3-10-2013

The Effects of Corporate Governance on the Innovation Performance of Chinese SMEs

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The Effects of Corporate Governance on the Innovation Performance of Chinese SMEs*

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March 10, 2013

Abstract

We investigate the degree to which corporate governance and ownership affects the innovation performance of firms in China with a particular focus on privately owned small and medium enterprises (SMEs). We hypothesize that (1) board-related governance measures will enhance innovation because they improve monitoring and provide access to necessary resources; (2) ownership concentration initially facilitates innovation because large shareholders are more likely to commit to the long-term nature of innovation, and have the incentive to monitor managers whose time horizon may be shorter; however we argue that these effects weaken as large shareholders becomes entrenched at higher levels of concentration; and (3) hiring an external CEO will enhance innovation both by ensuring professional management of the company, and by alleviating the entrenchment possibilities associated with large shareholders. These hypotheses are tested using a unique sample of 370 mostly private and relatively small Chinese firms in Zhejiang province, for the period 2004 to 2006. The results suggest that for this sample, corporate governance and ownership affect innovation activity when measured by patenting activity, but not when measured by new product sales. *JEL classification:* M1, M2, O3 *Keywords:* Chinese SMEs, corporate governance, innovation, patents, and new product sales

*Miaojun Wang is grateful for the financial support from the Ministry of Education of China (Grant 07JJD790146) and from Zijing Plan, Zhejiang University. We thank Nathan T. Joseph for his excellent research assistance.

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1 Introduction

Innovation is a key determinant of the competitive performance of both countries and firms. Innovation is particularly important to emerging economies as they attempt to raise productivity and incomes. As a large emerging economy, China recognizes the critical importance of innovation and has adopted policies to encourage innovative activities[1], including innovation by small and medium enterprises (SMEs) (Xinhua, 2013). Existing evidence suggests that research and innovation activities have indeed increased substantially over the past decade (Hu and Jefferson, 2009; Huang, 2010)), and this has led researchers to study the determinants of innovation in China, with a particular focus on the effects of R&D. Empirical studies (Jefferson et al, 2006; Sun and Du, 2010) show that in China, the R&D activities of firms have significant and positive effects on innovation and other measures of firm performance. Researchers also find that these positive effects are moderated by foreign knowledge access (Wang and Kafouros, 2009; Li et al, 2010a) and incentive schemes (Chow and Liu, 2007; Zhang and Li, 2009; Li et al, 2010b). These studies have not examined the impact of corporate governance on innovation in China.

However, there are studies from developed countries that focus on the effects of internal and external corporate governance mechanisms on the innovation outcomes of firms (Casper and Matraves, 2003; Sapra, Subramanian, and Subramanian, 2011; Belloc, 2012 provides a recent survey). This literature suggests a number of channels through which corporate governance (including ownership identity and concentration; board size and structure;) affects innovation. First, large, long-term block owners are providers of "patient capital". For example, institutional investors with a long investment horizon (Bushee, 1998; Eng and Shackell, 2001; Aghion et al, 2013) and owners who take control through leveraged buyouts (Lerner et al, 2008; Ughetto, 2010) can enhance innovation by providing long-term incentives to managers with career concerns, and by committing

[1]President Hu Jintao suggested that enhancing China's ability in independent innovation is the core of the country's national development strategy Hu (2007).

resources to innovation. Second, a concentrated owner has the incentive to monitor the innovative efforts of management and is more likely to commit to long-term objectives like innovation (Hill and Snell, 1988; Baysinger et al, 1991). Third, an effective board of directors, including one that splits the positions of Chair and CEO can enhance innovation by providing monitoring and access to outside resources (Hill and Snell, 1988; Lacetera, 2001).

It is not necessarily the case that corporate governance will affect innovation in emerging markets. In emerging economies where the general financial and institutional environments are less developed (La Porta et al, 2000; Heugens et al, 2009), there is evidence suggesting that corporate governance practices perceived to be effective in developed countries may not be readily translated to emerging market economies (Claessens and Fan, 2002; Gibson et al, 2003; Heugens et al, 2009; Van Essen et al, 2012). In the particular context of China, Chen et al (2011) find that corporate governance practices recommended by the OECD do not improve the financial returns of Chinese firms.

At the same time, there is little research on the relation between corporate governance and innovation in emerging economies. Existing studies (Choi et al, 2011, 2012; Chen et al, 2012) focus mainly on the effects of ownership structure. An exception is Wu (2008) who finds that managerial ownership and board competence have positive effects on the introduction of new products in Taiwan. The understanding of the general effects of corporate governance on innovation in emerging economies is therefore very limited.

In this paper, we address the research question: does corporate governance (including ownership structure) contribute positively to innovation of SMEs in the emerging country of China? In answering this question, we focus on the effects of three internal corporate governance mechanisms: the board of directors, ownership concentration, and whether the CEO is an outsider. Mindful of the important features of SMEs in China, which include concentrated ownership (Xu and Wang, 1999); restricted access to external

resources; and the absence of the market for corporate control (Chen et al, 2011), we apply elements of standard agency theory (Jensen and Meckling, 1976), principal-principal theory (Chen et al, 2011), and resource-dependence theory (Pfeffer and Salancik, 2003) in the context of China to hypothesize that (1) a large board, the presence of independent directors, and the presence of a supervisory board, contribute positively to innovation because they help the firm to improve monitoring and access to resources; and (2) innovation first increases with ownership concentration because such concentration allows the owner to commit to long-run and risky innovation projects, but this positive effect declines at a higher levels of ownership concentration because the controlling shareholder becomes entrenched and pursues other objectives ; and (3) an external CEO enhances innovation by ensuring professional management of the company, thus mitigating the entrenchment effects of a controlling shareholder.

We test these hypotheses using a sample of 370 firms in Zhejiang province, China between 2004 and 2006. As we discuss in more detail below, Zhejiang provinces is known for its entrepreneurial culture, and the firms we study are primarily private, and relatively small by Chinese standards. We use two measures for innovation, the number of new patents between 2004 and 2006, and annual new product sales. The former measure will include potential process and product innovations, while the latter covers actual product innovations. Overall, we find only limited evidence that corporate governance affects innovation performance, but the results do depend on the measure of innovation. In particular, we find little evidence that any corporate governance variable has a significant impact on innovation, measured by new product sales. However we do find that some dimensions of corporate governance have significant effects on the number new invention patents granted during the period studied. We find that patent activity at first increases with ownership concentration but ultimately the positive effect weakens, as hypothesized. Similarly, we find some evidence that the presence of external board members enhances

patenting, but the existence of a supervisory board does not. The presence of an outsider CEO has positive effects on patenting only in the group of firms with positive counts of new patents. The results indicate that the determinants of patenting, a more radical form of innovation, are different from those of new product sales, a more incremental form of innovation.

Relative to the literature on corporate governance and innovation, our paper makes three contributions. First, our study offers a particular emphasis on the governance of private SMEs, a topic rarely studied in the literature on corporate governance and/or corporate governance in China. Many studies in either literature (Li et al, 2010a; Van Essen et al, 2012) employ samples of listed firms and other large firms, often with significant state ownership. Compared to private SMEs, these firms have access to better financing and sometimes receive preferential support from the government. Because that the Chinese government has recognized the economic importance of private SMEs (Xinhua, 2013) and that private enterprises have emerged as the dominant source of invention patents (Huang, 2010), our study enriches the literature by examining the interactions between corporate governance and the more organic innovative activities that are present in small and medium private Chinese firms. Second, by focusing on China, we test the boundaries of important claims in the corporate governance literature (Tsui, 2006), and extend the existing literature on corporate governance and innovation that focuses mainly on developed countries (Belloc, 2012). Third, we add to the research on innovation in China, which so far emphasizes the role of inputs to the innovation process (Jefferson et al, 2006; Sun and Du, 2010), by highlighting corporate governance as a potentially important determinant of innovation in firms.

2 The Zhejiang Data

The data used in this paper come from a survey of firms in Zhejiang province which plays an important role in China's economy. In 2010, Zhejiang's population (52 million) accounted for 3.9% of the national total, but its GDP (402 billion US dollars) accounted for 6.8% of China's GDP[2]. The GDP per head of Zhejiang is 7,690 dollars, significantly higher than the national average of 4,384. Among all provinces in 2010, the disposable income for urban residents and rural residents of Zhejiang ranked 3rd and 1st, respectively. The fraction of R&D expenditure in Zhejiang's GDP was 1.82% in 2010, slightly higher than the national figure of 1.75%. However, it appears R&D expenditure in Zhejiang is especially productive, as patent grants to applicants in Zhejiang in 2010 (114,600) accounted for 14.1% of the national total.

What truly distinguishes Zhejiang from other provinces is that Zhejiang's economy is highly market-oriented, and it boasts a private sector which is arguably the most vibrant and developed in China. For instance, 82% of enterprises in Zhejiang are non-state-owned (Gu and Jiang, 2011). Coincidently, non-state-owned enterprises accounted for 83% of industrial output in Zhejiang. One key aspect underlying Zhejiang's strong private sector is therefore entrepreneurship. As a province with relatively poor natural endowments, entrepreneurship is understood to play an important role in Zhejiang's economic success (Economist, 2011). Therefore, Zhejiang constitutes an ideal context for studying private enterprise in China.

The survey from which this paper's data are obtained was carried out by the Association of Private Enterprises of Zhejiang Provincial Administration for Industry and Commerce (Zhejiangsheng Gongshangju Siying Qiye Xiehui) in 2007. The survey collected

[2]Unless specified otherwise, the figures in this paragraph and the next are obtained from Statistical Communique of the People's Republic of China on the 2010 National Economic and Social Development, and Statistical Communique of the Zhejiang Province on the 2010 National Economic and Social Development. The urls for the communiques are http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20110228_402705692.htm and http://www.zhejiang.gov.cn/gb/zjnew/node3/node22/node170/node406/node6083/userobject9ai122219.html.

data on firm performances, IT investment, innovation, compensation practices, corporate governance practices, the characteristics of the chair of the board (usually the largest owner) for three years (2004, 2005 and 2006). Most firms covered were privately owned and in manufacturing industries. In some of our regressions, we exclude the SOEs, which account for less than 4% of the firms in our sample, because SOEs often receive favorable financing from banks, and they also benefit from government grants for R&D. A total of 2400 surveys were sent and about 1920 were returned. Among the 1920 returned surveys, about 800 were nearly completed. To verify the data quality, six survey workers called the firms and requested that firm employees redo the surveys.

After comparing data from the 800 surveys initially returned to the data collected from phone calls, they found 95% of the data entries were consistent. Therefore, we conclude the quality of the surveys is high. We limit our sample to manufacturing firms, leaving us with a total of 909 firms. In the actual statistical analysis, other firms are excluded as they report missing values on some variables included in our regression analysis. In the end, our regression analysis involves an unbalanced panel of 370 firms and 725 firm-year observations. As noted, private firms constitute 86% of our sample. Applying the 2011 definitions of small and medium enterprises in China to our 2004 sample, 56% of the firms are small enterprises, and 96% of the firms are small and medium-sized enterprises

3 Hypothesis

Innovation, defined as the development of a new product or a production process, has two important features. First, innovation often requires team production. That is, it requires inputs from multiple parties. These parties can include the owner of physical capital, managers and workers who provide the human capital, and the financial sector that provides the financing. Because the investment of these inputs is often specific to the innovative project and irreversible, there are incentives for various parties to engage in self-

serving behavior which can undermine the project (the "hold-up" problem). For instance, after R&D workers have performed specified lab experiments and produced results, there may be disputes over the ownership and subsequent use of the intellectual property. In order for successful team production to occur, a mechanism is required to coordinate the interests of different parties. Second, the outcome of innovative activities is uncertain, but the individuals involved in innovation are often risk-averse. In particular, individuals who have little ability to reduce risk through diversification will be more risk-averse. Managers and workers may therefore prefer less risk-intensive R&D investment because they strongly dislike the income fluctuations associated with the outcome of the effort. To encourage the level of risk-taking which is efficient for the team, these individuals need to be properly motivated.

Although individuals and non-profit organizations also engage in innovative activities, firms are an important source of innovation. This is because they provide as a partial solution to the innovation problem by coordinating team production, and offering incentives for innovation (Hölmstrom, 1979, 1982; Hölmstrom and Milgrom, 1994). By shaping the coordination and incentive mechanisms, corporate governance, defined as ways in which a company is controlled and run, can play an important role in firm innovation. It offers a way to reduce the kinds of opportunism which threaten the innovation and also establishes incentives necessary to foster innovation (Belloc 2012). The governance of a firm is shaped by both external factors, such as laws and the market for corporate control, and the internal design of the firm, such as the distribution of control rights and compensation. Because our sample of firms in Zhejiang arguably face the same external corporate governance environment, in this paper we will focus three important dimensions of internal corporate governance: the board of directors, ownership concentration, and whether the CEO is hired from outside.

The board of directors is at the heart of corporate governance structure because it

has a number of important functions (Fama, 1980; Adams et al, 2010). First, the board of director can align the interests of management with those of shareholders (Fama and Jensen, 1983) through the hiring, firing, and assessment of management (Hermalin and Weisbach, 1998; Hermalin, 2005). Second, the board of directors can provide access to important external resources for the firm (Williamson, 1988; Pfeffer and Salancik, 2003). Third, the board guides the strategies of a firm (Mace, 1971; Baysinger and Hoskisson, 1990; Demb et al, 1992), including those related to innovation (Baysinger et al, 1991).

A board with more directors is likely to perform these functions better. First, larger boards are able to provide the resources and expertise to perform more and better monitoring that are demanded by the regulators or the general public (Linck et al, 2008). Second, a larger number of directors allow the firm to potentially access a larger pool of external resources, including technological and financial resources that are critical for innovation. In addition, from the perspective of stakeholder theory, a larger board can accommodate more stakeholders in innovation, such as key scientists, whose influence may lead to more innovation efforts (Lacetera, 2001; Adams et al, 2010). For the SMEs in Zhejiang that we study ownership is highly concentrated, with the mean holding of the largest shareholder being 56.4%. Because of this concentration in ownership, these firms are less likely to suffer from the problems of insufficient monitoring and managerial deviation from the innovation policy of the owner that can occur in firms with dispersed ownership. However, because private SMEs in China in general lack the same access to various innovation-related resources as state-owned enterprises and foreign-owned enterprises, the resource-providing function of the board will be important for these firms' innovation performance. Therefore, we hypothesize:

H1a. Innovation performance increases with board size.

As outsider or independent directors become more dominant in developed countries, particularly in the US after the Sarbanes-Oxley Act of 2002, they are now an important

factor in corporate governance (Fich, 2005; Fich and Shivdasani, 2006; Lehn et al, 2009; Linck et al, 2009). Although the current Company Law of China (the 2006 version) does not require companies to appoint independent directors, the regulatory authorities recognize and promote the use of independent directors. In particular, since 2001 all companies listed in mainland China are required to have independent directors and the number of independent directors must account for at least 1/3 of the board. In our sample in which there are almost no listed firms, 48% of the firm-year observations report the appointment of independent directors.

Independent directors play two important roles in a company. First, because of their independence, they are better positioned to monitor management (Rosenstein and Wyatt, 1990; Byrd and Hickman, 1992; Coles et al, 2001; Peng, 2004). Second, they provide access to external resources (Hillman and Dalziel, 2003; Peng, 2004). Again, the second function is likely to be more important for the SMEs in our sample that have concentrated ownership. In general, different types of independent directors, such as bankers, venture capitalists, and politically-connected appointees, can bring different assets to the company or represent important stakeholders (Adams et al, 2010). In China, for instance, companies sometimes appoint current and former government officials as independent directors for networking purposes (Peng, 2004; Tian and Lau, 2001). Consequently, we hypothesize:

H1b. Innovation performance is stronger for firms with independent directors.

Some countries, including China, have two-tier board systems (Maassen and van den Bosch, 1999; Melis, 2002; Franks et al, 2006). In China, the Company Law requires limited-liability companies to have a two-tier board. A supervisory board is supposed to monitor the board of directors (Peng, 2004; Lin, 2004; Yeh and Woidtke, 2005). The Company Law also stipulate that members of the board of directors and senior managers cannot serve as members of the supervisory boards, and at least 1/3 of the supervisory board members must be representatives of employees. Besides the function of monitoring, under the

personnel requirements for supervisory boards in China, a supervisory board can also serve the company by bringing in resources through the appointment of appropriate external persons. In addition, a supervisory board can provide representation to employees, an important group of stake holders within the company.

In practice, the supervisory directors often have low status and limited power. Compared to Germany where the supervisory boards are the first-tier boards, the supervisory boards in China are considered as second-tier boards with limited capacity (Kaplan, 1994; Dahya et al, 2003; Xiao et al, 2004). Therefore, supervisory boards in China are likely to be less effective in monitoring the board of directors and the management. However, based on the functions of attracting potential external resources and offering stake-holder representation, we hypothesize:

H1c. Innovation performance is stronger for firms with a supervisory board.

Concentration in ownership can lead to more effective monitoring of management because the gain from such monitoring is large for block owners. In contrast, when ownership is diffuse, each shareholder has little incentive to monitor the management, because the benefit is small relative to cost (Alchian and Demsetz, 1972; Jensen and Meckling, 1976). Consequently, diffuse ownership allows managers to engage in activities other than the inherently-risky innovation activities, while concentrated ownership may promote such activities (Hill and Snell, 1988; Baysinger et al, 1991).

In addition, concentration in ownership promotes commitment because it is hard for the large shareholders to exit the firm (Mayer, 1997). Consequently, large shareholders are more likely to engage in long-term and risky R&D projects. In other words, capital becomes patient allowing large shareholders to develop long-term relationships with the various stakeholders required for innovation (Driver and Guedes, 2012). At the same time, such long-term owners may also have better access to financing if they can establish a reputation for long run success (Miozzo and Dewick, 2002).

However, the effects of ownership concentration on innovation are likely to be non-linear (Lee, 2005). Fundamentally, a large controlling-shareholder can have two opposing effects on firm innovation (and performance in general): commitment and entrenchment (Yeh and Woidtke, 2005). Commitment, as discussed above, leads to patient capital and support for long run innovation. Entrenchment, however, works against innovation. There are multiple channels through which entrenched controlling-shareholders can act opportunistically in ways that limit innovation. They may hire unqualified individuals related to the controlling-shareholder (Faccio et al, 2001; Morck and Yeung, 2004; Su et al, 2008; Young et al, 2008), engage in self-benefiting transactions (Barclay and Holderness, 1989, 1991; Barclay et al, 1993; Rajan and Zingales, 1998; Chang and Hong, 2000; Khanna and Rivkin, 2000), and invest less in R&D and innovation than the optimal level (Backman, 1999; Young et al, 2008). If controlling-shareholders can easily benefit from expropriation, they are less likely to support innovative activities in the company. In China where the legal protection for property rights is weak, the expropriation of small shareholders by controlling-shareholders is particularly a realistic concern (Chen et al, 2011).

A concentrated owner in China is also likely to reduce innovation efforts because of risk-aversion. Because financial markets are less developed in China, the concentrated owners in the SMEs often have a substantial portion of their personal wealth locked in the firms they own and cannot diversify optimally their portfolio to reduce risk. Consequently, the concentrated owner will exhibit more risk-aversion than a diversified investor (Heugens et al, 2009), and avoid risky investment in innovation. Such risk-aversion will be more pronounced at a higher level of ownership concentration. Overall, because ownership concentration in China encourages commitment but also entails entrenchment and risk-aversion at high level of concentration, we hypothesize

H2. Innovation at first increases with ownership concentration, but ultimately the positive effect weakens.

The agency-based theory of corporate governance generally suggests that the positions of CEO and Chair of the board should be separate Combining the positions (CEO-duality), it is argued, compromises the ability of the board to monitor the running of the firm (Fama, 1980; Fama and Jensen, 1983; Jensen, 1993; Coles et al, 2001), because the single person can appoint friendly directors and stymie the flow of information (Westphal and Zajac, 1995; Monks and Minow, 2012). When the CEO and chairman are different persons, the boards of directors tend to be more independent and more effective in monitoring management (Mallette and Fowler, 1992), and firm performance tends to be better (Rechner and Dalton, 1991). This view is not universal, as stewardship theory argues that the separation between CEO and chairman may prevent unity and efficiency in decision making (Donaldson and Davis, 1991; Finkelstein and D'Aveni, 1994).

The empirical literature on the effects of CEO-duality in developed countries has produced mixed evidence, with positive effects (Donaldson and Davis, 1991; Finkelstein and D'Aveni, 1994), negative effects (Rechner and Dalton, 1991; Mallette and Fowler, 1992), and insignificant results (Coles et al, 2001) reported. The evidence from China on this issue is also mixed (Peng et al, 2007, p.209). However, one result that does emerge from Song, Song et al (2006) and Peng et al (2007) is that the performance effects of combining the positions is positive for firms with a high level of state ownership, and negative for firms with a low level of state ownership. In SOEs, the chair and the CEO are both career-minded agents in the large state-centered hierarchy that includes government agencies and SOEs. In the hierarchy, the state is often unable or unwilling to specify well-defined objectives against which agents can be evaluated objectively. In order to gain promotion to better positions in other SOEs or the government, high-ranking officials in SOEs may engage in non-cooperative behaviors designed to foster their career progression. When the positions of Chair and CEO are separated, such behavior can harm coordination and efficiency in the organization. Therefore, in firms with dominant state ownership,

the combination of the positions of Chair and CEO is valuable because it limits internal competition among senior executives and improves coordination and efficiency in decision-making.

However, in the case of our sample, the Chair is usually the largest shareholder in a highly-concentrated private firm. Thus, there is little ambiguity about who holds the ultimate power in the firm, and the CEO is unlikely to disregard the will of the owner in decision-making. Hence, the coordination and efficiency advantages of combining the Chair and CEO positions is not necessarily present for SMEs with low or no state ownership. Nevertheless, consistent with the general case of Asia (Van Essen et al., 2012), the founders of the company in our sample are often the concentrated owners and Board Chairs, and they or their direct relatives serve as the CEO. We argue that when the levels of (private) ownership concentration are high, and when CEO-duality is present investing in R&D becomes relatively less appealing, because the concentrated owners have both incentive and ability to expropriate the minority owners to increase their personal wealth and benefits. An external CEO can mitigate the expropriation of the minority owners and direct more resources to innovation. In addition, while CEO-duality may promote the interests of the family, it may limit the benefits from hiring the best available professional managers that can be particularly large for SMEs. Accordingly, we hypothesize that:

H3. Hiring outsider CEOs promotes innovation activity in privately owned firms.[3]

[3]It would be interesting to determine whether the effects of an external CEO on innovation differ between SOEs and other firms by interacting a dummy variable for external CEOs with a dummy variable for SOEs. However, in our sample only one SOE firm separates the positions of chair and CEO. Consequently, we are unable to include such an interaction in regressions, and limit our hypothesis accordingly.

4 Hypothesis testing

4.1 Measurement

The dependent variables are the number of new invention patents of a firm between 2004 and 2006, and new product sales of a firm in each year. The former is a measure that will include both product and process innovations, most likely of a technical nature. New products obviously do not include process innovations. A firm can acquire the designation of new products for some of its products through certification by central government or provincial governments. The new product sales measure the market success of a firm's innovation activity.

The independent variables are the size of the board, an indicator for whether a firm has independent directors, an indicator for whether a firm has a supervisory board, the shareholding of the largest shareholder, an indicator for whether the CEO is an outsider. We define a CEO as an outsider if s/he is not the largest shareholder or a relative of the largest shareholder. We refer to the first three variables as the board-related governance variables.

Control variables include the log of R&D expenditures, the fraction of senior managers who are subject to performance-based pay, log assets, log age of firms, and sector dummies. These are all well established in the innovation literature. We include the performance-based pay incentive for senior managers because may provide incentive for innovation. Log assets and the age of firm control for the effects the size and experience in production.

In all regressions, we include an indicator or indicators for past innovation activities to control for unobserved firm heterogeneity in innovation. For the patent equations, we use the stock of invention patents in 2004. In the regressions for new product sales, we use the number of patents in the same year and the one year lag of new product sales. We include dummies to represent five major industrial groups to account for sector het-

erogeneity. Because we already use indicators of past innovation to control for unobserved firm heterogeneity in the regressions, we do not include dummies for more disaggregated industries to preserve degrees of freedom.

4.2 Empirical Specification

The number of new invention patents is always non-negative. If a firm's innovation efforts are not successful, it will report zero new invention patents. Between 2004 and 2006, 75.4% of firms do not report an increase in the number of patents owned. Because patents are a non-negative count variable, we estimate two models of patents, the Poisson model, and a Probit-Poisson hurdle model.

The Poisson model is:

$$Prob(patents_{i,t} - patents_{i,t-2}) = f\left((X_{i,t-2})'\beta\right) \tag{1}$$

where f is the Poisson function, X is the vector of independent and control variables for firm i as detailed in subsection 4.1, and β is the vector of parameters. Since patenting usually lags the initial innovation efforts, in (1), we follow Lerner and Wulf (2007) to specify that independent and control variables in 2004 are related to new patents between 2004 and 2006.

The Poisson model assumes that the arrival of patents are independent events, hence the probability for a firm with zero patents to obtain the first patent is the same as the probability for a firm with five patents to obtain the sixth patent. Like many other productive activities, it is plausible that there exists learning-by-doing in innovation. For a firm without a patent, obtaining the first one through innovation is a substantial achievement. Once the firm has the first patent, the innovation experience gained can help the firm in further innovation, making future patents easier to obtain. Consequently, the stochastic process governing whether a firm obtains positive patents or not and the process governing the amount of patents conditional on a positive patent count can be different. To

allow for the difference, we estimate a Probit-Poisson hurdle model. In the first part of the hurdle model, we estimate a Probit model in which the chance of obtaining positive patents depend on the independent variables and control variables

$$Prob(patents_{i,t} - patents_{i,t-2} > 0) = \Phi\left(X_{i,t-2}\right)'\gamma\right) \tag{2}$$

where Φ is the density function for a normal distribution, X is the same vector of variables as in equation (1), and γ is the vector of parameters. Once a firm overcomes the innovation "hurdle" to obtain a positive patent count, we assume that conditional on X, the number of patents follows a truncated Poisson distribution. That is, the second part of the hurdle model is

$$Prob\left(patents_{i,t} - patents_{i,t-2} | patents_{i,t} - patents_{i,t-2} > 0\right) = g\left(X_{i,t-2}\right)'\delta\right) \tag{3}$$

where g is the distribution function for a zero-truncated Poisson distribution, X is the same vector of variables as in equation (1), and δ is the vector of parameters.

One important issue in estimating the effects of governance on innovation is unobserved firm heterogeneity, which can potentially lead to biased estimates. For instance, if a firm has accumulated valuable knowhow and experience in innovation, it is likely to choose endogenously to increase R&D inputs and adopt suitable corporate governance practices to boost innovation output. If such an initial advantage is not accounted for, an econometrician will overestimate the effect of R&D inputs and corporate governance on innovation by attributing the effect of initial advantage in innovation to R&D inputs and corporate governance.

In general, the inclusion of random effects or fixed effects can mitigate the problem of unobserved heterogeneity in estimations based on panel data. Random effects can account for firm heterogeneity that is uncorrelated with the included independent and control variables. In linear regressions, fixed effects can control for unobserved heterogeneity that is constant and correlated with independent and control variables. Unfortunately, fixed

effects cannot be included in the Probit, Poisson or Tobit models, because the nonlinearity in these models prevents identification and consistent estimation of the fixed effects.

The specification in equations (1) through (3) reduces our dataset to a simple cross-section, preventing us from including random effects. We control for unobserved firm heterogeneity by including the stock of patents in 2004. The idea is, if a firm has an initial advantage in innovation, it should be captured by the number of patents in 2004.

The other dependent variable, new product sales, is also a non-negative variable and takes continuous values. In our sample, in 2004, 2005, and 2006, the percentages of firms who report zero new product sales are 52.9%, 47.6%, and 45.7%. Because the new product sale is a non-negative continuous variable, we estimate two models, the conventional Type I Tobit model and the Lognormal hurdle Model.

To be specific, the conventional Type I Tobit model, augmented with random effects, is

$$new\ product\ sales^*_{i,t} = X'_{i,t}\zeta + u_i + e_{i,t} \tag{4}$$

where $new\ product\ sales^*_{i,t}$ the latent measure of market success of innovation for firm i in period t, X is the vector of independent and control variables described in subsection 4.1, ζ is the vector of parameters, u_i is a firm specific random effect, and e_{it} is the error term. As discussed in subsection 4.1, $X_{i,t}$ includes the number of patents in the same year and the one-year lag of new product sale. We only observe the $new\ product\ sales^*_{i,t}$ when it is positive:

$$new\ product\ sales_{i,t} = new\ product\ sales^*_{i,t} \quad if\ new\ product\ sales^*_{i,t} > 0$$
$$new\ product\ sales^*_{i,t} = 0 \quad if\ new\ product\ sales^*_{i,t} \leq 0$$

As noted in Wooldridge (2001), the Tobit model is restrictive in the sense that the same stochastic process governs whether we observe positive new product sale, and the amount of new product sale. For instance, the marginal effect of a variable on whether we

observe new product sale and the marginal effect of the same variable on the amount of new product sale, must have the same sign. In our application, to report any new product sales, a firm must invest significantly in R&D. However, when the new product is created, the actual sales amount is more likely to be influenced by the efforts of sales personnel. In general, the processes for creating and marketing new products need not be the same. The effects of corporate governance in these two processes can be different as well. To allow for different processes of developing and marketing new products, we estimate the Lognormal hurdle model, which is a hurdle model for nonnegative continuous variables.

The first part of the Lognormal hurdle model specifies a Probit model in which whether we observe positive new product sale depends on the vector of variables X:

$$Prob\left(new\ product\ sales_{i,t} > 0\right) = \Phi\left(X'_{i,t}\eta\right) \tag{5}$$

where Φ is the density function for a normal distribution, X is the same vector of variables as in equation (4), and η is the vector of parameters. For the second part of the Lognormal hurdle model, we estimate a log-normal model for observations with positive new product sale amount

$$new\ product\ sales_{i,t} = \exp\left(\left(X'_{i,t}\theta + v_{i,t}\right)\right. \tag{6}$$

where X is the same vector of variables as in equation (4), and θ is the vector of parameters, and v_{it} is an error term following a normal distribution.

4.3 Summary statistics

Table 1 presents the sample means, standard deviations, and the correlation matrix of the key variables. For all variables other than new invention patents, we compute the statistics for the years 2004, 2005, and 2006 combined. For new invention patents, we calculate the change in patents owned for each firm between 2004 and 2006.

On average, a firm in the sample has 1.15 invention patents. The average increase in patents owned between 2004 and 2006 was 0.85. The average annual new product

sales were 34.98 million yuan, while R&D expenditures were 4.22 million . The largest shareholder owned on average 58.64% of the shares of the firms, indicating a high level of ownership concentration in the medium and small enterprises. In the sample, 48% of the firms had independent directors, 74% had a supervisory board, and the average size of the board was about 4 directors. In only 9% of the observations did we observe that firms hired outsider CEOs. About 58.82% of managers are subject to performance-based pay. The firms are relative young, as the average age was about 10 years. Most of the firms are small or medium-sized, with an average asset level of 171.91 million yuan. Most of the firms are private and domestically owned. Only about 4% of firms are State-Owned Enterprises (SOEs), and about 9% are fully or partially Foreign-Owned Enterprises (FOEs).

4.4 Regression Results for Invention Patents

Column (1) of Table 2 presents the Poisson model for new invention patents. Columns (2) and (3) present the first part (Probit) and second part (zero-truncated Poisson) of the Probit-Poisson hurdle model. The coefficients are the marginal effects of the right-hand-side variables on the dependent variables, evaluated at the sample mean. The log-likelihood reported in column (3) is the combined log-likelihood of the two parts of regressions (presented in columns (2) and (3)). The same applies to the log-likelihood in column (6). Because the values of log-likelihood in columns (3) and (6) are higher than those in columns (1) and (3), respectively, the Probit-Poisson model and the lognormal hurdle model appear to fit the data better than the Poisson model and the Tobit model, respectively.

In H1, we argue that board size, presence of independent directors, and the supervisory board have positive effects on innovation (here measured by new invention patents). As shown in columns (1) through (3) of Table 2, both the Poisson model and the Probit-Poisson hurdle model indicate that the board size variable is always insignificant. Therefore, the results do not support H1a (the positive effects of board size). In the first column

(1) of Table 2, the Poisson model reports a positive and significant coefficient on independent directors. However, the positive effect of independent directors becomes insignificant in the Probit-Poisson model in columns (2) and (3) of Table 2. The results provide limited support for H1b (the positive effects of independent directors). From the first two columns of Table 2, in both the Possion model and the Probit part of the Probit-Poisson model, the supervisory board variable has a significant and negative effect on invention. This represents evidence against H1c.

Regarding ownership concentration, we hypothesize in H2 that its effect on new invention patents is initially positive but becomes weaker at higher levels of concentration. To test this hypothesis on ownership concentration (measured by the shares owned by the largest shareholder), we specify its effect on patenting as piece-wise linear. To implement this specification, we include the variable shares owned by the largest shareholder (labeled *largest sh %* in Table 2) and its interaction with a dummy variable indicating the shares owned by the largest shareholder is greater than 29% (labeled *high concentration dummy* in Table 2). We choose the threshold of 29% because this threshold value generates the highest log-likelihood value among the whole range of possible threshold values. In unreported regressions, we estimated a quadratic specification for ownership concentration, which results in a lower log-likelihood. In the first column of Table 2, when the ownership concentration level is below 29%, the marginal effect of ownership concentration, which equals the coefficient on *largest sh %*, is 0.06 and statistically significant. This implies if the share held by the largest owner increases by 10%, the number of new invention patents will increase by 0.6. When ownership concentration exceed 29%, its effect is equal to 0.01, which is the sum of the coefficients on the variable *largest sh %* and the interaction term labeled *high concentration dummy·largest sh %*. Although this effect of ownership concentration above the 29% threshold is still positive and statistically significant, it is markedly lower than the effect of ownership concentration below the threshold. When we

switch to the Probit-Poisson hurdle model, we observe the same pattern in columns (2) and (3) in Table 2, although the coefficients are not significant in column (2). Overall, the results offer support for H2.

The last hypothesis, H3, argues that hiring an external CEO will enhance innovation by restricting the entrenchment effect of a dominant shareholder in private firms. In the first two columns of Table 2, the coefficient on outsider CEO is insignificant. But it becomes marginally significant (with a p-value of 0.053) in the second part of the Probit-Poisson hurdle model. The regression results weakly support H3.

To check whether our results are driven by the SOEs or FOEs, we drop these firms from the regressions and report the results in columns (1) through (3) in Table 3. The results are very similar to those in columns (1) and (3) in Table 2, respectively. In column (1) in Table 2, we also include dummy variables for SOEs and FOEs.[4] These dummy variables are always insignificant. Overall, we conclude our results are not sensitive to the inclusion of SOEs and FOEs in the sample.

When we use patents as the measure for innovation, we see that H1c, H2, and H3 receive support of different degrees, while H1a has no support and H1b is rejected. That supervisory board has a negative effect on patenting, contrary to H1b, is surprising. Based on private conversations the authors had with entrepreneurs in Zhejiang, the entrepreneurs tend to believe the supervisory board should have no effect because the status of the supervisory board is low.

4.5 Regression Results for New Product Sales

An alternative measure of innovation is new product sales, a measure widely used in previous studies of China (e.g. Li et al, 2010a). To see if corporate governance has the same effects on new product sales as on new invention patents, we estimate the Type I

[4]In columns (2) and (3), the SOE dummy is dropped from the regressions by Stata because of perfect colinearity.

Tobit model and the Lognormal hurdle model with new product sales as the dependent variable, parallel to the equations for new invention patents. We present the results in columns (4) through (6) in Table 2. Column (4) corresponds to the Type I Tobit model, and columns (5) and (6) are the first (Probit) and second part (Lognormal) of the Lognormal hurdle model. Dropping SOEs and FOEs, we repeat the estimations and report the results in columns (4) through (6) in Table 3. The coefficients are the marginal effects of the right-hand-side variables on the dependent variables, evaluated at the sample mean. Overall, we find little evidence that corporate governance variables have significant effects on new product sales. In these regressions, all coefficients on governance variables are not significant, except that the coefficient on external CEO in marginally significant and negative in column (5) of Table 2 and column (5) of Table 3.

5 Summary and Discussion

Starting from a low level of economic development, the Chinese economy has achieved dramatic growth over the past three decades. Both the accumulation of productive factors and catch-up in technology contributed to the growth experience. However, as the return to investment in physical capital diminishes with the build up of the capital stock, and as more catch-up opportunities have been taken, a high future growth rate is not guaranteed for the Chinese economy and Chinese firms. Not surprisingly, Chinese firms have identified innovation as a path to future growth. Following the surge of innovation activities in China over the past decade, a new literature on innovation in China is expanding. At the same time, the literature on corporate governance and innovation suggests that firm governance affects its innovation performance, at least in developed countries.

We therefore address the question of whether corporate governance affects the innovation performance of firms in the emerging economy of China with a specific focus on privately owned SMEs. We study a sample of 370 mostly private and relatively small firms

in Zhejiang province, China between 2004 and 2006, using two measures of innovation, invention patents and new product sales. Overall, and regardless of innovation measure, we find that the innovation process does depend on R&D investments, and that past innovation is a good predictor of future innovation. With respect to corporate governance, we find that it matters only for innovation measured by new patents. We find relatively strong evidence that ownership concentration has a non-linear impact on innovation, with the implication that very high levels of ownership concentration might result in more attention to appropriation of benefits from minority shareholders or other stakeholders than to innovation activities. At the same time, there is some evidence that having independent members of the board and hiring an external CEO positively affects invention patents granted to the firms, but board size has no impact. The existence of a supervisory board is generally negatively related to patenting activity. For the other measure of innovation, new product sales, we find no evidence that our corporate governance measures have any impact, indicating that more work is required to understand the nature of innovation in Chinese firms, and its relationship to corporate governance.

In terms of the literature on corporate governance and innovation, our study makes three contributions. First, because 86% of the firms in our sample are private and have no state or foreign ownership and 96% of the firms are SMEs, our paper focuses mainly on innovation in private SMEs whose future success is critical to China's economic transition and development. In China, the deliberate efforts of the Chinese government in promoting innovation, often via the public sector, have not been effective (Breznitz and Murphree, 2011, p.28). Relative to other types of enterprise, state-owned enterprises (SOEs) had lower R&D inputs and outputs (Jefferson et al, 2003). Meanwhile, as the private sector has become a more important force in China's economy, private firms have become the most important source of China's innovation Huang (2010). The Chinese government itself also recognizes the important role of private firms in innovation (Breznitz and Murphree,

2011, p.77). Situated in Zhejiang, our study offers a good opportunity to understand the innovative activities in the most vibrant private Chinese firms. In this sense, it is important to note that our results indicate that our sample firms do indeed innovate, and that in important respects the determinants of innovation are similar to those observed in developed countries. In particular, our results suggest that innovative activity is related to R&D inputs, and that innovative activity is persistent, results consistent with those in developed countries (Geroski et al, 1997; Cefis and Orsenigo, 2001; Cefis, 2003; Raymond et al, 2010). Thus, innovation in these firms is not random. While we have not been able to establish a strong uniform role for board governance in this process, there is at least some evidence that it might matter. There is certainly quite strong evidence that ownership structure matters, particularly for patenting activities.

Second, our result adds to the literature on corporate governance and innovation by focusing on an emerging market. Current knowledge on corporate governance and innovation is based mostly on theory developed in the context of developed countries and evidence from developed countries Belloc (2012). We argue the many corporate governance factors should have similar positive effects on innovation in the SMEs in emerging economies. However, because the SMEs feature both high levels of ownership concentration and restricted obtain external resources, the effects of corporate governance on innovation are more likely to originate from need to access resources, rather than because of the need for efficient monitoring. In the business environment of an emerging economy, if the market institutions and legal system are less supportive innovation, the internal governance of a firm will play a more important role in achieving its innovative goals by pulling together resources and by engaging stakeholders. The empirical findings in our paper provide only very limited evidence consistent with the literature based on developed countries suggesting that the relation between corporate governance and innovation may be somewhat different and complex in emerging economies, and will require further study.

Third, we highlight the role of corporate governance in the innovation process in China. Existing studies on innovation in China focus on measurable inputs, in particular R&D (Jefferson et al, 2006; Sun and Du, 2010; Wang and Kafouros, 2009; Li et al, 2010a). We argue that corporate governance matters because it not only affects the amount of inputs of innovation available, but the allocation of the inputs, and the efficiency in the use of inputs. Once again, our empirical results provide limited supporting evidence in that board-related governance measures, ownership concentration, and hiring an external CEO to have significant effects on invention patents but not new product sales. In addition, our results suggest that supervisory boards at best do not enhance innovative activity. We note that supervisory boards are required of public companies in China, and so our results might call into question their efficacy.

Although we find that corporate governance has some effect on the number of invention patents, we do not find it to have significant effects on new product sale, the alternative measure for innovation in our paper. The insignificant findings on new product sales are quite surprising. We offer some thoughts on the insignificant results. First, invention patents and new product sale are very different forms of innovation. Invention patents likely represent a more radical form of innovation because to be considered for registration, innovations must be judged to represent a marked improvement over past patents and knowledge. In contrast, new products are often incremental innovations, because they can result from modification of existing products, and the commercialization of invention patents. Corporate governance may be better suited to support radical innovation efforts that require strategic, purposefully, and long-term planning. Second, new product sales are likely to involve more stakeholders, often at the operational level, and it is hard for the usual corporate governance practices to target these effectively. Besides the top management team and R&D workers, success in new product sales also requires inputs from marketing and sales personnel. The governance factors considered in our pa-

per (the board-related factors, ownership concentration, and hiring an external CEO) are not meant to provide direct incentives to all involved individuals.

Of course, these remain our speculative thoughts on the relationship between corporate governance and new product sales. The existing literature does offer some information about the determination of new product sales. Li et al (2010a) do find that spillovers from foreign firms contribute to higher new product sales in domestically owned Chinese firms. Apparently, future work is needed to understand the determination of invention patents, the determination of new product sales, and the interactions between the two processes.

The focus of our sample on private SMEs provides interesting insights, but it also warrants caution in interpreting the results. First, although Zhejiang provides a good background for the study of private SMEs, it is not the average province in China because the role of the private sector in Zhejiang is much more significant compared to other provinces. Consequently, our results may not readily extend to private SMEs in other provinces in China, because private firms there may face a business environment that is less friendly to the private sector. However, this also implies there are ample research opportunities in studying the effects of corporate governance on innovation and other aspects of firm performances. For instance, it would be very useful to conduct a systematic comparison of corporate governance in different ownership types in national samples.

As discussed above, further work is required to understand the determination of new product sales, and what is the relationship between patents and new product sales. This is important because eventually, innovations must achieve success in market for firms to benefit from them. As noted above, the wide availability of new product sales data in China has caused many researchers to focus on this measure of innovation. Our results suggest that this may be restrictive, and that more attention should be given to other measures of innovation activity. Regarding the finding that the supervisory board has negative effects, more empirical work would reveal whether it is caused by the idiosyncrasy in our sample,

or it is a robust general observation.

In general, as China continues to aggressively pursue success in innovation and as Chinese firms seek to improve their corporate governance, understanding the relationship between the two will become more important. This will be particularly true of SMEs, as they become more important in the Chinese economy.

References

Adams RB, Hermalin BE, Weisbach MS (2010) The role of boards of directors in corporate governance: A conceptual framework and survey. Journal of Economic Literature 48(1):58–107

Aghion P, Van Reenen J, Zingales L (2013) Innovation and institutional ownership. American Economic Review 103(1):277–304

Alchian A, Demsetz H (1972) Production, information costs, and economic organization. The American Economic Review 62(5):777–795

Backman M (1999) Asian eclipse: Exposing the dark side of business in Asia. J. Wiley Singapore/New York

Barclay M, Holderness C (1989) Private benefits from control of public corporations. Journal of financial Economics 25(2):371–395

Barclay M, Holderness C (1991) Negotiated block trades and corporate control. The Journal of Finance 46(3):861–878

Barclay M, Holderness C, Pontiff J (1993) Private benefits from block ownership and discounts on closed-end funds. Journal of Financial Economics 33(3):263–291

Baysinger B, Hoskisson RE (1990) The composition of boards of directors and strategic control: Effects on corporate strategy. The Academy of Management Review 15(1):pp. 72–87

Baysinger B, Kosnik R, Turk T (1991) Effects of board and ownership structue on corporate r&d strategy. Academy of Management Journal 34(1):205–214

Belloc F (2012) Corporate governance and innovation: A servey. Journal of Economic Surveys 26(5):835–864

Breznitz D, Murphree M (2011) Run of the Red Queen: Government, Innovation, Globalization, and Economic Growth in China. Yale University Press, New Haven, CN, USA

Bushee B (1998) The influence of institutional investors on myopic r&d investment behavior. Accounting review pp 305–333

Byrd J, Hickman K (1992) Do outside directors monitor managers?: Evidence from tender offer bids. Journal of Financial Economics 32(2):195–221

Casper S, Matraves C (2003) Institutional frameworks and innovation in the german and uk pharmaceutical industry. Research Policy 32(10):1865 – 1879

Cefis E (2003) Is there persistence in innovative activities? International Journal of Industrial Organization 21(4):489 – 515

Cefis E, Orsenigo L (2001) The persistence of innovative activities: A cross-countries and cross-sectors comparative analysis. Research Policy 30(7):1139 – 1158

Chang S, Hong J (2000) Economic performance of group-affiliated companies in korea: Intragroup resource sharing and internal business transactions. Academy of Management Journal pp 429–448

Chen V, Li J, Shapiro D (2011) Are oecd-prescribed "good corporate governance practices" really good in an emerging economy? Asia Pacific Journal of Management 28(1):115–138

Chen VZ, Zhang X, Li J, Shapiro DM (2012) Ownership structure and innovation performance: An emerging-market perspective. Available at SSRN 1299737

Choi SB, Lee SH, Williams C (2011) Ownership and firm innovation in a transition economy: Evidence from china. Research Policy 40(3):441 – 452

Choi SB, Park BI, Hong P (2012) Does ownership structure matter for firm technological

innovation performance? the case of korean firms. Corporate Governance: An International Review 20(3):267–288

Chow IHS, Liu SS (2007) Business strategy, organizational culture, and performance outcomes in china's technology industry. Human Resource Planning 30(2):47 – 55

Claessens S, Fan J (2002) Corporate governance in asia: A survey. International Review of Finance 3(2):71–103

Coles J, McWilliams V, Sen N (2001) An examination of the relationship of governance mechanisms to performance. Journal of Management 27(1):23–50

Dahya J, Karbhari Y, Xiao J, Yang M (2003) The usefulness of the supervisory board report in china. Corporate governance: an international review 11(4):308–321

Demb A, Neubauer F, et al (1992) The corporate board: Confronting the paradoxes. Long Range Planning 25(3):9–20

Donaldson L, Davis J (1991) Stewardship theory or agency theory: Ceo governance and shareholder returns. Australian Journal of Management 16(1):49–64

Driver C, Guedes M (2012) Research and development, cash flow, agency and governance: Uk large companies. Research Policy

Eng L, Shackell M (2001) The implications of long-term performance plans and institutional ownership for firms' research and development (r&d) investments. Journal of Accounting, Auditing & Finance 16(2):117–139

Faccio M, Lang L, Young L (2001) Dividends and expropriation. American Economic Review pp 54–78

Fama E (1980) Agency problems and the theory of the firm. The Journal of Political Economy pp 288–307

Fama E, Jensen M (1983) Agency problems and residual claims. JL & Econ 26:327

Fich E, Shivdasani A (2006) Are busy boards effective monitors? The Journal of Finance 61(2):689–724

Fich EM (2005) Are some outside directors better than others? evidence from director appointments by fortune 1000 firms. The Journal of Business 78(5):pp. 1943–1972

Finkelstein S, D'Aveni R (1994) Ceo duality as a double-edged sword: How boards of directors balance entrenchment avoidance and unity of command. Academy of Management Journal pp 1079–1108

Franks J, Mayer C, Wagner H (2006) The origins of the german corporation–finance, ownership and control. Review of Finance 10(4):537–585

Geroski P, Van Reenen J, Walters C (1997) How persistently do firms innovate? Research Policy 26(1):33–48

Gibson M, et al (2003) Is corporate governance ineffective in emerging markets? Journal of Financial and Quantitative Analysis 38(1):231–250

Hermalin BE (2005) Trends in corporate governance. The Journal of Finance 60(5):2351–2384

Hermalin BE, Weisbach MS (1998) Endogenously chosen boards of directors and their monitoring of the ceo. The American Economic Review 88(1):pp. 96–118

Heugens P, Van Essen M, van Oosterhout J (2009) Meta-analyzing ownership concentration and firm performance in asia: Towards a more fine-grained understanding. Asia-Pacific Journal of Management 26(3):481–512

Hill C, Snell S (1988) External control, corporate strategy, and firm performance in research-intensive industries. Strategic Management Journal 9(6):577–590

Hillman A, Dalziel T (2003) Boards of directors and firm performance: Integrating agency and resource dependence perspectives. The Academy of Management Review pp 383–396

Hölmstrom B (1979) Moral hazard and observability. The Bell Journal of Economics 10(1):pp. 74–91

Hölmstrom B (1982) Moral hazard in teams. The Bell Journal of Economics pp 324–340

Hölmstrom B, Milgrom P (1994) The firm as an incentive system. The American Economic Review 84(4):pp. 972–991

Hu AG, Jefferson GH (2009) A great wall of patents: What is behind china's recent patent explosion? Journal of Development Economics 90(1):57 – 68

Hu J (2007) Hold high the great banner of socialism with chinese characteristics and strive for new victories in building a moderately prosperous society in all respects. Speech by hu jintao to the seventeenth national congress, Beijing

Huang KG (2010) China's innovation landscape. Science 329:632–633

Jefferson G, Hu AG, Guan X, Yu X (2003) Ownership, performance, and innovation in china's large- and medium-size industrial enterprise sector. China Economic Review (1043951X) 14(1):89

Jefferson GH, Bai H, Guan X, Yu X (2006) R&d performance in chinese industry. Economics of Innovation & New Technology 15(4/5):345 – 366

Jensen MC (1993) The modern industrial revolution, exit, and the failure of internal control systems. The Journal of Finance 48(3):831–880

Jensen MC, Meckling WH (1976) Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3(4):305 – 360

Kaplan S (1994) Top executives, turnover, and firm performance in germany. Journal of Law, Economics, and Organization 10:142

Khanna T, Rivkin J (2000) Estimating the performance effects of business groups in emerging markets. Strategic management journal 22(1):45–74

La Porta R, López-de Silanes F, Shleifer A, Vishny R (2000) Investor protection and corporate governance. Journal of financial economics 58(1):3–27

Lacetera N (2001) Corporate governance and the governance of innovation: The case of pharmaceutical industry. Journal of Management and Governance 5:29–59

Lee P (2005) A comparison of ownership structures and innovations of us and japanese firms. Managerial and Decision Economics 26(1):39–50

Lehn KM, Patro S, Zhao M (2009) Determinants of the size and composition of us corporate boards: 1935-2000. Financial Management 38(4):747–780

Lerner J, Wulf J (2007) Innovation and incentives: Evidence from corporate r&d. The Review of Economics and Statistics 89(4):634–644

Lerner J, Sorensen M, Stromberg P (2008) Private equity and long-run investment: The case of innovation. Working Paper 14623, National Bureau of Economic Research

Li J, Chen D, Shapiro DM (2010a) Product innovations in emerging economies: The role of foreign knowledge access channels and internal efforts in chinese firms. Management & Organization Review 6(2):243 – 266

Li Y, Zhang C, Liu Y, Li M (2010b) Organizational learning, internal control mechanisms, and indigenous innovation: The evidence from china. IEEE Transactions on Engineering Management 57(1):63 – 77

Lin T (2004) Corporate governance in china: recent developments, key problems, and suggested solutions. Journal of Accounting and Corporate Governance 1(1):1–23

Linck J, Netter J, Yang T (2008) The determinants of board structure. Journal of Financial Economics 87(2):308–328

Linck JS, Netter JM, Yang T (2009) The effects and unintended consequences of the sarbanes-oxley act on the supply and demand for directors. Review of Financial Studies 22(8):3287–3328

Maassen G, van den Bosch F (1999) On the supposed independence of two-tier boards: formal structure and reality in the netherlands. Corporate Governance: An International Review 7(1):31–37

Mace M (1971) Directors: Myth and reality. Division of Research, Graduate School of Business Administration, Harvard University

Mallette P, Fowler K (1992) Effects of board composition and stock ownership on the adoption of" poison pills". Academy of Management Journal 35(5):1010–1035

Mayer C (1997) The city and corporate performance: condemned or exonerated? Cambridge Journal of Economics 21(2):291–302

Melis A (2002) Corporate governance in italy. Corporate Governance: An International Review 8(4):347–355

Miozzo M, Dewick P (2002) Building competitive advantage: innovation and corporate governance in european construction. Research policy 31(6):989–1008

Monks R, Minow N (2012) Corporate governance. Wiley

Morck R, Yeung B (2004) Family control and the rent-seeking society. Entrepreneurship Theory and Practice 28(4):391–409

Peng M (2004) Outside directors and firm performance during institutional transitions. Strategic Management Journal 25(5):453–471

Peng M, Zhang S, Li X (2007) Ceo duality and firm performance during china's institutional transitions. Management and Organization Review 3(2):205–225

Pfeffer J, Salancik G (2003) The external control of organizations: A resource dependence perspective. Stanford Business Books

Rajan R, Zingales L (1998) Which capitalism? lessons form the east asian crisis. Journal of Applied Corporate Finance 11(3):40–48

Raymond W, Mohnen P, Palm F, Van Der Loeff S (2010) Persistence of innovation in dutch manufacturing: Is it spurious? The Review of Economics and Statistics 92(3):495–504

Rechner P, Dalton D (1991) Ceo duality and organizational performance: A longitudinal analysis. Strategic Management Journal 12(2):155–160

Rosenstein S, Wyatt J (1990) Outside directors, board independence, and shareholder wealth. Journal of Financial Economics 26(2):175–191

Sapra H, Subramanian A, Subramanian K (2011) Corporate governance and innovation: Theory and evidence. In: 3rd Annual Conference on Empirical Legal Studies Papers, pp 08–05

Song F, Yuan P, Gao F (2006) Does large state shareholder affect the governance of chinese board of directors? Working paper (in chinese), Tsinghua University, Beijing

Su Y, Xu D, Phan P (2008) Principal–principal conflict in the governance of the chinese public corporation. Management and Organization Review 4(1):17–38

Sun Y, Du D (2010) Determinants of industrial innovation in china: Evidence from its recent economic census. Technovation 30(9-10):540 – 550

Tian J, Lau C (2001) Board composition, leadership structure and performance in chinese shareholding companies. Asia Pacific Journal of Management 18(2):245–263

Tsui A (2006) Contextualization in chinese management research. Management and Organization Review 2(1):1–13

Ughetto E (2010) Assessing the contribution to innovation of private equity investors: A study on european buyouts. Research Policy 39(1):126–140

Van Essen M, Oosterhout J, Carney M (2012) Corporate boards and the performance of asian firms: A meta-analysis. Asia Pacific Journal of Management

Wang C, Kafouros MI (2009) What factors determine innovation performance in emerging economies? evidence from china. International Business Review 18(6):606 – 616

Westphal J, Zajac E (1995) Who shall govern? ceo/board power, demographic similarity, and new director selection. Administrative Science Quarterly pp 60–83

Williamson O (1988) Corporate finance and corporate governance. The journal of finance 43(3):567–591

Wooldridge JM (2001) Econometric Analysis of Cross Section and Panel Data. No. 0262232197 in MIT Press Books, The MIT Press

Wu H (2008) When does internal governance make firms innovative? Journal of Business Research 61(2):141–153

Xiao J, Dahya J, Lin Z (2004) A grounded theory exposition of the role of the supervisory board in china. British Journal of Management 15(1):39–55

Xinhua (2013) Vice premier pledges support for china's smes. Online, URL http://news.xinhuanet.com/english/china/2013-02/23/c_132187599.htm

Xu X, Wang Y (1999) Ownership structure and corporate governance in chinese stock companies. China economic review 10(1):75–98

Yeh Y, Woidtke T (2005) Commitment or entrenchment?: Controlling shareholders and board composition. Journal of Banking & Finance 29(7):1857–1885

Young M, Peng M, Ahlstrom D, Bruton G, Jiang Y (2008) Corporate governance in emerging economies: A review of the principal–principal perspective. Journal of Management Studies 45(1):196–220

Zhang YC, Li SL (2009) High performance work practices and firm performance: evidence from the pharmaceutical industry in china. International Journal of Human Resource Management 20(11):2331 – 2348

Table 1: Descriptive Statistics and Correlation Matrix

Variable	Obs.	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1, invention patents	1035	1.15	4.57	1.00												
2, new invention patents 2004-2006	310	0.85	2.84	0.93*	1.00											
3, new product sales millions of yuans	1035	34.98	104.78	0.14*	0.12*	1.00										
4, R&D expenditure millions of yuans	1035	4.22	12.09	0.14*	0.14*	0.60*	1.00									
5, holding of the largest shareholder, %	1035	58.64	21.55	-0.03	-0.002	-0.03	-0.09*	1.00								
6, independent directors indicator	1035	0.48	0.50	0.04	0.04	0.01	0.04	-0.08*	1.00							
7, supervisory board indicator	1035	0.74	0.44	0.02	0.02	0.07	0.10*	-0.28*	0.17*	1.00						
8, board size	1035	4.20	3.12	0.07	0.03	0.17*	0.22*	-0.37*	0.13*	0.24*	1.00					
9, outsider CEO indicator	1035	0.09	0.29	0.02	0.02	0.11*	0.10*	0.07*	0.01	-0.03	0.08*	1.00				
10, managers subject to incentive pay, %	1035	58.82	38.31	0.08*	0.11*	0.12*	0.14*	-0.08	0.03	0.10*	0.15*	0.07	1.00			
11, firm age	1035	9.81	7.32	0.15*	0.06	0.09*	0.11*	-0.08*	0.01	0.01	0.15*	-0.11*	0.12*	1.00		
12, total asset millions of yuans	1035	171.91	449.02	0.08*	0.07	0.42*	0.49*	-0.04	0.03	0.10*	0.20*	0.05	0.06	0.06	1.00	
13, State-Owned Enterprises, indicator	1035	0.04	0.21	-0.06	-0.06	-0.07	-0.07	-0.04	0.005	0.06	0.03	-0.02	-0.09*	-0.08*	-0.05	1.00
14, Foreign-Owned Enterprises, indicator	1035	0.09	0.29	-0.03	-0.02	0.03	-0.003	0.01	-0.03	0.05	0.04	0.14*	0.08*	-0.11*	0.01	-0.07*

Notes: [1] * indicates statistical significance at 5% level. [2] The correlation coefficients between new invention patents (2004-2006) and other variables are calculated by using the values of these other variables in 2004. [3] All monetary figures are deflated with the national Consumer Price Index to obtain values in 2004 yuan.

Table 2: Innovation Regressions: All Firms

	Patents Poisson	Patents Hurdle-part 1	Patents Hurdle-part 2	NPS Tobit	NPS Hurdle-part 1	NPS Hurdle-part 2
Variables	(1)	(2)	(3)	(4)	(5)	(6)
board size	0.01	0.02	-.03	0.03	0.06	-.01
	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.01)
ind director dummy	0.38	0.13	0.12	0.06	0.14	0.08
	(0.14)***	(0.19)	(0.2)	(0.18)	(0.28)	(0.07)
sup board dummy	-.54	-.41	-.03	0.04	0.27	-.11
	(0.17)***	(0.23)*	(0.23)	(0.22)	(0.32)	(0.09)
largest sh %	0.06	0.02	0.05	0.006	0.002	-.0004
	(0.01)***	(0.02)	(0.02)***	(0.02)	(0.03)	(0.007)
high concentration dummy · largest sh %	-.05	-.01	-.04	-.005	0.0008	-.0005
	(0.01)***	(0.02)	(0.01)***	(0.02)	(0.03)	(0.006)
outsider CEO	0.19	-.30	0.45	-.30	-1.07	-.10
	(0.2)	(0.32)	(0.23)*	(0.31)	(0.57)*	(0.13)
patents in 2004	0.17	0.17	0.13			
	(0.01)***	(0.05)***	(0.01)***			
patent stock in the same year				0.02	0.08	-.003
				(0.02)	(0.04)**	(0.006)
lag new product sale				1.05	0.71	0.32
				(0.04)***	(0.09)***	(0.02)***
ln RnD expenditure	0.11	0.2	-.08	0.49	0.42	0.33
	(0.04)***	(0.05)***	(0.06)	(0.07)***	(0.1)***	(0.04)***
PBP manager,%	0.02	0.001	0.02	-.004	-.005	-.001
	(0.002)***	(0.003)	(0.003)***	(0.003)	(0.004)	(0.001)
foreign	-.07	0.003	-.28	0.3	0.13	-.11
	(0.26)	(0.33)	(0.3)	(0.3)	(0.49)	(0.12)
state-owned enterprises	-23.42			-.76	-1.00	-.04
	(51389.81)			(0.53)	(0.77)	(0.29)
ln asset	0.1	0.01	0.09	-.25	-.32	0.3
	(0.07)	(0.08)	(0.1)	(0.09)***	(0.13)**	(0.04)***
ln age	-.29	0.03	-.34	-.23	-.13	-.22
	(0.09)***	(0.12)	(0.15)**	(0.14)*	(0.17)	(0.06)***
sector dummies	included	included	included	included	included	included
Const.	-3.57	-1.85	-.97	1.74	1.90	-1.01
	(1.17)***	(1.46)	(1.70)	(1.46)	(2.03)	(0.66)
Obs.	310	310	310	725	725	725
Log-likelihood	-410.08		-268.06	-857.60		-442.78

Notes: [1] The top row indicates the dependent variable. Patents refer to new invention patents between 2004 and 2006, and NPS refer to the new product sales. [2] The second row indicates the estimation method. In columns (2) and (3), the hurdle model is the Probit-Poisson hurdle model. In columns (5) and (6), the hurdle model is the Lognormal hurdle model. [3] The log-likelihood value reported in column (3) is the log-likelihood for the two parts of the hurdle model combined, hence comparable to the log-likelihood value in column (1). The same applies to the log-likelihood value in column (6). [4] *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 3: Innovation Regressions: Domestic Private Firms

	Patents Poisson	Patents Hurdle-part 1	Patents Hurdle-part 2	NPS Tobit	NPS Hurdle-part 1	NPS Hurdle-part 2
Variables	(1)	(2)	(3)	(4)	(5)	(6)
board size	0.01	0.02	-.03	0.04	0.06	-.01
	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.01)
ind director dummy	0.37	0.18	0.03	0.09	-.007	0.03
	(0.15)**	(0.19)	(0.21)	(0.2)	(0.3)	(0.08)
sup board dummy	-.51	-.41	-.14	0.13	0.24	-.04
	(0.17)***	(0.23)*	(0.25)	(0.25)	(0.33)	(0.1)
largest sh %	0.06	0.02	0.04	0.02	0.02	0.003
	(0.01)***	(0.02)	(0.02)**	(0.02)	(0.03)	(0.008)
high concentration dummy · largest sh %	-.05	-.02	-.04	-.01	-.01	-.003
	(0.01)***	(0.02)	(0.01)***	(0.02)	(0.03)	(0.006)
outsider CEO	0.38	-.06	0.46	-.10	-1.10	-.13
	(0.21)*	(0.34)	(0.23)**	(0.36)	(0.58)*	(0.14)
patents in 2004	0.17	0.17	0.13			
	(0.01)***	(0.05)***	(0.01)***			
patent stock in the same year				0.02	0.09	-.005
				(0.02)	(0.04)**	(0.006)
lag new product sale				1.02	0.68	0.3
				(0.04)***	(0.09)***	(0.02)***
ln RnD expenditure	0.08	0.19	-.11	0.54	0.41	0.35
	(0.04)*	(0.06)***	(0.07)	(0.08)***	(0.11)***	(0.04)***
PBP manager,%	0.02	-.0002	0.02	-.005	-.004	-.001
	(0.002)***	(0.003)	(0.003)***	(0.003)	(0.004)	(0.001)
ln asset	0.13	0.02	0.15	-.25	-.27	0.3
	(0.07)*	(0.09)	(0.11)	(0.1)**	(0.13)**	(0.04)***
ln age	-.23	0.05	-.34	-.16	-.07	-.18
	(0.1)**	(0.12)	(0.15)**	(0.16)	(0.18)	(0.06)***
sector dummies	included	included	included	included	included	included
Const.	-4.07	-2.17	-1.69	0.97	0.78	-1.29
	(1.23)***	(1.53)	(1.79)	(1.65)	(2.12)	(0.69)*
Obs.	271	271	271	620	620	620
log-likelihood	-380.29		-249.21	-759.21		-389.26

Notes: [1] The top row indicates the dependent variable. Patents refer to new invention patents between 2004 and 2006, and NPS refer to the new product sales. [2] The second row indicates the estimation method. In columns (2) and (3), the hurdle model is the Probit-Poisson hurdle model. In columns (5) and (6), the hurdle model is the Lognormal hurdle model. [3] The log-likelihood value reported in column (3) is the log-likelihood for the two parts of the hurdle model combined, hence comparable to the log-likelihood value in column (1). The same applies to the log-likelihood value in column (6). [4] *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels.