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Top Management Turnover and Corporate Governance in China: effects on innovation performance

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Abstract

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Research Insights: A balance is maintained between the negative effect of (relatively high) top management turnover on investment horizons and innovation productivity, mitigated by positive effects of high state ownership, up to a certain level of ownership concentration. Beyond this level, potential for abuse by the dominant shareholder curtails positive effects on innovation. This contrasts with foreign dominant shareholders where no alignment between dominant shareholder and top management occurs and shorter investment horizons are preferred with lower innovation productivity.

Theoretical Implications: In China, with state-held and controlled publicly listed firms, there is an alliance between the dominant shareholder and top management with relatively low employee protection and weak protection for lesser shareholders . This may have positive outcomes for long term innovation but may also lead to principal-principal abuses. Any such alliance needs to be tempered by stronger internal governance structures to protect minority shareholders. But stronger protection may in turn reduce investment horizons and lower innovation.

Policy Implications: As well as strengthening external corporate governance mechanisms, insider corporate governance mechanisms need to be strengthened to discipline managers. However stronger countervailing powers to secondary shareholders, stronger Supervisory Board rights and greater independence of Directors may tend to decrease time horizons of investment for the firm and impede innovation.

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Keywords: Corporate governance; Top management turnover; innovation performance; China

1. Introduction

This paper examines the links between Chinese corporate governance structures, top management entrenchment and Chinese publicly-listed firms' innovativeness. It unpicks the governance structures of blockholder power, managerial discretion, countervailing power through Board structures and strong other countervailing blockholders to examine how the distinctive Chinese corporate governance with high state blockholder control affects innovation. Does state control of publicly-listed firms lead to entrenchment of managers, in the absence of market discipline through a market for corporate control? Does state blockholding increase innovation through giving greater capacity to invest in the long-term, not being subjected to other shareholder pressure that might have shorter-term horizons? Or does state blockholding, allowing abuse of minority shareholders and taking of perquisites, lead to shorter investment horizons and innovation? How do internal countervailing governance powers such as strong other blockholders, strong Boards of independent Directors or larger Boards, affect investment in innovation?

Corporate governance structures affect investment horizons and innovation. (Shapiro et al 2013; Belloc 2012). This is because governance determines whose objectives predominate in internal decision-making, and therefore whose time horizons and which investment decisions will occur. These decisions are made by Top Management under the supervision of a Board of Directors on behalf of shareholders, in the case of publicly-listed firms (Strange, Filatotchev, Buck and Wright 2009). But the degree of managerial discretion and the objectives of the Top Management depends on who the shareholders are, how concentrated ownership by lead shareholders is, and how much control is exercised by those lead shareholders.

In western capitalism, Top Management Turnover is seen as a mechanism whereby shareholders exert discipline, either through external mechanisms of acquisition and merger or through internal mechanisms of monitoring of management by the Board and replacement of under-performing managers. The literature emphasises the improvement in performance of

firms subsequent to top management turnover, reasoning that poor management is replaced by superior management teams. However this literature is inconclusive on the trade-offs between less management turnover, greater weight to managerial objectives and discretion that allows for access to patient capital and longer investment horizons and more innovation on the one hand, and more management turnover, following shareholder objectives with less managerial discretion, with shorter time horizons, less long-term investment and less innovation on the other. Different western capitalisms organize the governance of this trade-off in varying ways (Hall and Soskice 2001; Hall and Gingerich 2009).

However this trade-off is resolved in western capitalisms, they have in common a relatively strong external governance environment. European and North American countries have stronger legal systems, greater independence of judiciaries, rank better on corruption indices and have greater protection for minority shareholders than do governance systems in emerging markets (Charron 2013; Kuncic 2013; Rodrik, Subramanian and Trebbi 2004). Huang (2008) argues that Chinese stock market valuations are not linked to fundamentals, that firms are highly vulnerable to shocks and links this to poor corporate governance practices of listed firms with low regulatory standards and corruption. (p295). Gourevitch and Shinn (2005) characterises Chinese corporate governance as weak in external governance mechanisms, weak in rule of law and lacking in minority shareholder protection.

Using a unique firm-level dataset, this paper studies the relationship between management turnover and innovation productivity in Chinese publicly-listed firms. The first step is examining whether there is entrenched management ie low management turnover in China, as one might expect with relatively weak external governance mechanisms through the stock market and legal system. It goes on to establish the underlying relationship between top management turnover and innovation productivity. It explores three key aspects of the corporate governance environment: corporate ownership, corporate control and Board structure, and their effects on innovation.

Our empirical findings are that management turnover is relatively high but this has a negative impact on firms' capability to deliver effective innovation. This negative relationship is positively moderated by corporate governance environments where the state and legal entities are controlling shareholders. Our results also suggest that top management turnover is less disruptive to innovation when there is countervailing power to the leading blockholders

through strong secondary blockholders, larger Boards and independent Directors. This underlines the importance of internal corporate governance structures in Emerging Markets on firms' innovation potential.

This paper makes several key contributions to the literature. Firstly, we study the efficiency of R&D investment in China, innovation productivity, rather than measuring innovation simply as R&D expenditures; we construct a measure of effectiveness of R&D through patent outcomes to reflect more accurately firms' capabilities in delivering innovation. Secondly we update Firth's (2006) work to establish whether there exists entrenched management in China in the decade to 2011. We establish that management turnover rates, although declining since Firth's rates of 1998-2002, have remained higher at around 18% (including normal and forced turnover) than rates reported for the US and Western Europe. We conclude that entrenchment of top management has not been an issue in China and moreover that management turnover itself is not critically determined by performance measures of the firm but is intrinsically related to the internal governance structures of the firm. Thirdly we study the theoretical links between internal corporate governance environment – ownership type, control and Board structure – that interacts with management objectives in determining innovation productivity. Fourthly we examine empirically these combined effects: of management turnover combined with governance structures of different ownership types, the extent of their leading shareholder control, the countervailing power held by secondary shareholders and various aspects of Board structure in affecting innovation productivity in Chinese firms. These contributions highlight how critical it is to incorporate these governance issues in understanding the key influences on firms' innovation in China.

This paper is structured as follows. Section 2 develops our hypotheses in the context of the current literature; Section 3 describes data sources and methodology. We then report our research results first on top management turnover rates, on the relationship between management turnover and innovation productivity and on the combined relationships between shareholder power and control, and Board structures in affecting this relationship. The final section concludes the paper and discusses managerial implications.

2. Literature review and hypothesis building

Management turnover in China

Does management turnover in China reflect disciplining of management, in the way it is assumed to do in the West? If external governance mechanisms (stock market development, market for corporate control, law enforcement) are relatively weak in China, does this imply that there is entrenched management ie that top management of firms are not removable and that management turnover is lower in China than in the west?

Recent research has been interested in examining the effectiveness of Chinese corporate governance for the relatively recently listed but growing number of publicly-listed firms in China. They have used agency theory to assess whether Chinese management is being disciplined by the stock market, by looking at the incidence of top management turnover in China and whether that is related to poor performance, both in terms of accounting profitability and stock market returns. High turnover means lack of entrenched management and signals effective corporate governance.

Contrary to expectations, top management turnover in China between 1998 and 2002 is far from entrenched but has turnover rates of between 48% in 1998 falling to 34% by 2002 (Firth et al 2006). CEO turnover in Chinese listed firms is negatively related to firm performance as measured by earnings(Chang & Wong, 2009), and to firm accounting performance but management turnover in China is not related (negatively or positively) to stock market returns. i.e performance by a stock market measure does not determine management turnover. Conyon and He (2012) investigates the relative weights attached to accounting as opposed to stock market performance measures in CEO turnover, showing that CEO turnover is negatively associated with accounting performance but not with stock market measures. Chang and Wong (2009) finds management turnover negatively related to profitability when the firm is making losses, but not when the firm is making profits. They put forward the idea that the objective function for Chinese firms varies over time, being geared to financial objectives when the firm is making losses, but maintaining other objectives as long as the firm is achieving a certain level of profitability. Shen and Lin (2009) concur with this: that management turnover in Chinese listed firms has positive impact on subsequent firm profitability when firms have been performing below average for that industry sector, but has a negative impact on profitability when firm performance has been above average. Moreover management turnover has no impact on subsequent profitability when the state is the largest shareholder, although it has positive impact when the state is not

the largest shareholder. From this literature we conclude that Chinese listed firms are not greatly influenced by stock market measures of performance and that top management turnover and disciplining of management occurs through other mechanisms. Also we conclude that there is not entrenched management in Chinese publicly-listed firms, with top management turnover rates comparable to those in the US and Western Europe.

Management turnover and innovation productivity

This paper focuses on the effect of top management turnover in China on innovation productivity. If there is relatively high management turnover and the absence of entrenched management in China, what does this imply for objectives in relation to long term investments and innovation? There are two conflicting views on this. One stream of literature argues that over decision-taking for the long-term which involves risky uncertain R&D projects, the conflict is between more risk-neutral shareholders favouring longer-term investments and risk-averse top management with shorter investment horizons (Jensen and Smith 1985). Shorter time-horizons of management are accentuated by such characteristics of top management as age (the horizon or myopia problem, older management becoming more risk-averse) (Barker & Mueller, 2002), but are mitigated by the 'hubris' characteristic, more optimistic CEOs are likely to undertake longer-term riskier investments (Li and Tang 2010).

Management attitudes towards innovation are also affected by technology-intensity in the sector: where R&D spending is expected, this conditions management decision-making in its favour, compared with low-technology non-R&D industry where management are not expected to invest in technology. Fong (2010) notes the division between CEO behaviour towards R&D spending in R&D intensive industries compared with low-tech industries; in high-tech industries, higher R&D spending is rewarded by higher CEO payment in R&D intensive industries but by lower CEO payment in low-tech industries. This concurs with Makri, Lane and Gomez-Mejia (2006) also for the US, that as technology intensity increases CEO pay is more closely linked to innovation behaviour associated with the likely impact of the science and innovation involved. If there is evidence of scientific impact on other firms' research and through commitment to scientific research, then CEO behaviour and incentives will reflect that, with higher bonuses for CEOs related to more 'resonant' research. For technology intensive firms, the positive association between CEO incentives and innovation resonance and science harvesting are positively associated with firms' market performance.

We hypothesize that high management turnover suggests an inability to commit to long-term and risky investments. Top management turnover itself is disruptive to investment and innovation trajectories, requiring the reassessment of strategic direction and likely to create greater short-termism. High managerial turnover indicates lower managerial discretion, which is linked to lower risk-taking in the Chinese context (Li and Tang 2010). Hence we expect:

H1 Management turnover in China is negatively related to innovation productivity

The effects of Corporate Governance on innovation

Innovation is a particular challenge in emerging markets such as China due to the weakness in external corporate governance institutions (Chen, Jing Li, Zhang and Shapiro 2013). Chen et al (2013) focuses on ownership type, ownership concentration and Board structure in disciplining management that compensate for weak external institutions.

We build on theories of corporate governance that contrast external market-oriented corporate governance systems with insider internal corporate governance systems (Douma, George and Kabir 2006; Khanna and Rivkin 2001; Park and Luo 2001; Carney and Gedajlovic 2009; Peng and Jiang 2006, Huyghebaert and Wang 2012). Effective corporate governance in China needs to be interpreted through the prism of weak external governance mechanisms (poor legal enforcement, weak independence of judiciary, weakly developed stock markets) and stronger emphasis on internal governance mechanisms (concentrated ownership, Board structures and institutions to monitor and represent shareholders). This emphasis on internal governance hinges on ownership concentration and control mechanisms which characterise many developed countries such as Germany and Japan (Hall and Soskice 2001; Franks, Mayer and Rossi 2005;) as well as emerging markets (Shleifer and Vishny 1997; Morck, Wolfenzon and Yeung 2005). These internal governance mechanisms operate through strong Boards of Directors and Supervisory Boards, to restrain management discretion and discipline poor performance.

However internal mechanisms to discipline management and deal with principal-agent issues increase the problem of principal-principal conflicts, between majority or leading shareholders and minority shareholders. This is particularly acute in the context of weaker legal and external governance mechanisms of the kind that protect minority shareholders in the UK and US systems. These risks of principal-principal conflicts are more acute if the

leading block-holder owner is able to expropriate from minority shareholders without restraint, due to weakness of countervailing power within the Board structures and Supervisory Boards to prevent such channels of abuse. Huyghebaert and Wang (2012) investigating the expropriation of minority investors in Chinese listed firms find evidence of expropriation of minority shareholders in China, through related party transactions, that grows more extensive as the controlling shareholder's control rights over cash flow rights increase. They also find that abuse in the form of excessive labour employment is increased when the state is the controlling shareholder. Expropriation of minority shareholders also increases when a greater fraction of Board directors is affiliated to the controlling shareholder, whereas when there is greater countervailing power on the Board, through control rights of the second to tenth investors, this can offset expropriation.

There is also a contrasting view, particularly for non-Anglo-American governance systems, that governance practices favouring shareholder rights (the Anglo-American system) are not favourable for long-term investment behaviour, as managers are constrained by short-termist horizons of the markets. Lhuillery (2011) finds mixed evidence in looking for a positive impact of shareholder governance practices on R&D decisions by managers for French companies. Moreover OECD (2008) data on R&D by country suggests that the Anglo-American shareholder-promoting system has fared worse more recently on R&D spending and that systems with greater managerial discretion have done better in the past at maintaining high R&D spending (Franks and Mayer 1997; Hall and Soskice 2001; Franks, Mayer & Rossi 2005).

We argue that the disruptive effects of management turnover on innovation are mitigated by controlling shareholder influences on management strategies. If there is a controlling shareholder, that shareholder's time horizons for investment are likely to dominate over management time horizons (Hu and Leung 2012). Shapiro et al (2013) argue that large long-term block owners are providers of "patient capital". They argue that institutional investors having longer investment horizons can enhance innovation by providing long-term incentives to managers with career concerns and by committing resources to innovation. They also argue that dominant shareholders have greater incentives to monitor the innovation efforts of management and this will be conducive to innovation. We argue that dominant shareholders are less risk averse than managers and are likely to have longer time horizons and be more inclined to long term investments for innovation.

However we also suggest that dominant shareholder long-termism depends on type of shareholder: that state-owners are likely to have fewer budget constraints, be more patient regarding performance returns and especially in strategic industries, be more likely to favour longer-term risk-taking for innovation purposes. In addition, management turnover when the state is controlling shareholder may not be related to firm performance objectives but to state-determined management career objectives. This means that management turnover is not triggered by firm profitability *per se* in the short or long term. Hence:

H2a: the negative effect of top management turnover on innovation productivity is constrained when the state is the controlling shareholder.

Management turnover is more likely to be performance related and disciplinary in character when the dominant shareholder is a foreign investor. When the dominant shareholder is a foreign investor, we expect shorter-term horizons and greater risk aversion to long-term investments. This is line with the findings of Kor (2006) which argues that monitoring by outside investors, in the context of the US, leads to lower levels of R&D investment intensity. We hypothesise that:

H2b: the negative effect of top management turnover on innovation productivity is constrained when a foreign investor is the controlling shareholder.

The legal entity is a private, domestic shareholder in China, somewhere between a) and b) in terms of objectives relating to long-term investments in innovation and relating to the disciplining of management according to performance criteria. We would expect legal entities to promote longer term investments more than foreign investors but less than state investors. We thus hypothesise that:

H2c: the negative effect of top management turnover on innovation productivity is constrained when a legal entity is the controlling shareholder.

Is concentration of power or control by the leading shareholder positive for investment horizons and innovation? Up to a point, control by the leading shareholder (high concentration of the lead investor) enables them to influence firm objectives, to improve monitoring and have access to resources, making them less risk averse and more long-term in horizon than management. (Shapiro et al 2013) But after a certain point in concentration,

principal-principal conflicts emerge: the leading shareholder becomes entrenched and is more likely to abuse minority shareholders and follow their own more narrow short-term objectives (Huyghebaert and Wang 2012). These abuses take the form of cronyism and hiring unqualified managers (Huyghebaert & Wang, 2012), engaging in transactions to benefit themselves (Khanna & Rivkin, 2001; Rajan & Zingales, 1998), and investing less in R&D and innovation than the optimal(Young, Peng, Ahlstrom, Bruton, & Jiang, 2008). With weak protection for minority shareholders in China, this type of expropriation and abuse is a sizable concern (Chen, Li, & Shapiro, 2011). Shapiro et al (2013) argue for a non-linear relationship with regard to ownership concentration and its effects on innovation, and we follow this in our hypothesis. Hence:

H3a: the ownership concentration of largest shareholder exhibits a curvilinear (inverted U-shaped) moderating effect on the relationship between management turnover and innovation productivity.

H3b: the ownership concentration of second to fifth largest shareholders positively moderates the relationship between management turnover and innovation productivity.

H3c: the ownership of institutional investors positively moderates the relationship between management turnover and innovation productivity.

Zhang, Ji, Tao and Wang (2011) argue that competition among top managers in Chinese firms plays an important role in the internal monitoring of firms. This can be reflected in the composition of the Board and its structure. Shapiro et al (2013) for Chinese firms in one unusually entrepreneurial province (Zhejiang) with a predominance of smaller, non-state-controlled firms, argue that innovation performance is increased with Board size, for firms with independent directors on their Boards and with stronger Supervisory Boards. We test this out for our larger sample, across the full spectrum of ownership structures in Chinese listed firms: that the size of the Board, the number of independent outside directors on the Board, the size of the Supervisory Board lessen the dominance of leading shareholder objectives. All of these strengthen the countervailing power against the domination of leading shareholders on the one hand and against the risk aversion of the management on the other and are likely to lengthen investment horizons and lead to higher innovation productivity. We thus hypothesise that:

H4a: the negative effect of top management turnover on innovation productivity is constrained when boards have a higher proportion of independent outside directors

H4b: the negative effect of top management turnover on innovation productivity is constrained with an increase in Board size.

H4c: the negative effect of top management turnover on innovation productivity is constrained with an increase in Supervisory Board size.

3. Method and data sources

Sample and the construction of the dataset

The analysis of this study is based on a unique dataset of Chinese listed firms. The annual accounting and corporate governance information of all A-share firms listed in Shanghai and Shenzhen stock exchanges are obtained from the China Stock Market Accounting Research (CSMAR) database. The sample period spans 2000-2011. We use this period because information about top management turnover and major governance variables such as Board and ownership structures became increasingly available after new disclosure regulations were first announced by the China Securities Regulatory Commission (CSRC) in 1999.

Patent data is obtained from the China State Intellectual Property Office (SIPO) from 2000-2011. Patents filed with the SIPO contain information of the patent granted year, classification, inventors' names, and full address of the applicants. We match firms' top management turnover and accounting information with this patent data. Due to the complicated ownership structure of Chinese listed firms, legal entities related to listed companies can file patents independently. Their financial information may not form part of firms' financial reports. We therefore only consider patents that are granted to the listed firms and not to other related parties.

We require all firms in our sample to have at least two years of financial information available in order to calculate firms' earnings and stock returns in year t and to $t_{-2,}$ and innovation productivity proxies using the number of patents in year t and to t_{+2} . We exclude financial, services and retail sectors as patenting is of limited importance to these sectors. We also exclude firms with missing financial and corporate governance information, and also

singleton groups of 119 observations in our analysis. We winsorise all financial performance variables at the 1% level to mitigate outlier effects. Our final sample covers the period from 2002 to 2009. It is an unbalanced panel of 6,967 firm-year association for 1,011 firms, with a record of 78,915 successfully granted patents when innovation productivity is the dependent variable. When measured by patent count, our sample is extended to 8,763 firm-years associated with 1,227 firms.

Dependent variable

Previous studies on innovation focus on three measures: R&D expenditure, number of patents, and patent citation to measure firms' innovation(Cuddington & Moss, 2001; Fong, 2010; Wu, Levitas, & Priem, 2005).[i] R&D expenditure may only capture the effect of firms' budget allocation for innovation activities (Acs, Anselin, & Varga, 2002). The number of patents and citations can represent a novel and potentially valuable combination of knowledge. But not all innovations will be patented or lead to successful commercialisation that improves firms' value (Acs et al., 2002). Patent citations are unavailable to us because the SIPO does not record them. We therefore rely on patent counts as part of our measure because they can reflect process and product innovation relatively well. (Lin, Lin, Song, & Li, 2011; Wang & Zhou, 2013).

Nevertheless, innovation does not simply require R&D investment and well trained research staff. Firms' capabilities and organisation of resources for innovation are also important (Wei & Liu, 2006; A. Zhang, Zhang, & Zhao, 2003). The role of top managers to ensure the effective organisation for innovation is critical to its success. (Wu, et al., 2005). Following Bereskin and Hsu (2013), we adopt the innovation productivity proxy and measure efficiency of firms' innovation effort through the transformation of R&D expenditure into patents.

We construct patent count as follows:

$$Patent_{i,t}^{(N)} = Ln(1+\sum_{\kappa=1}^{N} Counts_{i,t+\kappa})$$

where *Counts* denotes firm *i*'s cumulative number of granted patents from year *t* to *k*. *N* is the number of years studied. We choose N=2 to study the impact of top management in the following two years after they depart. We assume that patent counts in a given year reflect the innovation decision of the previous year. This time period reflects the length of

patent grant application which is 1-1.5 years on average and 6months or less for utility or design patents (Fu, 2008) (Liegsalz & Wagner, 2012). Although our data does not differentiate between types of patents, we adopt 2 year cumulative period to take this patent application process into account. The high frequency of top management turnover in Chinese listed firms may require the use of short time periods to reflect managers' efforts for innovation within relatively short periods of office. The log-linearisation mitigates the skewedness of this measure according to Lerner (1994).

We calculate innovation productivity as the difference between log-linearisation of R&D investments and patent counts ($Patent_{it}$), expressed as:

$$Innovation_Productivity_{i,t}^{(N)} = Patent_{i,t}^{(N)} - Ln(1+\sum_{\kappa=1}^{N} RD_{i,t+\kappa})$$

where *RD* is R&D expenditure of firm *t*. Unlike international accounting systems, there is no item recorded as R&D investment or expenditure in the Chinese one. Dong and Gou (2010) suggest that "Cash Paid for the Business Related Activities" reported in firms' financial statement is equivalent to R&D investment in China. It includes the development and design, technology development and research. Like other types of capital, R&D investment depreciates. Following Hirshleifer, Hsu, and Li (2012) and Kafouros (2006), we assume R&D investment has an annual depreciation rate of 20%.

Independent variables

Top Executive turnover: previous studies on top management turnover in the context of developed countries treat CEOs as firms' top executives. The classification of top executives in China is complicated. Top managers generally use General managers (GM) or President as their job titles. Only recently, CEO has been adopted by some firms. Previous research suggests it is not appropriate to treat CEOs as top executives in China (Conyon & He, 2011; Firth, Fung, & Rui, 2006; Kato & Long, 2006; Shen & Lin, 2009). Chairman is an executive position and ranks above CEO in Chinese firms. Chairmen are also firms' legal representatives (Conyon & He, 2011; Firth, et al., 2006; Shen & Lin, 2009; L. Zhang, et al., 2011). We therefore follow the previous literature and identify a change in Chairman in each firm year.

Corporate governance measures: To test our hypotheses 3-5, we measure the strength of corporate governance that mitigates the impact of top executive turnover through the following corporate governance measures. To measure *characteristics of corporate control*, we include state (*STATE*) to indicate if the state is the controlling shareholder coded 1, otherwise 0. Similarly, two dummy variables, legal entities (*LEGAL*) and foreign investors (*FOREIGN*), are used to indicate when they are controlling shareholders. For ownership structure, we include percentage of shares held by firms' largest shareholder (*Top1*), the square of Top1 (*Top1square)* to test the curvilinear effect of the largest shareholders, and the Herfindahl index of the sum of the squared percentage shareholding by top 5 shareholders excluding the largest shareholder (*Top2_5)* to test the countervailing power of the top2 to 5 shareholders against the largest shareholder. Following Firth, et al. (2006), we do not include the Chairman's stock ownership as the amounts are small and insignificant as voting power. For Board structure, we examine the moderating effect of the size of Board and the proportion of independent outside directors. (see below equation 1)

Control variables: in line with the previous literature, we control for a number of factors that might affect top management turnover. We control for firm performance by including firms' earnings and annual stock returns in the contemporaneous and lagged years. Strong past and current performance are expected to have a positive effect, while firms with poor performance might have lower innovation productivity and higher executive turnover rate (see model specification for endogeneity issues and instrumental variables)(Bereskin & Hsu, 2013; Murphy & Zimmerman, 1993). Tobin's Q is used to control for firms' capabilities and resources that are reflected in market capitalisation(Kumar, 2010). We normalise it with respect to firm size and expect firms with higher Tobin's Q to have higher innovation performance. For firm characteristics, we control for firm age as the number of years listed. Older firms may become more bureaucratic, inward looking and be less innovative (Lin, et al., 2011; Tassey, 1991). Firm size is used to capture firms' available resources and capability as well as complexity of organisational structure for innovation (Audia & Greve, 2006; Hoffman, Parejo, Bessant, & Perren, 1998). We use industry classification provided by CSMAR to calculate industry-adjusted measurements to reduce variation among industries. We include GDP per capita in the firm's region, to control for differences in macro-economic environment, labour market and local economic development (Fan, Wong, & Zhang, 2007; Lin, et al., 2011).

Model specification

To evaluate the impact of top management turnover on firms' innovation performance, we use two-stage least squares regression models (2SLS) with fixed effects and Heteroskedasticity and Autocorrelation-Consistent (HAC) robust standard errors. Our choice of method is based on the consideration that top executive turnover can be a function of firm performance and age, as the work of (Bereskin & Hsu, 2013; Murphy & Zimmerman, 1993) indicate. The endogeneity of top executive turnover can arise due to simultaneity (Larcker & Rusticus, 2010), as our predictor, turnover, can be partially determined by performance and age. The decline of innovation productivity associated with top executive departures may also reflect strength of corporate governance. To address the concern of endogeneity, we use 2SLS models to account for endogeneity of our predictors (Semadeni, Withers, & Trevis Certo, 2013).

Following the work of (Bereskin & Hsu, 2013; Murphy & Zimmerman, 1993), we adopt top executive age and the dummy variable for top executive age 64 as instrumental variables. We also include Chairman duality because a top executive who holds positions as both CEO and Chairman of the Board controls Board decisions and agendas as well as reduces power struggles between a separate Chairman and CEO (Weisbach, 1988(Shen and Cannella, 2002), thereby minimising the risk of turnover (Firth, et al., 2006). Based on Hausman tests, we introduce fixed effects to control for time-invariant and unobserved heterogeneity among firms in our models. The HAC robust standard errors was applied to allow efficient and valid estimations in the presence of autocorrelation (Green 2003)(Bascle, 2008). We also follow the 2SLS procedure set out by (Wooldridge, 2002) to reduce biases when interaction variables are introduced into the model.

In the first stage regressions, we regress top executive turnover on firms' performance, instrumental variables, corporate governance and control variables that reflect firms' characteristics in the second stage. The first stage regression can be expressed (1) as:

$$\begin{aligned} Turnover_{it} = {} & \alpha + \beta_1(returns)_{it} + \beta_1(returns)_{it-1} + \beta_2(earnings)_{it} + \beta_1(earnings)_{it-1} \\ & + \beta_3(age)_{it} + \beta_4(age_dummy) + \beta_4(duality) \\ & + \beta_1(governance) + \beta_4(control) + \varepsilon_{it} \end{aligned} \quad (1)$$

where

$Turnover_{it}$ is an indicator variable equal to one when a chairman departs from firm *i* in year *t*.

$return_{it}$ is the industry adjusted annual stock returns. $return_{it-1}$ is the lagged $return_{it.}$

$earnings_{it}$ and $earnings_{it-1}$ are the contemporaneous and lagged earnings scaled by the sales of previous year calculated as $\frac{net\ income_{it}}{sales_{it-1}}$ and adjusted by the median return of the industry. Net income is after the extraordinary items.

age is the age of the chairman.

age_dummy equals 1 if a chairman is over 64

duality equals 1 if chairman also serves as CEO.

Governance variables include:

Corporate control

Foreign equal to 1 for foreign investors being the largest shareholder, 0 otherwise.

State equal to 1 for state owners being the largest shareholder, 0 otherwise.

Legal equal to 1 for legal entities being the largest shareholder, 0 otherwise.

Ownership structure

Top1 is the percentage of shares held by firms' largest shareholder.

Top1square is the square of the largest shareholder's percentage of shareholding.

Top2_5 is the Herfindahl index of the sum of the squared percentage shareholding by top 5 shareholders excluding the largest shareholder.

Board characteristics

Board size is number of Board directors.

Independence ratio is the ratio of independent outside directors to Board size.

Control variables include:

Size is the logarithm of total assets at the end of fiscal year.

Firm_age is the number of years firm is listed in the stock market.

Tobin Q is market value of assets over book value of assets.

GDP is the log of provincial GDP per capita in the location a firm is based.

In our second stage regression equation (2), we regress our innovation productivity measures on predicted top executive turnover from equation (1) along with firm performance, corporate governance and control variables. It is expressed as:

$$(2)\quad \begin{aligned} Innovation_{it} = {} & \alpha + \beta_1(Turnover)_{it} + \beta_1(performance)_{it} + \beta_1(performance)_{it-1} + \\ & \beta_2(earings)_{it} + \beta_1(earnings)_{it-1} + \beta_1(goverance) + \beta_1(control) + \varepsilon_{it} \end{aligned}$$

where $innovation_{it}$ is innovation productivity as in formula (2) of firm i adjusted to industry median. All other variables are defined previously.

To test the moderating effects of corporate governance, we include interaction terms of corporate governance measures defined previously in equation (3). The estimation model is as follows:

$$(3)\quad \begin{aligned} Innovation_{it} = {} & \alpha + \beta_1(Turnover)_{it} + \beta_2(performance)_{it} + \beta_3(performance)_{it-1} + \\ & \beta_4(earings)_{it} + \beta_5(earnings)_{it-1} + \\ & \beta_6(governance)_{it} + \beta_7(Turnover \times goverance)_{it} + \varepsilon_{it} \end{aligned}$$

4. Empirical results

Descriptive statistics

Table 1 shows the turnover statistics by years for our sample of 6,967 firm year observations. There are in total 1,221 cases of Chairman turnovers in the sample period when innovation productivity is the dependent variable. Table 2 reports summary statistics of key variables used in our regression analyses. It shows the average Chairman turnover rate is 18% in our sample. This is slightly lower than the ratio found in earlier research (Conyon & He, 2011; Kato & Long, 2006). This is because we do not include services and financial industries in our sample. It is still higher than the CEO turnover rate in the US, which is around 17% (Kaplan & Minton, 2012). Chairman duality is not a common feature in China. It accounts for 17% of the total observations. The mean age of Chairmen is 50, ranging from 29 to 72. Three per cent of the sample are over 63. The mean of industry adjusted variables are R&D productivity 0.33 with a range from -3.24 to 7.34, earnings -0.01 percent with a range from -2.10 to 1.44, and annual stock returns 0.11 with a range from -0.15 to 2.46. Foreign controlled firms represent 1% of the sample, while state-owned as largest shareholders account for 61% and legal entities as largest shareholders account for 25% of the sample. The largest shareholders have on average 39% of shares of the companies. The mean of institutional investors' shares is 0.07 percent with a range from 0 to 53 percent. China's corporate governance regulations require that listed firms have one third of directors

independent. In our sample, the ratio of non-executive directors to Board size is 34 per cent. The mean of Board size is 9.55 while the size of Supervisory Board on average is 4.17. The summary statistics show values of our independent variables are similar to those in previous research.

Table 4 presents the correlation matrix of our key variables. To ensure results are not affected by multi-collinearity, we compute variance inflation factors (VIFs). All VIF values are within an acceptable range (mean 1.32). As expected, Chairman turnover is significantly negatively related to R&D productivity as well as to firms' financial performance such as stock returns and earnings.

Table 3 reports empirical results of the second stage regressions that show effects of Chairman turnover on our two innovation measures. The validity of our instruments needs to satisfy the conditions of both strength and exogeneity. As discussed in model specification, we adopt age, age64 and duality as our instruments for turnover. Both endogeneity tests and under-identification tests are all significant across all models at the 0.05 or below significance level. This leads us to reject the possibility of weak instruments in our estimations (Stiger and Stock 1997). The Sargen-Hansen J-statistics are all insignificant (above the 0.1 significance level) across all models. This indicates that our instruments are valid and uncorrelated with the error term, and excluded instruments are omitted from the estimated equations correctly. We also report the HAC consistent standard errors (Hayashi, 2000, Greene 2010).

As shown in table 3, Chairman turnover has led to declines in both innovation productivity and patent counts across all models. All turnover coefficients are significant at the 0.05 or above significance level. These results support our hypothesis 1 that Chairman turnover brought discontinuities to firms' innovation activities. This may be because the Chairman was the ultimate decision- maker in the Chinese firms' hierarchical management system (L. Zhang, et al., 2011), with turnover leading to some R&D activities being deprioritised and disrupted. Models 1 and 4 contain only control variables. They are similar to the base model used by Murphy and Zimmerman (1993) to address endogeneity of turnover. We find that firm size is significantly positively related to both innovation measures, while firm age is significantly negatively related across all models. This implies that larger firms have higher innovation productivities and research outputs given their resources and capabilities accumulated over time. Firms listed on the stock market for longer are more likely to focus on their financial performance rather than their long term

development. Firms' earnings are also important in affecting innovation performance and outputs. We find there is a negative and significant effect of firms' earnings in the t-1period on both innovation measures across all models. Similarly, although we do not find significant results, stock returns are negatively related to both measures. This is similar to the finding of Firth, et al. (2006) that stock returns may not reflect top management's abilities. Also contrary to expectations, Tobin's Q is significant and negatively related to patent counts in all models but not to innovation productivity. This indicates that firms' innovation activities measured by the transformation of R&D spending may not be perceived as efficient by the market. Investors prefer short term accounting returns.

Models 2 and 3 give direct effects of corporate governance on both innovation measures. We find that foreign and legal- entity- controlled firms are significantly negatively related to both measures while the state-controlled firms are significantly positively related to patent counts. The largest shareholders have a significant positive effect on both measures and as expected, this effect is curvilinear. The largest 2-5 shareholders also have a positive effect on both measures. Institutional investors however do not exert a significant effect. Both Board size and Board independence ratio are significant and positive in both models 2 and 5.

Models 3 and 6 show the interaction effects of corporate governance and provide direct tests of hypotheses 2-4. For ownership control, both interaction terms of state (coefficients 0.683 and 0.354 respectively) and legal (coefficients 1.137 and 0.695 respectively) with Chairman turnover are positive and significant at the 0.05 significance level in both models. This result indicates that these two types of controlling shareholders positively moderate negative turnover effects on innovation activities measured by both innovation productivities and patent counts, as expected in hypotheses H2a and H2c. The coefficient of foreign*turnover is not significant and H2b is rejected. Foreign owners do not improve firm innovation performance and financial performance might be more important to them. For ownership concentration, we find that top1*turnover is positive and significant (coefficients $\beta=0.201$, $P<0.05$ and $\beta=0.147$, $P<0.1$ respectively). Top1squared*turnover is negative and significant (coefficients $\beta=-0.217$, $P<0.05$ and $\beta=-0.161$, $P<0.1$ respectively) in both models. This supports our H3a that ownership concentration of the largest shareholders positively moderates the negative management turnover effect on innovation activities, and this effect exhibits a curvilinear relationship. The interaction term of turnover with ownership concentration of the second to fifth largest shareholders is not consistent with H3b and not significant. This implies that the influence of multiple shareholders is relatively

weak, especially given the cost and coordination of monitoring by multiple shareholders, and less effective given listed firms' concentrated ownership structure that is often dominated by one controlling shareholder. In our sample, the largest controlling shareholders on average have 39% share of the firms and therefore may have a strong influence on firms' decision-making process and moderating effects. We also find the coefficient of institutional investors and turnover is not significant and leads to rejection of *H3c*.

For the Board structure, both the interaction terms of Board size (coefficients β=0.317, P<0.05 and β=0.234 P<0.1 respectively) and independent directors (coefficients β=0.116, P<0.05 and β=0.317, P<0.05 respectively) with turnover are positive and significant in both models. Similar to Firth, et al. (2006), we argue that internal control mechanisms play proactive roles when a market for corporate control is absent. Our results indicate that independent directors and large Board size moderate the negative impact of Chairman turnover on firms' innovation performance, which affects the long term success of the firm. Our H4a and H4b are supported. The coefficient of interaction term supervisor*turnover is not significant. We reject *H4c.* This implies that larger Supervisory Boards may be inefficient in monitoring the Board's ability to balance the power of insiders, because both they and the Board of directors might be affiliated with the controlling shareholders (Peng, 2004; Xiao, Dahya, & Lin, 2004).

Robustness tests

The analysis above was undertaken using 2 year innovation performance after the turnover. Griliches (1998) and Hall, Griliches, and Hausman (1986) suggest that the lag between R&D spending and patent application can be as short as one year. As a robustness check, we estimated the regression models using the one year period after turnover. The results are broadly similar. We have also used Return on Assets (ROA) and Return on Equity (ROE) as alternative financial performance measurements, firm age as the year firms were incorporated, and aggregate GDP of the regions. Again our results remain materially unchanged. For brevity, results are upon request.

5. Conclusions and Implications for management

Firstly we establish that for China, despite the absence of strong stockmarket influence on firm performance, there does not appear to be entrenchment of management, as top management turnover (here Chairman turnover) rates for 2001-2011 were at 18%, comparable with the 17% rates for the US and Western Europe.

In terms of the association between Chairman turnover and innovation performance in the context of an emerging market, we study a sample of 1,027 Chinese listed firms and their innovation performance from 2002 to 2009. After controlling for endogeneity of turnover, our evidence suggests that turnover of Chairmen brings discontinuities to firms' innovation performance in China. This could be related to the hierarchical nature of top management. The involvement of Chairmen is critical in shaping firms' strategic innovation behaviour. Secondly, we find that certain aspects of corporate governance moderate this negative impact. A high level of controlling shareholder concentration positively mitigates the negative turnover impact but this effect is non-linear. Once largest shareholders have effective control of a firm, their intention may be toward expropriation of minority principals in the short term rather than improving firms' long term development through innovation. Although lower rank blockholders have a positive effect on innovation performance, their power to moderate management entrenchment is rather weak. Firms with state and legal entities as the controlling shareholders may not efficiently use R&D spending, but they have a strong intention to improve firms' innovation capability and thus we find a positive moderating effect. We also find Board independence and Board size have significant effects in moderating negative turnover impact. This is similar to Firth's argument that internal control mechanisms play a proactive role when a market for corporate control is absent. Our findings provide some new insights on the effects of top management turnover as a determinant of firms' innovation performance in an emerging market context.

Managerial implications

Attitudes to investment in R&D and its productivity depends on who the lead shareholders are: state influence is positive up to a point, providing patient capital and longer horizons. Additionally top management turnover for state firms appears more likely to be

linked to state management objectives rather than to firm performance *per se.* This is worrying in that top management are not being assessed according to market or commercial criteria but more in line with political and strategic criteria. This is a systemic criticism: that to promote managerial performance in terms of market and commercial judgment of investment and innovation decisions, senior management must be allowed to exercise independent judgment on these issues. This will be assisted if, as with foreign-held firms, stock market performance indicators are enabled to have greater impact on the internal governance decisions of the firm.

We found also that countervailing power on lead shareholders is relatively weak in China. This countervailing power would come through internal governance structures such as more coordinated secondary shareholders, independent directors on Boards, and through Supervisory Boards to counteract the influence of the main Board. All of these influences are weak in Chinese listed firms, and all point to policy implications that strengthen these countervailing powers. The immaturity of Chinese governance structures, both internally and externally, mean that management objectives are only very weakly aligned to optimal investment decision-making. It also means that there are few mechanisms in place that can curb lead shareholder abuses of power, both of secondary shareholders and of management. Promoting greater independence of top management from the state, alongside strengthening countervailing powers of secondary shareholders, independent directors on Boards and independent Supervisory Boards would all help to enable commercially-minded judgments to be made over long-term investment decisions and to give incentives and disciplinary mechanisms over top management of firms that assist in that process.

Tables

Table 1. Summary statistics of chairman turnover

Year	no change	turnover	total
2003	616	131	747
	82.46	17.54	100
2004	638	161	799
	79.85	20.15	100
2005	693	169	862
	80.39	19.61	100
2006	800	148	948
	84.39	15.61	100
2007	784	156	940
	83.4	16.6	100
2008	838	146	984
	85.16	14.84	100
2009	832	173	1,005
	82.79	17.21	100
Total	5,746	1,221	6,967
	82.47	17.53	100

Table 2. Summary statistics

Variable	n	Mean	s.d	Min	0.25	Mdn	0.75	Max
innovation productivity	6967	0.33	1.56	-3.24	-0.43	0	1.1	7.34
turnover	6967	0.18	0.38	0	0	0	0	1
age	6967	50.03	7.33	29	45	50	55	72
age64	6967	0.03	0.16	0	0	0	0	1
duality	6967	0.14	0.34	0	0	0	0	1
foreign	6967	0.01	0.12	0	0	0	0	1
state	6967	0.61	0.49	0	0	1	1	1
legal	6967	0.25	0.43	0	0	0	1	1
top1	6967	39.34	16.15	3.24	26.53	37.87	51.76	85.23
top1square	6967	18.08	13.66	0.1	7.04	14.34	26.79	72.64
top2_5	6967	1.77	2.63	0	0.07	0.5	2.52	19.41
institution	6967	0.03	0.07	0	0	0	0.03	0.53
IND_ratio	6967	33.92	6.33	0	33.33	33.33	36.36	66.67
board size	6967	9.55	2.06	3	9	9	11	19
supervisory	6967	4.17	1.42	0	3	4	5	13
size	6967	21.44	1.11	14.16	20.73	21.35	22.05	27.49
firm age	6967	11.43	3.91	2	8	11	14	28
stock return	6967	0.11	0.57	-1.03	-0.15	0	0.23	2.46
earnings	6967	-0.01	0.27	-2.1	-0.04	0	0.06	1.44
Tobin's Q	6967	0.22	0.89	-0.92	-0.16	-0.01	0.28	6.57
GDP	6967	9.04	0.89	5.12	8.57	9.09	9.62	10.58

Table 3. Correlation matrix

Variables		1	2	3	4	5	6	7	8
1	innovation productivity	1							
2	turnover	-0.049	1						
3	size	0.215	-0.068	1					
4	Firm age	-0.207	0.038	0.029	1				
5	stock return	0.001	-0.037	0.052	0.028	1			
6	earnings	0.053	-0.105	0.178	-0.047	0.16	1		
7	Tobin's Q	-0.114	0.021	-0.343	0.133	0.23	0.037	1	
8	GDP	0.057	-0.019	0.145	0.286	0.01	0.047	0.056	1
9	foreign	0.014	-0.012	0.042	0.065	-0.02	0.002	-0.024	0.043
10	state	0.079	0.023	0.151	-0.214	-0.014	0.024	-0.185	-0.178
11	legal	-0.063	-0.03	-0.191	0.114	0.009	-0.013	0.075	0.065
12	top1	0.116	0.001	0.204	-0.399	0.008	0.096	-0.148	-0.098
13	top1square	0.014	0.011	-0.009	-0.053	-0.028	-0.002	-0.022	-0.023
14	institution	0.143	-0.073	0.291	0.031	0.212	0.199	0.219	0.146
15	IND_ratio	-0.048	-0.035	0.073	0.178	0.032	0.04	0.053	0.237
16	Board size	0.097	0.004	0.256	-0.094	0.008	0.045	-0.112	-0.066
17	supervisory	0.082	0.02	0.212	-0.038	0.02	0.032	-0.077	-0.107

Variables		9	10	11	12	13	14	15	16	17
9	foreign	1								
10	state	-0.147	1							
11	legal	-0.068	-0.724	1						
12	top1	-0.05	0.347	-0.227	1					
13	top1square	0.057	-0.095	0.075	-0.262	1				
14	Institution	0.004	-0.042	-0.011	-0.025	-0.052	1			
15	IND_ratio	-0.001	-0.121	0.045	-0.077	-0.01	0.105	1		
16	Board size	-0.011	0.14	-0.119	0.012	0.092	0.025	-0.243	1	
17	Supervisory	-0.043	0.214	-0.168	0.064	0.037	0.045	-0.088	0.349	1

Table 4. The effect of top management turnover on innovation performance and the moderating effect of corporate governance (2sls regressions with fixed effects)

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
			Innovation productivity						Patent			
	coef	se	coef	se	coef	se	coef	se	coef	se	coef	se
Turnover	-0.357***	(0.134)	-0.392***	(0.137)	-12.147**	(5.491)	-0.270**	(0.130)	-0.256**	(0.130)	-9.152**	(4.655)
foreign*turnover					0.646	(0.585)					0.579	(0.431)
state*turnover					0.683**	(0.307)					0.354*	(0.198)
legal*turnover					1.137**	(0.490)					0.695*	(0.375)
top1*turnover					0.201**	(0.094)					0.147*	(0.076)
top1square*turnover					-0.217**	(0.102)					-0.161*	(0.083)
top2_5*turnover					-0.012	(0.016)					-0.010	(0.013)
fund*turnover					-1.058	(0.926)					-1.206	(0.808)
IND_ratio*turnover					0.116**	(0.053)					0.093**	(0.047)
board*turnover					0.317**	(0.140)					0.234*	(0.121)
supervisory*turnover					0.078	(0.053)					0.097	(0.050)
Foreign			-0.481***	(0.162)	-0.608***	(0.191)			-0.403***	(0.126)	-0.462***	(0.138)
State			0.050	(0.048)	-0.074	(0.077)			0.121***	(0.036)	0.071	(0.049)
Legal			-0.074	(0.049)	-0.309**	(0.124)			0.089**	(0.039)	-0.033	(0.080)
top1			0.017***	(0.006)	-0.012	(0.015)			0.014***	(0.005)	-0.009	(0.013)
top1square			-0.011*	(0.006)	0.022	(0.017)			-0.016***	(0.006)	0.010	(0.015)
top2_5			0.026***	(0.010)	0.040***	(0.012)			0.022***	(0.008)	0.033***	(0.011)
Institution			0.239	(0.248)	0.494	(0.302)			0.121	(0.233)	0.278	(0.260)
IND_ratio			0.009***	(0.002)	-0.016	(0.012)			0.013***	(0.002)	-0.007	(0.011)
Boardsize			0.035***	(0.010)	-0.029	(0.029)			0.036***	(0.009)	-0.011	(0.026)
Supervisory			0.015	(0.018)	-0.004	(0.023)			-0.015	(0.017)	-0.034	(0.021)
Size	0.260***	(0.036)	0.222***	(0.037)	0.233***	(0.039)	0.204***	(0.029)	0.204***	(0.031)	0.212***	(0.033)
firm age	-0.164***	(0.034)	-0.154***	(0.035)	-0.158***	(0.042)	-0.160***	(0.029)	-0.141***	(0.030)	-0.139***	(0.033)
stock return	-0.014	(0.018)	-0.017	(0.019)	-0.024	(0.022)	0.017	(0.018)	0.009	(0.018)	0.006	(0.020)
stock return (t-1)	-0.025	(0.021)	-0.024	(0.021)	-0.026	(0.023)	-0.022	(0.018)	-0.027	(0.018)	-0.026	(0.019)
Earnings	-0.042	(0.034)	-0.066*	(0.034)	-0.078	(0.050)	-0.008	(0.029)	-0.021	(0.028)	-0.017	(0.034)
earnings (t-1)	-0.085***	(0.033)	-0.098***	(0.033)	-0.144***	(0.051)	-0.075**	(0.029)	-0.082***	(0.029)	-0.120***	(0.043)
Tobin's Q	-0.016	(0.017)	-0.014	(0.019)	-0.003	(0.022)	-0.069***	(0.014)	-0.053***	(0.015)	-0.050***	(0.016)
GDP	-0.180	(0.209)	-0.142	(0.212)	-0.099	(0.250)	0.111	(0.177)	-0.016	(0.177)	-0.007	(0.200)
Endogeneity test	0.000		0.004		0.007		0.043		0.056		0.020	
Hansen J statistic	0.825		0.669		0.804		0.202		0.197		0.530	
Underidentification tests	0.000		0.000		0.003		0.000		0.000		0.002	
Observations	6,967		6,967		6,967		8,763		8,763		8,763	
Number of firms	1,027		1,027		1,027		1,227		1,227		1,227	

HAC Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

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[i] Wang, Cao, Zhou, and Ning (2013) suggests that new product sales may reflect the part of innovation which is not necessarily captured in the patent data. However, it is not an accounting measure and therefore not available in firms' financial report. In fact, patents may indicate a more accurate level of technological capability than new product sales, especially in China where new products are often loosely defined and potentially over-recorded by firms in order to gain subsidies from local authorities.