Culturally Diverse Board and Corporate Innovation

Abstract

We investigate the role of culturally diverse board of directors on firm outcomes in China. We examine whether the diverseness of the educational, professional, and cultural backgrounds of board members influences firm innovation. We find that firms whose directors have international experience are more innovative. In addition, the positive cultural diversity effect is more pronounced for returnee directors with postgraduate and science-related degrees, and longer international work experience. Further, the directors who gain international experience from the countries with higher standards of management practice, corporate governance, and intellectual property rights protection have a higher impact on corporate innovative activities.

JEL classification: G34; G38; O31

Keywords: Board of directors; international experience; corporate innovation

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1. Introduction

The tactics of top management, such as their strategies, decisions, and visions, can greatly influence firm performance (Sullivan, 1994; Marquis and Qiao, 2020). Executives can gain a global mindset through their educational and/or professional experiences, both domestically and internationally, which will give them a broad view of the diversity of cultural values, visions, attitudes, and preferences in their business operations, strategies, and decision making (Wowak *et al*., 2016). Given today's competitive global economy, culturally diversity experience thus provides executives with better informational resources and skill sets (i.e., cultural capital), which should positively influence firm outcomes (Caligiuri *et al*., 2004; Jia et al., 2018).[1] While previous diversity research generally focuses on the executives' age, gender, ethnicity, and tenure (e.g., Chemmanur *et al*., 2018), in this paper we focus on the cultural background of the board and its impact on firm-level innovation.

In this study, we measure the cultural diversity of the board as the proportion of the board that has studied and/or worked overseas. While a firm's innovative activities are critical to its competitiveness and survival (e.g., Porter, 1990), firm innovation primarily relies on a firm's capacity to generate and adopt novel ideas (Thompson, 2003; Aggarwal and Woolley, 2019). As a key player in corporate governance, the board of directors is an important mechanism through which firms respond to innovation (Allemand *et al*., 2017). The board provides the firm with knowledge, information, skills, and connections, etc. (Mizruchi and Stearns, 1988). Specifically, a culturally diverse board is typically knowledgeable about

[1] While each has its own value, the diversity of educational, professional, and cultural backgrounds contributes to firms in a number of ways, such as higher absorptive capacity (e.g., Moreira, Markus, and Laursen, 2018), a more interactive flow of relevant knowledge skills and abilities (e.g., Earley and Mosakowski, 2000; Jang, 2017), higher creative and problem-solving abilities (e.g., De Dreu and West, 2001; Tesluk, Farr, and Klein, 2011) and increased socio-cognitive complexity (Murtha *et al*., 1998; Rickley, 2019).

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international competition, overseas operations, and suppliers that will enhance the innovative activities of the firm (Tesluk, Farr, and Klein, 2011). Therefore, a culturally diverse board provides the firm with a resource base that is relevant to the firm's exploratory and exploitative activities and consequently, should enhance corporate innovation.

It is evident that the value of information flows from the immigration of highly educated workers, which can accelerate economic development (Docquier and Rapoport, 2012, Burchardi *et al*., 2019). In developing countries like China, someone with an overseas graduate degree and/or work experience is considered elite (Bai, Tsang, and Xia, 2020). These returnees are viewed as intellectually competent, global minded, and proficient in foreign languages, in addition to their international connections (Zweig, 2006). For instance, the global mobility of talent and ideas contributed to China's economic growth in the past two decades. These returnees greatly facilitated the innovation and technological advancement in China (Fan, 2014). Hence, the institutional environment in China provides an important yet idiosyncratic setting to examine the conditional value of cultural board diversity.

We focus on Chinese market for at least two reasons. First, given the current challenging international business environment, Chinese firms experienced a severe shortage of talents with international experiences (Farrell and Grant, 2005). In a weak legal protection environment, several corporate governance problems in China were documented in literature: highly concentrated ownership structure, weak protection of shareholders' rights, frequent insider trading, weak auditing profession, etc (Lin, 2004; Jia et al., 2013). In Jan 2003, the Chinese Securities Regulatory Commission (CSRC) mandate that all the listed firms should appoint at least one-third independent directors on the boards. However, unlike developed countries, the labor market for directorship is relatively small in China. One of the important sources is the returnees who gained managerial and professional experiences in overseas. Therefore, to evaluate the value of such diversity brought by the overseas returnees is particularly important

for Chinese market. Second, the policy shock to recruit returnees in China represents an unique setting which allows us to utilise a quasi-experimental design to tackle the endogeneity issue. The board structure has an endogenous nature which limits our understanding of corporate governance issues (Adams et al., 2010). From 1994 to 2007, about 30 provinces in China adopted policies to attract highly skilled returnees at different times by a bunch of incentives such as housing subsidiaries, schooling of children, jobs for spouses etc. (Zweig, 2006). The staggered adoptions of these policies create exogenous supply shocks on the local labour market of the firm directors. This unique institutional setting helps us to establish a casual effect of board diversity.

In this paper, we explore whether the international education and work experience of the returnee directors influence a firm's innovative activities. We focus on the board only, since they are responsible for implementing and monitoring a firm's strategic decisions. The diverseness of the educational, professional, and cultural backgrounds of the board should have a direct impact on firm innovation (Fama and Jensen, 1983).

We collect the biographical features of all board members in A-share listed firms in the Shanghai and Shenzhen stock markets from 1990 to 2016 from the China Stock Market and Accounting Research (CSMAR) database and cross-check them with various online sources. We construct two proxies for cultural diversity: *Board ratio*, the proportion of board members with international experience, and *Board indicator*, a dummy variable when there is at least one director with (either study and/or work) international experience and zero otherwise.

We begin our multivariate analysis by regressing the measure of innovation (i.e., number of patents granted) on the measures of culture diversity. Consistent with our prediction, the baseline result reveals that firms with culturally diverse boards are associated with a higher number of granted patents than firms without such boards. This pattern holds in various regression specifications, including Poisson, negative binomial, zero-inflated Poisson, and

zero-inflated binomial models, as suggested by Hausman, Hall, and Griliches (1984) and Sunder *et al*. (2017). These findings suggest that the cultural diversity of a board boosts firm innovation.

To mitigate endogeneity concerns, we use an instrumental variable research design by utilising a policy shock in China. During 1994-2007, to attract overseas talent, 30 provinces in China adopted a series polices to recruit global talent. These policies included preferential treatments, such as housing subsidiaries, tax benefits, and funds to support investments (Zweig, 2006). The staggered adoptions of these recruitment policies and inter-city competition for returnees create an exogenous supply shock on the local labour market (Giannetti, 2015).[2] Therefore, we construct an instrumental variable indicating whether the province where the headquarters of the firm is located has adopted a recruitment policy. We then conduct a two-stage least squares (2SLS) and the Heckman (1974) two-stage test. The results provide further support that a director's overseas experience has a positive effect on the firm's innovative activities.

We argue that a culturally diverse board can affect innovation through two mechanisms; an advising channel and a monitoring channel. In the advising channel, overseas returnees are generally characterized as highly educated with a wide range of task-relevant knowledge, expertise, skill, and abilities (Rivas, 2012). These characteristics enable creative and flexible reactions to competitive environments (i.e., technology). In addition, the diverseness of their educational and professional backgrounds provides the firm with different resources (e.g., knowledge, information, and connections), thereby creating a better environment for resource allocation and decision making (Tabesh *et al*., 2019). These cultural diversity-related factors should increase a firm's capacity to innovate.

[2] Since the introduction of the policies, the growth of the business sector (especially, new technology), coupled with China's fast-growing economy over the period have attracted large numbers of entrepreneurs who return to China and settle in the business sectors, especially in the science and technology industries.

In the monitoring channel, the board is generally regarded as an important mechanism in reducing the principal-agency conflict. Its monitoring role mitigates conflicts of interest and reduces information asymmetry, which enables the firm to achieve its goals more efficiently (Giannetti *et al*., 2015). In particular, the returnee directors are less likely to have strong local ties to institutional investors and politicians, hence can act more independently in their monitoring role (Fisman et al., 2020; Hu et al., 2020). In addition, culturally diverse directors will typically demonstrate superior management practices and adhere to a higher code of ethics. This should result in a reduction in moral hazard and managerial myopia. Moreover, directors with experience in countries with more stringent intellectual property rights protection are more likely to have a better awareness of the importance of innovation (Huang et al., 2017). Overall, this increased monitoring should alleviate agency problems that might otherwise undermine a firm's innovation efforts (Aghion *et al*., 2013).

To explore these two channels, we assess the characteristics of the returnee directors. For the advising channel, we focus on the educational background of returnee directors, based on level of overseas education, field of study, and international work experience. Consistent with our argument, firm innovation is higher for the returnee directors with postgraduate and science-related degrees and more international experience.

For the monitoring channel, we argue that the country (or countries) where the directors gained their overseas experience affects the innovation of the firm. Given different national cultures and legal systems, they affect individuals' values, attitudes, and behaviour and should affect the governance norms of their firms (Lichit *et al*., 2005; Haveman et al., 2017). We find that the positive effect of cultural diversity on innovation is more pronounced when the director's overseas experience is gained in countries with high firm governance, management practice, and intellectual property rights protection.

Our paper makes contributions to three main strands of literature. First, our work

enriches the emerging literature on cross-board technology transmission. Studies document that foreign direct investment (or namely foreign ownership), or cross-border mergers and acquisitions can transmit technology and stimulate firm innovation (e.g., Joel, 2016; Luong *et al*., 2017). In contrast, we investigate the impact of the decision maker's cultural background and position on a culturally diverse board as a key factor that shapes a firm's resource allocation and innovation activities. We highlight the human capital movement as an important mechanism of the transmission of advanced technology and management knowledge among countries.

Second, our paper also contributes to the literature on firm innovation. Recent studies address various factors that can affect a firm's innovation. For instance, Chemmanur, Loutskina, and Tian (2014) find that venture capital has a greater tolerance for failure, therefore nurturing a firm's innovation. Aghion et al. (2013) argue that institutional ownership can increase a firm's innovation by reducing a manager's career concern. Ferreira, Manso, and Silva (2014) show that public and private ownership have different impacts on firm innovation. Sunder et al. (2017) and Islam and Zein (2019) show that pilot CEOs and inventor CEOs generate greater innovation success. Hirshleifer et al. (2012) find that over-confident CEOs can better exploit innovation growth opportunities and foster innovation output. Chemmanur et al. (2018) show that high quality top managers engage in more risky innovation strategies. Chang et al. (2015) argue that the incentive compensation of non-executive employees is also an important determinant of firm innovation.We broaden this stream of literature by investigating the effect of returnee directors' knowledge and experience on firm innovation.

Third, our paper contributes to the literature on the impact of the characteristics of CEO and directors on firm performance. Prior studies observe the effect of foreign directors (Masulis et al., 2012) and CEO with international experience (Le and Kroll, 2017) on corporate governance and firm performance. The board diversity in terms of gender (Srinidhi et al., 2011),

ethnicity (Carter and Simkins, 2003), nationality (Garcia-Meca et al., 2015) are documented to have certain values on corporate governance. Our paper provides new insight on how the board diversity benefits a firm's innovation by examining the foreign experience of the Board of Directors in China.

The remainder of this paper is organized as follows. In Section 2, we describe the sample selection process and descriptive statistics. We present the main results in Section 3. Additional tests and robustness checks are reported in Sections 4 and 5. Concluding remarks are in Section 6.

2. Data Sources and Descriptive Statistics

2.1 Data sources and sample selection

We obtain financial information and board biography data for all the A-share listed firms in the Shanghai and Shenzhen stock markets from the China Stock Market and Accounting Research (CSMAR) database for 1990 to 2016. We cross-check the biographical information (e.g., including nationality, birthplace, gender, age, university attended, shareholding, salary, resume, and other personal information) of the board against the annual reports of the firms, their websites, and various online sources. After removing firms with missing financial, director biography, and patent information, the final sample includes 1,774 firms with 27,752 firm-year observations.

2.2 Measures of key variables

We measure the innovation activities of a firm using their patenting activities. The patent information is hand-collected from the Chinese Research Data Services Platform (CRNDS) database for 1990 to 2016 period. The database contains information on all patents granted by the Chinese State Intellectual Property Office since 1990. Our principal measure of innovation is the number of patents granted. To address a look-ahead bias discussed by Cao,

Jiang, and Ritter (2015), we measure a firm's innovation (*Patent*) in year *t* using number of patents granted from year *t* to year *t*+2, given that the patent approval process takes approximately two years. Due to the right-skewed distributions of patent counts, the natural logarithm of one plus *Patent* is applied when applicable.

As discussed above, we construct two proxies to measure cultural diversity: *Board ratio*, the proportion of board members with international experience, and *Board indicator*, a dummy variable when there is at least one director with (either study and/or work) international experience and zero otherwise.

2.3 Estimation method

To test whether a culturally diverse board enhances firm innovation, we employ an ordinary least squares (OLS) regression as follows:

$$Patent/Ln(Patent)_{i,t+n} = \alpha + \beta \times (cultural\ Diversity)_{i,t} + \gamma controls_{i,t} + e_{i,t}, \quad (1)$$

The key independent variable is the measures of cultural diversity (*Board ratio* or *Board indicator*). Following Chemmanur, Loutskina, and Tian (2014), we apply a control vector of firm characteristics in the models, which have been proven to influence a firm's innovation. These include *Firm size* (total assets of the firm); the Herfindahl-Hirschman Index (*HHI*) based on sales; *Leverage* (total liabilities divided by total assets); three profitability measures: *ROA* (operating income divided by total assets), *Q* (market-to-book ratio), and *Share return* (annually share return without dividend and reinvestment); *Capital expense* (total capital expenditure divided by total assets); *Tangibility* (tangible assets divided by total assets); and *Foreign ownership* (percentage of foreign institutional ownership). To capture the potential non-linear effect of market competition between firms that may impact innovation output, we also control for the squared HHI (Aghion *et al*., 2005). All control variables are winsorized at the 1% and 99% levels. We also include industry and year fixed effects in all models. Variable descriptions are in Appendix 1.

2.4 Descriptive statistics

Table 1 provides the summary statistics on the main variables. There are 45.62 patents per firm on average with a standard deviation of 286.84, exhibiting a great variation. About 47% of firm-year observations have at least one returnee director as indicated by the mean value of *Board indicator*. Returnee directors comprise 8% of the boards on average.

[Table 1 about here]

3. Results

In this section, we first discuss the baseline results. We then use an instrument variable approach and a Heckman two-stage approach to address the identification issues.

3.1 Baseline results

We now examine the relation between firm innovation and the cultural diversity of the board by regressing the measures of patents on the measures of cultural diversity. We control for firm characteristics that are likely correlated with firm innovation. We use robust standard errors clustered by firm throughout our analysis. To mitigate the concern of correlated omitted variables, we also estimate the models with industry and year fixed effects.

For the robustness, we utilize four more types of regression models in addition to the ordinary least squares (OLS) model, including Poisson, negative binomial, zero-inflated Poisson, and zero-inflated regressions. Following Hausman, Hall, and Griliches (1984), Hirshleifer *et al*. (2013), and Sunder, Sunder, and Zhang (2017), we use the innovation proxy of *Ln*(*Patent*) in our OLS regressions, while *Patent* is used in the other models.

Panel A of Table 2 provides the baseline regression results for *Patent*. Columns (1) to (5) present the results for *Board indicator* in all five alternative model specifications,[3] while

[3] Apart from the OLS regression, we conduct Poisson and negative binominal models by assuming different assumptions on the distribution of patents, following Hausman, Hall, and Griliches (1984). For instance, count variables tend to follow distributions like the Poisson or negative binomial, both of which are discrete and bounded.

columns (6) to (10) report the results for *Board ratio*. For each model specification, the estimated coefficients of cultural diversity (*Board indicator* and *Board ratio*) are all significantly positive in all the model specifications and are significant at the 1% level. These results suggest that the innovation activities of the firms with returnee directors outperform the firms without returnee directors. Thus, the results strongly support our conjecture that directors with international experience enhance firms' innovation outputs.

[Table 2 about here]

In terms of firm-specific control variables, we find that *Leverage* is significantly negatively associated with firm innovation, while ROA is positively related, as expected. In line with Aldatmaz and Celikyurt (2015), we find that large firms are more innovative than small firms.

3.2 Instrumental variable analyses

The main concern in examining the relationship between the foreign experience of board members with firms' innovation performance is the potential endogeneity problem. It is difficult to distinguish whether the foreign experienced directors increase innovation, or the innovative firms attract them. To tackle this issue, we conducted instrumental variables (IV) analyses by using the policy year dummy as our instrumental variable. The rationale is that, a series of policies have been adopted by provincial governments to attract skilled returnees since the late 1990s (Zweig, 2006) represents a so-called human capital supply shock in some degrees. The time line of the provincial recruitment of global talent policy in each province from 1994 to 2007 is collected from the Guidelines for Overseas Returnees to Set Up Ventures in China (Wang, Zeng, and Pu, 2011), and verified with Giannetti *et al*. (2015) and through various online sources. The staggered adoptions of these provincial policies and inter-city competition for talent returnees create exogenous labour supply shocks (see Appendix 2 for

Also, to mitigate the problem of excessive observations with zero patent counts, Sunder, Sunder, and Zhang (2017) address this issue with a zero-inflated and a zero-inflated negative binomial models.

details on the provincial policies). Therefore, an instrumental variable *Policy dummy* is constructed indicating whether the province where the headquarters of the firm is located has adopted such policy. With this instrumental variable, we utilize both the two-stage least squares (2SLS) and the Heckman (1974) two-stage tests.

The model we use for the two-stage least squares regression is

$$Board\ ratio_{i,t} = \alpha + \beta Policydummy_{i,t} + \gamma controls_{i,t} + IndustryFE + YearFE + e_{i,t} \quad (2)$$

$$Patent_{i,t} = \alpha + \beta fitted\ board\ ratio_{i,t} + \gamma controls_{i,t} + IndustryFE + YearFE + e_{i,t} \quad (3)$$

The *fitted board ratio* in the equation (3) is the predicted value of *Board ratio* in the equation (2).

To conduct the Heckman two-stage tests, we first estimate the inverse miller ratio (IMR) by predicting the probability of having directors with foreign experience on the board, and then control IMR in the second stage. The model we use is

$$Board\ indicator = \alpha + \beta policydummy_{i,t} + \gamma controls_{i,t} + IndustryFE + YearFE + e_{i,t} \quad (5)$$

$$Patent_{i,t} = \alpha + \beta board\_indicator_{i,t} + IMR_{i,t} + \gamma controls_{i,t} + IndustryFE + YearFE + e_{i,t} \quad (6)$$

Columns (1) and (2) of Table 3 provide the two-stage least squares (2SLS) regression results when the *Policy dummy* is used as the instrument variable. We find that the estimated coefficient of *board ratio* is positive and significant at 1.456, which provides support for the results in Table 2. The results of the Heckman two-stage model (columns (3) and (4)) provide further confirmation. Overall, the results in Table 3 indicate that after controlling for endogeneity and sample selection bias, our results are robust and thus confirm the important role of the cultural diversity of a board on firm innovation.

[Table 3 about here]

4. Underlying Mechanisms

In this section, we examine the economic mechanisms underlying our findings. Given the agency conflict, the board of directors is the core of firm governance. In addition, the personal attributes of the directors tend to influence innovation investment in the firm. Hence, to explain the positive effect of the board's cultural diversity, we focus on two elements relating to the directors' duties: the advising channel and the monitoring channel. While the advising channel relates to personal attributes (i.e., educational background) of the board, the monitoring channel is associated with firm governance.

For parsimony, we only report results based on *Board ratio* in this section and the remaining analyses. Results based on *Board indicator* are qualitatively the same, which is not surprising because these two measures are highly correlated.

4.1 Advising channel

In the advising channel, the returnee directors with more advanced professional skills or abundant industry-specific knowledge (i.e., obtained their degrees from technologically-advanced countries, level of education is Masters or PhD degrees) provide more technological and managerial advice and thus enhance firm innovation in a more efficient way (Jones and Romer, 2010). In contrast, returnees from a developing country may be incapable of doing so (Harzing, 2001). Therefore, for the advising channel, we focus on the educational background of returnee directors since it is important in firm governance and the development and implementation of complex business strategies (e.g., Sanders and Carpenter, 1998; Marquis and Qiao, 2020). Specifically, we focus on three components of returnee director educational background: level of education, field of study, and international work experience.

To identify the level of education of a returnee director, we employ dummy variable, *Degree dummy*, defined as equal to 1 if more than 50% of the returnee directors possess overseas postgraduate degrees, and is 0 otherwise. The rationale is that a postgraduate degree

normally involves a research component that is directly relevant to innovation. We next categorise the returnee directors' field of study using another dummy variable, *Science dummy*, where returnees who completed their overseas degrees in a science and/or engineering related field are giving a binary variable equal to 1 and is zero otherwise. While a science and/or engineering background is directly relevant to innovative activities, returnees with non-science related degrees will often provide management and business operations assistance. The length of international work experience is also important since it is directly related to the directors' advising capability and capacity to compete in an international environment. Hence, we define *Working length* as the number of years the returnee has worked overseas in a professional capacity.

Our variable of interest is the interaction term in each model that captures the change in innovation activities for firms with a higher proportion of returnee directors, relative to the change for firms with a lower proportion of returned directors, conditional on the educational background of the directors. We find that the coefficients on the interaction term in Table 4 are consistently positive. For instance, in column (1), the estimated coefficients of the interaction term, *Board ratio*Degree dummy*, are positive and significant at the 1% level, suggesting that returnee directors with postgraduate degrees significantly improve firms' innovative activities. The results in column (2) indicate that returnee directors with science and/or engineering related degrees have a greater impact on the number of patents granted. Columns (3) and (4) present the regression results relating to international work experience. Not surprising, the results suggest that the length of director international work experience positively affects a firms' innovation. Overall, the results in Table 4 provide strong support for the advising channel.

[Table 4 about here]

4.2 Monitoring channel

Directors with international experience from countries with higher standards of

corporate governance may perform a better monitoring role and enhance firm governance. This can be attributed to their expertise accumulated abroad (Giannetti, Liao, and Yu, 2015). International experience also partially resolves the moral hazard problem, which may reduce the agency cost while increasing innovation incentives. Moreover, directors with international experience would likely demonstrate superior management practices, and exhibit a higher code of ethics, which may reduce moral hazard and managerial myopia. Finally, directors with international experience in countries with more stringent intellectual property rights protection are more likely to have a better awareness of the importance of innovation. All of these factors highlight the important role of the cultural diversity of a board since the countries where the directors obtained their educations and/or work experiences possess diverse cultural values and attitudes that will affect their innovation-related activities.

We employ three alternative national measures of firm governance. The first measure is based on the anti-director rights index developed by La Porta *et al*. (1998). The index captures the level of shareholder protection across 46 countries. Following Giannetti *et al*. (2015), we include Switzerland, Japan, Denmark, the United States, and Germany as the highest governance index countries. We create a dummy variable, *CG dummy*, that is equal to one if firms hired more than 50% of returnee directors whose education and/or work experience was in the highest governance index countries, and is zero otherwise. The second measure is based on the country monitoring production index reported in Bloom *et al*. (2012). This index captures the quality of management practices, such as modern management techniques, reducing cost, and improving quality, in select countries (Bloom and Van, 2007). Following Giannetti *et al*. (2015), we include the U.S., Japan, and Germany as the highest management practice countries. Similarly, we construct a dummy variable, *MP dummy*. which is equal to one when the firms hire more than 50% of returnee directors from the highest monitoring practice countries, and is zero otherwise. The third measure is based on the global intellectual property index provided

by the 2009 Global Intellectual Property Index Report (GIPI 2) (Taylor Wessing, 2009).[4] In the report, the U.K., Germany, U.S., Australia, and the Netherlands are classified as Tier 1 intellectual property protection countries. Therefore, we construct a dummy variable, *IP dummy*, that is equal to one if firms hire greater than 50% of returnee directors whose education or work experience was in the Tier 1 intellectual property protection countries, and is zero otherwise.

In column (1) of Table 5, the coefficient of *Board ratio* is 0.775, which is significant at the 1% level. Again, our focus here is on the interaction term, *CG dummy*Board ratio*. The coefficient of the interaction term is 0.688, which is highly significant. This indicates that directors whose international work experience was in high firm governance countries have a relatively higher impact on firm innovation. Similarly, the estimated coefficients of the interaction terms *MP dummy*Board ratio* and *IP dummy*Board ratio* are all significantly positive at the 1% level. Overall, the results of Table 5 highlight that directors who gained their international experience in countries with high firm governance, management practices, and intellectual property rights protection exhibit a relatively higher influence on firm innovation, compared to their counterparts.

[Table 5 about here]

5. Robustness Checks

In this section, we provide robustness checks to confirm our main findings. To investigate whether there may be measurement errors with our key variable, we examine whether our conclusion holds when we use alternative proxies.

First, invention patents may be a more relevant proxy for innovation since they can measure the quality of a firm's patents (e.g., Hu and Jefferson, 2009). Therefore, we collect

[4] The report is found at: https://amarbheenick.blogspot.com/2009/05/taylor-wessing-launches-its-second.html

invention patent data and use it as an alternative measure of innovation. The results indicate that our conclusions remain unchanged (results available upon request).

Second, as an alternative measure of *Patent*, we construct a measure of the number of leaded 2 years patents granted . In unreported results (but available upon request), the estimated coefficients of the variables, both *Board ratio* and *Board indicator,* are positive and significant at the 1 % level. These results thus support our baseline results in Table 2.

Third, while our initiative is to assess the role of the cultural diversity of a board on firm performance, the scope of the cultural diversity may not be complete assessed by focusing solely on the international experience of the board (Caligiuri *et al*., 2004). Hence, we construct two similar proxies for the cultural diversity of the top managers (i.e. chief executive officer and chief financial officer), *Manager ratio* and *Manager indicator,* to evaluate the international experience of the top managers. The results support our position that the cultural diversity in the top management team also enhances the firm's innovation outputs (The robustness results are not tabulated but are available upon request.)

6. Conclusion

We explore the innovation output of a firm as it is an important determinant of its long-term competitive advantage and survival. We show that the cultural diversity of the board of directors matters, and the directors with international experience significantly enhance the innovation production of the firm.

We evaluate the advising and monitoring channels to examine the economic mechanisms of the value of cultural diversity. For the advising channel, we find that directors who hold an overseas postgraduate degree in a science or engineering related discipline and have more international work experience affect company innovative activities. For the monitoring channel, it appears that the positive effect of a culturally diverse board is more

apparent for the firms with returnee directors with international work experience in countries with higher standards of firm governance, management practises, and intellectual property rights protection lead to an increase in patent production.

By investigating the impact of the cultural exposure of firm decision makers and positioning the culturally diverse board as a key factor that shapes firms' resource allocation and innovative activities, we highlight the role of human capital movement as an important mechanism of the transmission of technology and management knowledge among countries. By doing so, we reveal the positive benefits of a culturally diverse board.

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Appendix 1: Variable Definitions

Variable	Definition
Dependent Variables	
Patent	The years patents are granted from year *t* to year *t*+2.
Ln(Patent)	The natural logarithm of the number of years patents are granted from year *t* to year *t*+2.
Independent Variables	
Board ratio	The number of returnee directors divided by board size.
Board indicator	A dummy variable that equals one if there is at least one returnee director, and zero otherwise.
Degree Dummy	A dummy variable that equals one if more than 50% of returnees have a postgraduate degree, and zero otherwise.
CG dummy	A dummy variable that equals one if over 50% of returnee directors are from the highest firm governance countries (Switzerland, Japan, Denmark, U.S., or Germany), and zero otherwise.
MP dummy	A dummy variable that equals one if over 50% of returnee directors are from the highest management practice countries (U.S., Japan, or Germany), and zero otherwise.
IP dummy	A dummy variable that equals one if over 50% of returnee directors are from Tier 1 intellectual property protection countries (U.K., Germany, U.S., Australia, or Netherlands), and zero otherwise.
Science dummy	A dummy variable that equals one if over 50% of returnee directors possess science and/or engineering related degrees from overseas, and zero otherwise.
Controls	
Ln(Firm size)	The natural logarithm of a firm's total assets.
HHI	The Herfindahl-Hirschman Index, classified by 3-digit industry code in China.
Squared HHI	The squared Herfindahl-Hirschman Index.
ROA	The operating income divided by total assets.
Leverage	Total liabilities divided by total assets.
Q	Market-to-book ratio of a firm.
Capital Expense	Total capital expenditures divided by firm's total assets.
Net Profit	Net profit divided by firm's total assets.
Share Return	Annually share return without dividend and reinvestment.
Tangibility	Tangible assets divided by firm's total assets.
Foreign Ownership	The percentage of foreign institutional ownership.

Appendix 2: The Impact of Policies to Attract Skilled Returnees

This table shows the policy adoption year in each province, the total number of sample firms, and the ratio of senior level returnees with overseas experience in each province before and after the adoption. The sample period is from 1990 to 2010. "Policy Year" is the year that the policy was adopted. "Before" corresponds to firm level observations before and during the policy year. "After" corresponds to observations after the policy year. "Ratio" is the percentage of the observations.

					Firm Year		Ratio	
Province	**Policy Year**	**No. of Firms**	**%**	**Total**	**Before**	**After**	**Before**	**After**
Anhui	1994	54	0.030	767	5	762	1.25%	4.36%
Beijing	2000	140	0.079	1752	183	1569	4.20%	10.12%
Chongqing	2005	38	0.021	592	246	346	2.54%	5.73%
Fujian	2000	69	0.039	990	195	795	1.62%	6.87%
Gansu	2003	24	0.014	354	104	250	0.75%	2.49%
Guangdong	1999	171	0.096	2951	610	2341	1.62%	11.38%
Guangxi	2005	29	0.016	432	162	270	2.28%	5.40%
Guizhou	2003	19	0.011	295	84	211	1.69%	4.80%
Hainan	2001	28	0.016	498	142	356	2.69%	5.47%
Hebei	2001	38	0.021	631	130	501	0.82%	3.61%
Heilongjiang	2002	38	0.021	613	181	432	0.53%	4.61%
Henan	1992	41	0.023	604	0	604	0.00%	2.89%
Hubei	2002	66	0.037	1156	315	841	0.89%	4.92%
Hunan	2001	54	0.030	795	148	647	0.52%	7.29%
Inner Mongolia	2001	22	0.012	379	75	304	0.74%	2.03%
Jiangsu	2004	152	0.086	1698	509	1189	3.01%	5.14%
Jiangxi	2003	25	0.014	434	121	313	2.95%	5.24%
Jilin	2001	40	0.023	684	176	508	0.34%	4.34%
Liaoning	1999	66	0.037	1077	180	897	0.98%	4.95%
Ningxia	2003	11	0.006	208	65	143	1.55%	2.95%
Qinghai	1999	11	0.006	185	28	157	0.81%	3.75%
Shaanxi	1995	33	0.019	524	15	509	0.00%	4.10%
Shandong	2005	92	0.052	1375	554	821	2.97%	5.74%
Shanghai	2005	181	0.102	3072	1518	1554	3.09%	8.24%
Shanxi	2007	26	0.015	449	215	234	2.55%	3.06%
Sichuan	2005	73	0.041	1290	593	697	1.97%	4.26%
Tianjin	2001	29	0.016	463	89	374	1.26%	7.70%
Tibet	NA	10	0.006	158	NA	NA	NA	NA
Xinjiang	2003	33	0.019	494	135	359	1.31%	3.11%
Yunnan	2001	22	0.012	396	86	310	1.00%	4.26%
Zhejiang	2001	139	0.078	1436	249	1187	2.05%	6.12%

Table 1: **Summary Statistics**

This table presents summary statistics of main variables. *Patent* is the number of 3 years granted patents of a firm from year *t* to *t+2*. *Board ratio* is the number of directors with international experience divided by board size. *Board indicator* is a dummy variable which equals 1 if there is at least one returnee director, and zero otherwise. *Degree dummy* is a dummy variable which equals one if more than 50% of returnee directors have a postgraduate degree, and zero otherwise. *CG dummy* is a dummy variable which equals one if more than 50% of returnee directors are from the highest firm governance countries, and zero otherwise. *MP dummy* is a dummy variable which equals one if more than 50% of returnee directors are form the highest management practice countries, and zero otherwise. *IP dummy* is a dummy variable which equals one if more than 50% of the returnee directors are from tier one IP protection countries, and zero otherwise. *Science dummy* is a dummy variable that equals one if over 50% of returnee directors gained science related degree overseas, and zero otherwise. *Ln(Firm size)* is the natural logarithm of firm's total asset. *HHI* is the Herfindahl-Hirschman Index, classified by 3-digit industry code. *Tangibility* is the tangible asset divided by total asset. *Foreign Ownership* is the percentage of foreign institutional ownership in a firm. *Leverage* is the total liabilities divided by total asset. *Capital Expense* is the total capital expense divided by total asset. *Net Profit* is the net income divided by total asset. *ROA* is the operating income divided by total assets. *Q* is the market to book ratio. *Share Return* is the annually share return without dividend and reinvestment. All control variables are winsorized at the 1% and 99% levels.

	Mean	**Median**	**Std. Dev.**	**Obs.**
Dependent Variable				
Patent	45.62	1.00	286.84	26,752
Independent Variables				
Board ratio	0.08	0.00	0.11	24,619
Board indicator	0.47	0.00	0.50	24,619
Degree dummy	0.26	0	0.37	24,619
CG dummy	0.87	0.3	1.50	24,619
MP dummy	0.45	0.5	0.43	24,619
IP dummy	0.53	0.5	0.42	24,619
Science dummy	0.43	0.33	0.43	24,619
Controls				
Ln(Firm size)	16.96	20.66	5.83	26,442
HHI	0.13	0.08	0.13	26,506
Tangibility	0.20	0.15	0.18	26,749
Foreign Ownership	0.15	0.00	0.93	26,752
Leverage	0.78	0.57	14.43	26,751
Capital Expense	3.38	0.12	4.00	24,640
Net Profit	0.04	0.04	0.09	26,526
ROA	0.03	0.03	0.76	26,748
Q	2.21	1.40	17.31	26,442
Share Return	0.25	0.00	0.77	26,612

Table 2: **Main Results**

Panel A reports the effect of *Board ratio* and *Board indicator* on *Ln(Patent)* under different model settings: OLS (columns (1) and (6)), Poisson (columns (2) and (7)), negative binomial (columns (3) and (8)), zero-inflated Poisson (columns (4) and (9)), and zero-inflated negative binomial (columns (5) and (10)). The dependent variable *Patent* is the years patents are granted from year *t* to year *t*+2. *Board ratio* is the number of returnee directors divided by board size. *Board indicator* is a dummy variable which equals one if there is at least one returnee director, and zero otherwise. *Ln(Firm size)* is the natural logarithm of firm's total asset. *HHI* is the Herfindahl-Hirschman Index, classified by 3-digit industry code. *Tangibility* is the tangible asset divided by total asset. *Foreign Ownership* is the percentage of foreign institutional ownership in a firm. *Leverage* is the total liabilities divided by total asset. *Capital Expense* is the total capital expense divided by total asset. *ROA* is the operating income divided by total assets. *Q* is the market to book ratio. *Share Return* is the annually share return without dividend and reinvestment. The clustered standard errors at the year level are reported in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Ln(Patent)	*Patent*				*Ln(Patent)*	*Patent*			
	OLS	Poisson	Negative Binomial	Zero-inflated	Zero-inflated Negative Binomial	OLS	Poisson	Negative Binomial	Zero-inflated	Zero-inflated Negative Binomial
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Board ratio	0.870***	1.436***	1.025***	1.365***	0.880***					
	(0.088)	(0.007)	(0.128)	(0.007)	(0.139)					
Board indicator						0.181***	0.461***	0.229***	0.470***	0.187***
						(0.019)	(0.002)	(0.028)	(0.002)	(0.031)
Ln(Firm size)	0.559***	1.227***	1.001***	1.347***	1.037***	0.564***	1.232***	1.013***	1.352***	1.050***
	(0.015)	(0.002)	(0.022)	(0.002)	(0.026)	(0.015)	(0.002)	(0.022)	(0.002)	(0.026)
HHI	10.153***	2.610***	-4.613***	3.429***	-4.794***	10.166***	2.593***	-4.530***	3.366***	-4.824***
	(0.635)	(0.108)	(0.965)	(0.115)	(1.203)	(0.635)	(0.109)	(0.965)	(0.115)	(1.202)
Squared HHI	-17.253***	-5.041***	8.363***	-4.704***	8.088***	-17.289***	-5.463***	8.114***	-4.938***	8.025***
	(1.401)	(0.227)	(2.082)	(0.247)	(2.458)	(1.401)	(0.227)	(2.082)	(0.248)	(2.454)
ROA	0.773***	1.556***	1.800***	2.054***	1.309***	0.762***	1.547***	1.764***	2.112***	1.294***
	(0.144)	(0.022)	(0.221)	(0.024)	(0.285)	(0.144)	(0.022)	(0.221)	(0.024)	(0.286)
Leverage	-0.147***	-1.610***	-0.321***	-1.680***	-0.634***	-0.151***	-1.637***	-0.313***	-1.707***	-0.629***
	(0.043)	(0.005)	(0.065)	(0.006)	(0.071)	(0.043)	(0.005)	(0.065)	(0.005)	(0.071)
Q	-0.066***	-0.281***	-0.132***	-0.275***	-0.085***	-0.065***	-0.291***	-0.133***	-0.286***	-0.087***
	(0.007)	(0.001)	(0.010)	(0.001)	(0.011)	(0.007)	(0.001)	(0.010)	(0.001)	(0.011)
Capital expenses	0.325***	0.333***	0.172***	0.181***	0.170***	0.326***	0.328***	0.170***	0.169***	0.166***
	(0.014)	(0.002)	(0.021)	(0.002)	(0.020)	(0.014)	(0.002)	(0.021)	(0.002)	(0.020)
Tangibility	-0.059	1.356***	0.600***	1.471***	0.933***	-0.059	1.450***	0.627***	1.574***	0.947***
	(0.149)	(0.021)	(0.222)	(0.022)	(0.254)	(0.149)	(0.021)	(0.222)	(0.022)	(0.253)
Share Return	-0.063***	0.0001	-0.082***	0.049***	-0.008	-0.066***	-0.014***	-0.088***	0.033***	-0.012
	(0.020)	(0.002)	(0.029)	(0.002)	(0.029)	(0.020)	(0.002)	(0.029)	(0.002)	(0.029)
Foreign ownership	0.071***	0.102***	0.030	0.122***	0.089***	0.075***	0.101***	0.029	0.116***	0.088***
	(0.018)	(0.001)	(0.026)	(0.001)	(0.027)	(0.018)	(0.001)	(0.026)	(0.001)	(0.027)
Industry and Year	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	22,939	22,939	22,939	13,424	13,424	22,939	22,939	22,939	13,424	13,424
Adjusted R^2	0.452					0.452				

Table 3: Results of Instrument Variable Analysis and Heckman Two-stage Model

This table reports the instrument variable regression results and Heckman two-stage test results. In the first stage of IV analysis, we regress the instrument variable *Policy dummy* on dependent variables. In the second stage, we estimate the model using fitted value of variable *Board indicator* or *Board ratio*. The dependent variable is *Ln*(*Patent*). In the first stage of the Heckman test regression, we use a probit model with the instrumental variable *Policy dummy* to estimate the inverse Mills ratio (*IMR*), and include it in the second stage. *Ln(Firm size)* is the natural logarithm of firm's total asset. *HHI* is the Herfindahl-Hirschman Index, classified by 3-digit industry code. *Tangibility* is the tangible asset divided by total asset. *Foreign Ownership* is the percentage of foreign institutional ownership in a firm. *Leverage* is the total liabilities divided by total asset. *Capital Expense* is the total capital expense divided by total asset. *ROA* is the operating income divided by total assets. *Q* is the market to book ratio. *Share Return* is the annually share return without dividend and reinvestment. The clustered standard errors at the year level are reported in the parentheses. ***, **, and * stand for the significance at the 1%, 5%, and 10% levels, respectively.

	Instrumental Variable		Heckman	
	Stage1*:* *Board ratio*	Stage 2: *Ln(Patent)*	Stage1*:* *Board indicator*	Stage 2: *Ln(Patent)*
	OLS	OLS	Probit	OLS
	(1)	(2)	(3)	(4)
Policy dummy	0.031***		0.653***	
	(0.002)		(0.040)	
Board ratio		1.456***		
		(0.111)		
Board indicator				0.218***
				(0.019)
IMR				-0.016
				(0.013)
Ln(Firm size)	0.002***	0.546***	0.015	0.559***
	(0.0005)	(0.015)	(0.010)	(0.015)
HHI	0.052*	10.164***	0.685	10.149***
	(0.028)	(0.634)	(0.658)	(0.634)
Squared HHI	-0.074	-17.235***	-0.024	-17.211***
	(0.064)	(1.398)	(1.523)	(1.400)
ROA	0.020**	0.761***	0.289	0.757***
	(0.008)	(0.143)	(0.182)	(0.143)
Leverage	-0.004	-0.151***	-0.035	-0.154***
	(0.003)	(0.043)	(0.065)	(0.043)
Q	-0.003***	-0.064***	-0.057***	-0.066***
	(0.0004)	(0.007)	(0.009)	(0.007)
Capital Expense	0.003***	0.322***	0.049***	0.324***
	(0.001)	(0.014)	(0.015)	(0.014)
Tangibility	-0.050***	-0.039	-1.551***	-0.049
	(0.010)	(0.149)	(0.243)	(0.149)
Share Return	0.002**	-0.063***	0.046***	-0.065***
	(0.001)	(0.020)	(0.016)	(0.020)
Foreign Ownership	0.007***	0.064***	0.121***	0.075***
	(0.001)	(0.018)	(0.026)	(0.018)
Industry fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Observations	19,850	19,850	19,850	19,850
Adjusted R^2	0.581	0.454		0.453

Table 4: Advising Channel

This table reports the results of the advising channel. The variable definitions are in Appendix 1. The dependent variable is *Ln*(*Patent*). *Degree dummy* is a dummy variable which equals one if more than 50% of returnee directors have a postgraduate degree, and zero otherwise. *Science dummy* is a dummy variable that equals one if over 50% of returnee directors gained science related degree overseas, and zero otherwise. *Ln(Firm size)* is the natural logarithm of firm's total asset. *HHI* is the Herfindahl-Hirschman Index, classified by 3-digit industry code. *Tangibility* is the tangible asset divided by total asset. *Foreign Ownership* is the percentage of foreign institutional ownership in a firm. *Leverage* is the total liabilities divided by total asset. *Capital Expense* is the total capital expense divided by total asset. *ROA* is the operating income divided by total assets. *Q* is the market to book ratio. *Share Return* is the annually share return without dividend and reinvestment. The clustered standard errors at the year level are reported in the parentheses. ***, **, and * stand for the significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Board ratio	0.307*	0.397**	0.890***	
	(0.164)	(0.177)	(0.150)	
Degree dummy	-0.068			
	(0.052)			
Science dummy		-0.063		
		(0.048)		
Board ratio Degree dummy*	1.677***			
	(0.282)			
Board ratio Science dummy*		1.132***		
		(0.269)		
Ln(Working length)			0.100***	0.118***
			(0.016)	(0.016)
Ln(Firm size)	0.587***	0.598***	0.620***	0.638***
	(0.020)	(0.020)	(0.023)	(0.023)
HHI	9.173***	9.342***	9.084***	9.067***
	(0.915)	(0.917)	(1.073)	(1.076)
Squared HHI	-15.490***	-15.857***	-15.138***	-15.083***
	(2.012)	(2.015)	(2.381)	(2.385)
ROA	0.594***	0.603***	0.222	0.220
	(0.214)	(0.214)	(0.249)	(0.249)
Leverage	-0.326***	-0.323***	-0.268***	-0.276***
	(0.064)	(0.064)	(0.074)	(0.074)
Q	-0.095***	-0.095***	-0.114***	-0.113***
	(0.010)	(0.010)	(0.011)	(0.011)
Capital Expense	0.331***	0.333***	0.330***	0.332***
	(0.020)	(0.020)	(0.024)	(0.024)
Tangibility	0.125	0.132	0.327	0.323
	(0.214)	(0.214)	(0.253)	(0.253)
Share Return	-0.037	-0.039	-0.014	-0.019
	(0.027)	(0.027)	(0.032)	(0.032)
Foreign Ownership	0.078***	0.077***	0.050*	0.055**
	(0.024)	(0.024)	(0.027)	(0.027)
Industry fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Observations	11,785	11,785	8,566	8,566
Adjusted R^2	0.484	0.482	0.500	0.498

Table 5: Monitoring Channel

This table reports the results of the monitoring channel. *Patent* is the number of three years granted patents of a firm from year *t* to *t*+2. *Board ratio* is the number of returnee directors divided by board size. *Board indicator* is a dummy variable which equals one if there is at least one returnee director, and zero otherwise. *CG dummy* is a dummy variable that equals one if over 50% of returnee directors are from the highest firm governance countries, and zero otherwise. *MP dummy* is a dummy variable which equals one if over 50% of returnee directors are from the highest management practice countries, and zero otherwise. *IP dummy* is a dummy variable that equals one if over 50% of returnee directors are from tier one IP protection countries, and zero otherwise. *Ln(Firm size)* is the natural logarithm of firm's total asset. *HHI* is the Herfindahl-Hirschman Index, classified by 3-digit industry code. *Tangibility* is the tangible asset divided by total asset. *Foreign Ownership* is the percentage of foreign institutional ownership in a firm. *Leverage* is the total liabilities divided by total asset. *Capital Expense* is the total capital expense divided by total asset. *ROA* is the operating income divided by total assets. *Q* is the market to book ratio. *Share Return* is the annually share return without dividend and reinvestment. The clustered standard errors at the year level are reported in the parentheses. ***, **, and * stand for the significance at the 1%, 5%, and 10% levels, respectively.

	Dependent variable: *Ln(Patent)*		
	(1)	(2)	(3)
Board ratio	0.775***	0.341*	0.335
	(0.173)	(0.192)	(0.210)
CG dummy	0.065		
	(0.049)		
MP dummy		0.198***	
		(0.047)	
IP dummy			0.086*
			(0.048)
Board ratio CG dummy*	0.688**		
	(0.277)		
Board ratio MP dummy*		0.920***	
		(0.265)	
Board ratio IP dummy*			0.844***
			(0.271)
Ln(Firm size)	0.601***	0.596***	0.594***
	(0.020)	(0.020)	(0.020)
HHI	9.250***	9.091***	9.262***
	(0.916)	(0.912)	(0.915)
Squared HHI	-15.856***	-15.550***	-15.709***
	(2.014)	(2.004)	(2.012)
ROA	0.612***	0.619***	0.596***
	(0.214)	(0.213)	(0.214)
Leverage	-0.311***	-0.304***	-0.316***
	(0.064)	(0.064)	(0.064)
Q	-0.093***	-0.095***	-0.097***
	(0.010)	(0.010)	(0.010)
Capital Expense	0.338***	0.323***	0.330***
	(0.020)	(0.020)	(0.020)
Tangibility	0.179	0.197	0.176
	(0.214)	(0.213)	(0.214)
Share Return	-0.042	-0.040	-0.036
	(0.027)	(0.027)	(0.027)
Foreign Ownership	0.076***	0.087***	0.083***
	(0.024)	(0.023)	(0.024)
Constant	-14.354***	-14.296***	-14.192***
	(0.578)	(0.575)	(0.578)
Industry fixed effect	YES	YES	YES
Year fixed effect	YES	YES	YES
Observations	11,785	11,785	11,785
Adjusted R^2	0.482	0.488	0.483