-0.092**	-0.092**	-0.090**
	(0.045)	(0.045)	(0.039)	(0.039)	(0.039)
FirmAge	-0.002	-0.002	-0.003	-0.002	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
IndepRatio	0.006	0.006	0.001	0.004	0.007
	(0.091)	(0.091)	(0.115)	(0.115)	(0.115)
Constant	-1.576***	-1.574***	-1.533***	-1.580***	-1.574***
	(0.286)	(0.286)	(0.412)	(0.413)	(0.414)
Observations	22,527	22,527	22,520	22,520	22,520
R^2	0.738	0.738	0.738	0.738	0.738

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Figure 1: Distribution of Foreign Patent Citation Countries

This figure demonstrates the distribution of foreign patent sources countries. Data sources: PatSnap Database.

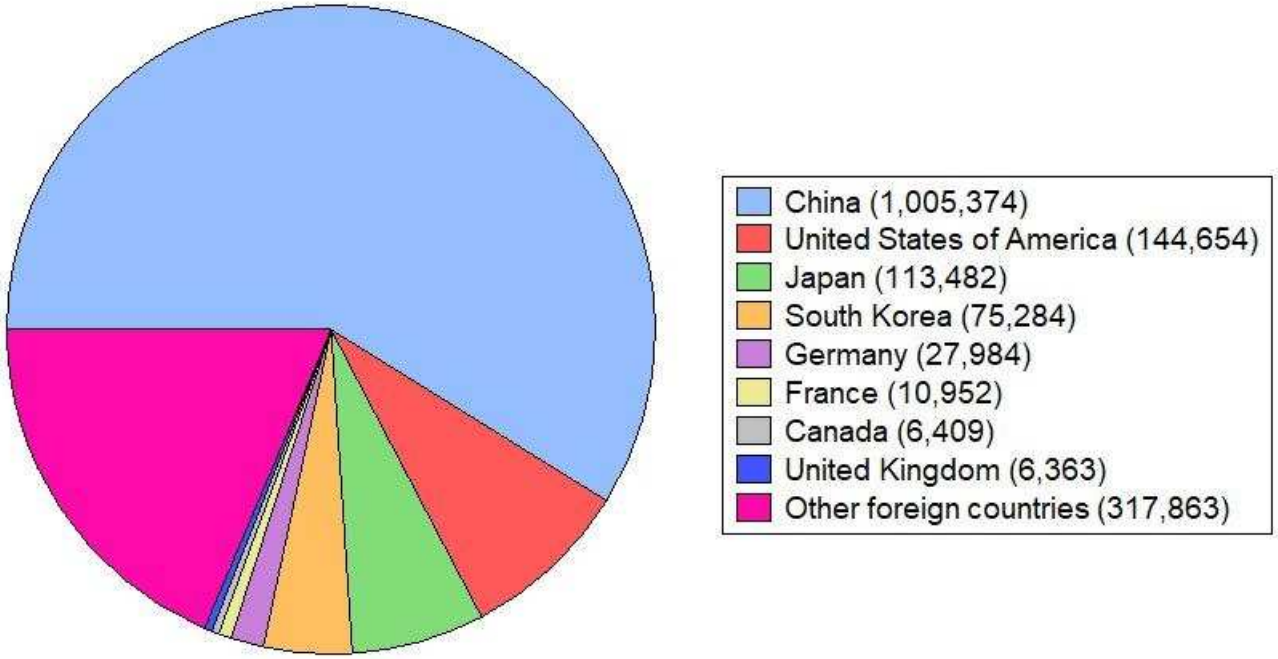

Figure 2: Time series of foreign patent citation change tendency

This figure demonstrates the time series change tendency of the total foreign patent cite numbers of all Chinese firms from year 2008 to year 2017. The figure shows a linearly increase tendency for the total foreign patent citation numbers in China, and the tendency is consistent with the fast development of innovation activities in China.

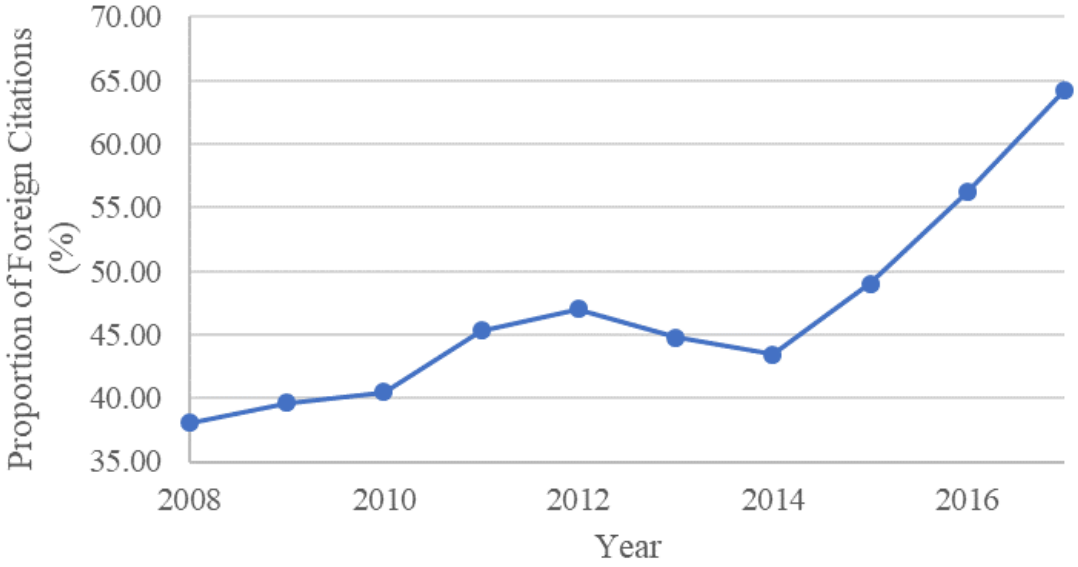

Table 1: Descriptive statistics.

This table reports descriptive statistics of the main variables defined in Appendix A. during the sample period 2008-2017. All continuous variables are winsorized at 1% at both tails.

Variables	N	Mean	Std. Dev.	Min	Max
Panel A: Variables of Foreign Citations					
ForeignCite	22,888	32.816	649.999	0	44,236
USCite	22,888	6.320	136.230	0	10,953
UKCite	22,888	0.278	4.631	0	296
CACite	22,888	0.280	7.153	0	629
JPCite	22,888	4.958	120.156	0	9,022
DECite	22,888	1.223	14.528	0	644
FRCite	22,888	0.479	8.438	0	544
KRCite	22,888	3.289	118.813	0	9,211
Panel B: Variables of Managerial Foreign Work Experience					
ForeignWork	22,888	0.271	0.731	0	11
USWork	22,888	0.053	0.283	0	7
UKWork	22,888	0.007	0.092	0	2
CAWork	22,888	0.008	0.104	0	4
JPWork	22,888	0.012	0.137	0	4
DEWork	22,888	0.006	0.090	0	4
FRWork	22,888	0.004	0.067	0	3
KRWork	22,888	0.003	0.075	0	4
RDWork	22,888	0.196	0.574	0	9
ManufWork	22,888	0.024	0.180	0	4
DesignWork	22,888	0.015	0.136	0	5
MarketWork	22,888	0.139	0.475	0	9
ManageWork	22,888	0.188	0.467	0	11
Panel C: Control Variables					
RDRatio	22,888	2.663	3.766	0.000	20.970
FirmSize	22,888	21.921	1.309	19.212	25.899
EquityMultiplier	22,888	2.432	1.887	0.000	12.979
ROE	22,639	0.064	0.126	-0.679	0.363
AssetTurnover	22,862	0.673	0.468	0.057	2.669
RevenueGrowth	22,866	0.166	0.375	-0.615	2.177
Ownership	22,888	0.579	0.494	0.000	1.000
FirmAge	22,888	15.766	6.035	0.000	74.000
IndepRatio	22,798	0.364	0.097	0.150	0.625

Table 2: 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 ***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)
$lnForeignCite$	(1)	1								
$lnForeignWork$	(2)	0.124***	1							
$RDRatio$	(3)	0.246***	0.183***	1						
$FirmSize$	(4)	0.136***	0.056***	-0.205***	1					
$EquityMultiplier$	(5)	-0.068***	-0.055***	-0.249***	0.339***	1				
ROE	(6)	0.068***	0.038***	0.022***	0.079***	-0.240***	1			
$AssetTurnover$	(7)	0.040***	-0.004	-0.184***	0.044***	0.055***	0.180***	1		
$RevenueGrowth$	(8)	-0.001	0.043***	0.016**	0.029***	0.012*	0.225***	0.111***	1	
$Ownership$	(9)	0.016**	0.129***	0.298***	-0.363***	-0.248***	0.083***	-0.061***	0.120***	1
$FirmAge$	(10)	-0.069***	-0.030***	-0.111***	0.161***	0.161***	-0.059***	-0.039***	-0.041***	-0.133***
$IndepRatio$	(11)	0.032***	0.032***	0.131***	-0.110***	-0.112***	-0.002	-0.014**	0.021***	0.217***

Table 3: Overseas experience and international knowledge spillovers.

This table presents the results of the impact of overseas experience on corporate international knowledge spillovers. The dependent variable $LnForeignCite_{i,t}$ is the logarithm of one plus foreign patent citations of firm i in year t. $LnOverseas_{i,t}$ is the log number of managers who have overseas work experience of firm i in year t. 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.

	(1)	(2)	(3)	(4)
	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$
$LnOverseas_{i,t}$	0.135***	0.271***	0.280***	0.080***
	(0.027)	(0.026)	(0.027)	(0.031)
$RDRatio_{i,t}$	0.042***	0.093***	0.098***	0.023***
	(0.003)	(0.003)	(0.003)	(0.003)
$FirmSize_{i,t}$	0.120***	0.235***	0.224***	0.087***
	(0.011)	(0.008)	(0.008)	(0.014)
$EquityMultiplier_{i,t}$	-0.004	-0.029***	-0.047***	0.006
	(0.005)	(0.005)	(0.005)	(0.005)
$ROE_{i,t}$	0.069	0.448***	0.177**	0.043
	(0.055)	(0.075)	(0.076)	(0.055)
$AssetTurnover_{i,t}$	0.070***	0.178***	0.216***	-0.005
	(0.025)	(0.021)	(0.020)	(0.030)
$RevenueGrowth_{i,t}$	-0.025	-0.016	-0.049**	-0.016
	(0.017)	(0.024)	(0.025)	(0.017)
$Ownership_{i,t}$	-0.036	-0.135***	-0.116***	-0.095**
	(0.032)	(0.021)	(0.022)	(0.045)
$FirmAge_{i,t}$	-0.021***	-0.010***	-0.014***	-0.002
	(0.003)	(0.002)	(0.002)	(0.004)
$IndepRatio_{i,t}$	0.060	-0.062	-0.025	0.011
	(0.086)	(0.092)	(0.094)	(0.091)
Constant	-2.126***	-4.799***	-4.478***	-1.528***
	(0.238)	(0.182)	(0.185)	(0.287)
Fixed Effect	Year	Year & Industry	Year & Location	Year & Firm
Observations	22,527	22,527	22,527	22,527
R^2	0.121	0.193	0.157	0.738

Table 4: Country-level managerial overseas experience and knowledge spillovers.

This table reports the results of the impact of country-level managerial overseas experience on country-level knowledge spillovers. $LnUSCite_{i,t}$, $LnUKCite_{i,t}$ and $LnCACite_{i,t}$ are the log number of patent citations from the United States, the United Kingdom and Canada of firm i in year t, respectively. $LnUSoverseas$, $LnUKoverseas$ and $lnCAoverseas$ are the log number of managers gaining overseas experience in United States, United Kingdom and Canada work experience of firm i at year t, respectively. 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.

	(1)	(2)	(3)
	$LnUSCite_{i,t}$	$LnUKCite_{i,t}$	$LnCACite_{i,t}$
$LnUSoverseas_{i,t}$	0.132***		
	(0.040)		
$LnUKoverseas_{i,t}$		0.143***	
		(0.044)	
$LnCAoverseas_{i,t}$			0.101***
			(0.035)
$RDRatio_{i,t}$	0.016***	0.004***	0.003***
	(0.002)	(0.001)	(0.001)
$FirmSize_{i,t}$	0.058***	0.014***	0.011***
	(0.009)	(0.004)	(0.003)
$EquityMultiplier_{i,t}$	-0.001	-0.001	0.001
	(0.003)	(0.001)	(0.001)
$ROE_{i,t}$	0.054	0.002	0.017
	(0.036)	(0.015)	(0.013)
$AssetTurnover_{i,t}$	0.007	0.013	0.008
	(0.019)	(0.008)	(0.007)
$RevenueGrowth_{i,t}$	-0.006	-0.003	-0.004
	(0.011)	(0.005)	(0.004)
$Ownership_{i,t}$	-0.040	-0.004	-0.011
	(0.029)	(0.012)	(0.011)
$FirmAge_{i,t}$	-0.006**	-0.001	-0.001
	(0.002)	(0.001)	(0.001)
$IndepRatio_{i,t}$	0.045	-0.051**	0.043*
	(0.059)	(0.024)	(0.022)
Constant	-1.076***	-0.276***	-0.231***
	(0.185)	(0.077)	(0.070)
Year Fixed Effect	YES	YES	YES
Firm Fixed Effect	YES	YES	YES
Observations	22,527	22,527	22,527
R^2	0.704	0.609	0.604

Table 5: Managers gaining experience in innovation-oriented countries.

This table reports the results the impact of managerial overseas experience gained in the innovation-oriented countries or regions on corporate international knowledge spillovers. The dependent variable $LnForeignCite_{i,t}$ is the logarithm of one plus foreign patent citations of firm i in year t. The test variables $LnInnovOriented_{i,t}$ and $LnInnovOriented_{i,t}$ (Weighted) are log number of managers from innovation-oriented countries and the log number of weighted sum of managers with overseas experience of firm i in year t, respectively. $LnOther_{i,t}$ stands for the log number of managers from other countries of firm i in year t. 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.

	(1)	(2)	(3)	(4)
	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$
$LnInnovOriented_{i,t}$	0.162***			
	(0.047)			
$LnInnovOriented_{i,t}$ ((Weighted))		0.080***	0.066***	0.069***
		(0.020)	(0.020)	(0.020)
$LnOther_{i,t}$	-0.007	0.008	-0.011	-0.008
	(0.034)	(0.034)	(0.034)	(0.034)
$RDRatio_{i,t}$	0.023***		0.023***	0.023***
	(0.003)		(0.003)	(0.003)
$FirmSize_{i,t}$	0.086***		0.0076***	0.086***
	(0.014)		(0.013)	(0.014)
$EquityMultiplier_{i,t}$	0.006			0.006
	(0.005)			(0.005)
$ROE_{i,t}$	0.043			0.043
	(0.055)			(0.055)
$AssetTurnover_{i,t}$	-0.004			-0.004
	(0.030)			(0.030)
$RevenueGrowth_{i,t}$	-0.016			-0.016
	(0.017)			(0.017)
$Ownership_{i,t}$	-0.094**			-0.093**
	(0.045)			(0.045)
$FirmAge_{i,t}$	-0.001			-0.001
	(0.004)			(0.004)
$IndepRatio_{i,t}$	0.014			0.012
	(0.091)			(0.091)
Constant	-1.532***	0.294***	-1.353***	-1.528***
	(0.287)	(0.021)	(0.270)	(0.287)
Year Fixed Effect	YES	YES	YES	YES
Firm Fixed Effect	YES	YES	YES	YES
Observations	22,527	22,527	22,527	22,527
R^2	0.738	0.738	0.738	0.738

Table 6: Manager's working background and international knowledge spillovers.

This table reports the estimation results for manager's overseas work background's effects on the international knowledge spillovers. The dependent variable $LnForeignCite_{i,t}$ is the logarithm of one plus foreign patent citations of firm i in year t. $LnRD_{i,t}$, $LnMarket_{i,t}$ and $LnManage_{i,t}$, respectively, are the log number of managers with professional experience in R&D, marketing and management for firm i in year t. 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.

	(1)	(2)	(3)
	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$	$LnForeignCite_{i,t}$
$lnRD_{i,t}$	0.043***		
	(0.015)		
$lnMarket_{i,t}$		0.104***	
		(0.036)	
$lnManage_{i,t}$			0.054***
			(0.013)
$RDRatio_{i,t}$	0.023***	0.023***	0.023***
	(0.003)	(0.003)	(0.003)
$FirmSize_{i,t}$	0.089**	0.087***	0.087**
	(0.033)	(0.014)	(0.033)
$EquityMultiplier_{i,t}$	0.006	0.006	0.007
	(0.006)	(0.005)	(0.006)
$ROE_{i,t}$	0.042	0.043	0.044
	(0.031)	(0.055)	(0.032)
$AssetTurnover_{i,t}$	-0.004	-0.004	-0.004
	(0.031)	(0.030)	(0.031)
$RevenueGrowth_{i,t}$	-0.016	-0.016	-0.016
	(0.015)	(0.017)	(0.015)
$Ownership_{i,t}$	-0.093*	-0.095**	-0.095*
	(0.048)	(0.045)	(0.048)
$FirmAge_{i,t}$	-0.002	-0.002	-0.002
	(0.006)	(0.004)	(0.006)
$IndepRatio_{i,t}$	0.008	0.015	0.009
	(0.070)	(0.091)	(0.071)
Constant	-1.566*	-1.535***	-1.535*
	(0.816)	(0.287)	(0.807)
Year Fixed Effect	YES	YES	YES
Firm Fixed Effect	YES	YES	YES
Observations	22,527	22,527	22,527
R^2	0.738	0.738	0.738

Table 7: Two-stage least squares (2SLS) regression with the instrument.

Column (1) in this table reports the 2SLS regression of the international knowledge spillovers ($LnForeignCite_{i,t}$) on managerial overseas experience ($LnOverseas_{i,t}$), with management average salary as the instrument variable. The last columns reports the the OLS regression of one- and two-year-ahead international knowledge inflow ($LnForeignCite_{i,t+1}$,$LnForeignCite_{i,t+2}$) on managerial overseas experience ($LnOverseas_{i,t}$). 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.

	(1)	(2)	(3)
	$LnOverseas_{i,t}$	$LnForeignCite_{i,t+1}$	$LnForeignCite_{i,t+2}$
$LnOverseas_{i,t}$	1.172***	0.087**	0.081**
	(0.373)	(0.035)	(0.040)
$RDRatio_{i,t}$	0.017***	0.008**	-0.008**
	(0.004)	(0.003)	(0.004)
$FirmSize_{i,t}$	0.053***	0.111***	0.093***
	(0.018)	(0.016)	(0.019)
$EquityMultiplier_{i,t}$	0.010*	0.000	-0.002
	(0.005)	(0.006)	(0.006)
$ROE_{i,t}$	0.073	0.145**	0.112*
	(0.058)	(0.059)	(0.063)
$AssetTurnover_{i,t}$	-0.016	-0.002	0.019
	(0.031)	(0.034)	(0.037)
$RevenueGrowth_{i,t}$	-0.017	0.006	0.010
	(0.018)	(0.019)	(0.021)
$Ownership_{i,t}$	-0.129***	-0.060	-0.019
	(0.047)	(0.050)	(0.058)
$FirmAge_{i,t}$	-0.006	-0.001	-0.037***
	(0.004)	(0.004)	(0.005)
$IndepRatio_{i,t}$	0.077	0.115	0.064
	(0.096)	(0.099)	(0.108)
Constant	-	-2.091***	-0.972**
	-	(0.328)	(0.380)
Year Fixed Effect	YES	YES	YES
Firm Fixed Effect	YES	YES	YES
Observations	22,058	18,986	16,014
R^2	-	0.762	0.790
LM Statistic	160.580	-	-
F Statistic	139.787	-	-

Table 8: The alternative measures of international knowledge spillovers and managerial overseas experience

This table reports the results of the impact of managerial overseas experience on international knowledge spillovers, using the ratio level of measurement of independent and dependent variables.

	(1)	(2)
	$ForeignCiteRatio_{i,t}$	$ForeignCiteRatio_{i,t+1}$
$OverseasRatio_{i,t}$	0.013*	0.020**
	(0.007)	(0.010)
$RDRatio_{i,t}$	0.000	-0.01**
	(0.001)	(0.001)
$FirmSize_{i,t}$	0.008***	0.009***
	(0.002)	(0.003)
$EquityMultiplier_{i,t}$	0.001	0.000
	(0.001)	(0.001)
$ROE_{i,t}$	0.013*	0.019*
	(0.007)	(0.010)
$AssetTurnover_{i,t}$	-0.005	0.003
	(0.006)	(0.006)
$RevenueGrowth_{i,t}$	0.002	0.001
	(0.003)	(0.003)
$Ownership_{i,t}$	0.003	-0.008
	(0.007)	(0.009)
$FirmAge_{i,t}$	-0.002***	-0.001*
	(0.000)	(0.001)
$IndepRatio_{i,t}$	-0.017	0.017
	(0.015)	(0.017)
Constant	-0.069	-0.105*
	(0.048)	(0.057)
Observations	22,527	18,986
R^2	0.577	0.594