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Article

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ACCOUNTING, CORPORATE GOVERNANCE & BUSINESS ETHICS | RESEARCH ARTICLE

Does state ownership affect R&D investments? Evidence from China

Ala'a Azzam^{1*} and Salem Alhababsah²

Abstract: This study provides up-to-date evidence concerning the relationship between government ownership and R&D investments in the Chinese context. Using a large sample comprised of 15,138 observations from A-share firms traded on the Shanghai and Shenzhen stock exchange between 2009 and 2018, the findings show that government ownership has a positive impact on R&D investment decisions. Furthermore, a supplementary test confirms that government ownership has also a positive impact on board monitoring intensity, as measured by the frequency of board meetings. This study injects the literature with fresh evidence on the role of state ownership in R&D investment in China, especially after the most recent wave of privatization, namely Split-Share Structure Reform (SSSR) which started in 2005. The results of this study have implications for different stakeholders as they do not support the common impression regarding the negative impact of state ownership on business outcomes.

Subjects: Accounting; Strategic Management; Corporate Governance

Keywords: State ownership; R&D; China

JEL: G34; G38; O32

Introduction

R&D investment has obtained much attention by prior studies as a vital input to increase the stock of knowledge and drive innovation and growth of firm (Coad et al., 2016; Cohen, 2010; Griliches, 1979; Mairesse & Mohnen, 2002). It is of interest to consider R&D spending in China where 2.18% of the country's GDP was spent on R&D in 2018 and where the resident applications to the State Intellectual Property Office (SIPO) increased at a rate of 30% per year from 2001 to 2011. This is predominately due to the movement of China's strategy from being the world's manufacturer (the so-called 'Made in China') to the world's innovator (the so-called 'Created in China' strategy).

Prior studies report that R&D investments are largely affected by ownership structure (Chung et al., 2003; Connelly et al., 2010; Honore et al., 2015; Lee & O'Neill, 2003). Owners with different characteristics can have different objectives, interests, and preferences in terms of R&D investments (Lee & O'Neill, 2003; Tribo et al., 2007). As an important ownership type in China, the government has a significant impact on firms' strategy and performance (G. Chen et al., 2009; Tsai, 2012). Specifically, the Chinese government plays a very important role in the availability of resources for firms to develop and become more innovative (Cao et al., 2020; Sindhu et al., 2016).

Given the above presented evidence, this study has a motivation to provide fresh evidence concerning the role of government ownership in R&D investment in the Chinese context. In

particular, the distinctive feature of such evidence is that it comes following the most recent wave of privatization, namely Split-Share Structure Reform (SSSR) which started in 2005. The SSSR boosted state-owned firms' output, profits, and employment, and improved corporate governance and share price informativeness (Liao et al., 2014). Hence, the outcome of this study would be important for policymakers and interesting for academics to understand whether and how state ownership shapes R&D expenditures.

The empirical results regarding the impacts of state ownership on R&D investments remain inconclusive. In the context of China, there is no definitive theory or empirical evidence indicating whether the advantages of state ownership shall outweigh the constraints in R&D investments, or vice versa (Fan & Wang, 2021). In one hand, due to the horizon of investments and the availability of resources for state-owned firms to develop and become more innovative, state ownership might positively affect firms' R&D expenditures (Cao et al., 2020; Munari, 2002). On the other hand, state ownership might have a negative impact on R&D owing to dual agency problem caused by this type of ownership, the interference of politicians with business operations for their own benefit, and the potential lack of managers' capabilities or motivations to run companies efficiently (Megginson & Netter, 2001; Shleifer, 1998).

This study uses non-financial A-share companies traded on the Shanghai and Shenzhen stock exchange between 2009 and 2018. Using panel data regression and different proxies for R&D investments, the study finds that state ownership has a positive impact on R&D investment. A further test shows that state ownership has also a positive impact on board monitoring intensity, as measured by the frequency of board meetings.

The rationale to focus on a large and important emergent economy such as China are the following: first, R&D investments in Chinese firms have been rapidly growing, China's total spending on research and development is estimated to have been 1.76 trillion Yuan in 2017 (Reuters, 2017). Second, both state-owned firms and private firms coexist in China. Specifically, the government maintains its control on listed state-owned firms by appointing top executives, many of whom possess political connections as current or former government officials/bureaucrats. Such a situation likely facilitates investment financing (Cheng et al., 2017; Cull et al., 2015), enabling them to invest more in R&D.

Third, the Chinese government plays a vital role in business activities through its majority ownership in state-owned firms. Although listed private enterprises (non- state-owned firms) are growing in number and the private sector has fueled most of China's economic growth in the last two decades (Allen et al., 2005), listed state-owned firms still dominate the capital market in China. Moreover, recent years have observed increasing government policies favoring the state sector. Thus, state ownership and government politics are likely to continue to influence Chinese state-owned firms' corporate policies.

Fourth, China's state sectors are the most important force in financing and carrying out research to spur innovations. For example, the recent Nobel Prize winner, Youyou Tu, has proven to the world that the state sector can perform well in the field of innovative research. Moreover, in China, most universities belong to and are owned by the government; several top schools, such as Peking University and Tsinghua University, are directly owned by the central government. Thus, it is much easier for state-owned firms to cooperate with these universities for top-level research, working together with the super talented, while private firms usually have difficulty accessing both research institutions and talent.

The findings of this study make a valuable addition to literature and have important implications to practice. The contribution of this study over prior studies can be summarized as follows: first, this study focuses on China where government dominates business activities and its role is essential in facilitating investment financing. Second, although R&D investments are crucial for all industries (Han et al.,

2015; Bravo & Reguera-Alvarado, 2017), several studies from China limit their sample to a particular industry (Fan & Wang, 2021; Teng & Yi, 2017; Zhou et al., 2017). Third, some studies employ old data, especially before the recent wave of privatization that took place in 2005. For instance, Fu et al. (2021) use data for 2004 only while the sample used by Zeng and Lin (2011) covers six years between 2000 and 2005. Hence, by using a large sample covering all non-financial firms in China, this study enriches the extant literature by providing up-to-date evidence concerning the relationship between government ownership and R&D investments in the Chinese context. Moreover, this study has implications for different stakeholders because it does not support the common impression regarding the likely negative impact of state ownership on business outcomes. In particular, businesses that are eager to maintain sustained innovation might look favorably to state ownership.

The remainder of the paper proceeds as follows. Next section includes discussion of the literature review and hypotheses development. This is followed by the methodology section. The last two sections cover the discussion of the empirical findings and the conclusion, respectively.

Literature Review and Hypotheses Development

The purpose of this paper is to provide fresh evidence on the role of state ownership in R&D decisions in the world's largest developing country, China. Chang et al. (2006) illustrate the value of state-run companies that have the access to vital infrastructure which helps firms to grow and develop. Despite continuing changes in the corporate ownership structures resulting from the government's reform in the financial systems and regulatory mechanisms, many of China's listed firms are still closely linked to the government. The Chinese government increasingly promotes, encourages, and invests in R&D. It commits a large number of funds to subsidize or incentivize corporate innovation, and firms in which the government invests are often favored to receive such investment. Although prior studies show different arguments and pay much attention to the impact of state ownership on financial performance (e.g. Aguilera et al., 2021; Hess et al., 2010; Ng et al., 2009), the relationship between state ownership and R&D investment decisions has not been sufficiently explored.

There are different arguments concerning the impact of state ownership on R&D investment. On one hand, state ownership has an incentive to closely monitor management, and in so doing reduce agency costs, hence it has positive effects on R&D spending (Hess et al., 2010; Teng & Yi, 2017). In support of this argument, Dalziel et al. (2011) report that better monitoring ensures that managers do not underinvest in R&D. In the same vein, Yi et al. (2017) convey that R&D intensity is high in state-owned firms owing to the ability of these firms to secure critical resources which are not open to domestic market channels. Firms in which government has ownership obtain exclusive access to licenses, administrative privileges, and resources such as raw materials, low-cost capital and subsidies as well as information (Cao et al., 2020; Luo, 2003). Such access also helps the firm secure unique technological resources and outputs of publicly-funded R&D, and thus enhances the effect of R&D intensity.

There is an increasing pressure on state-owned firms in countries that are growing to operate and reach the efficiency levels of private entities, which almost gives managers no other option to focus on profitability and market share rather than public welfare (Liu & Sun, 2005). Wu et al. (2018) conclude that state-owned firms are less likely to face financial problems with the investment in R&D or struggle to gain much output from the investment. State-owned businesses can act as a testing ground for innovated product procurement and can give direction and support knowledge creation as a procurers of innovation (Rothwell, 1994; Tonurist & Karo, 2016). Private firms do not have this sort of opportunity to take risks on R&D, so are more likely to be risk-averse and consequently hinder their overall development. Relatedly, Wu et al. (2018) illustrate that state-owned businesses might obtain preferential tax rates compared to private firms leading to higher retained earnings which could be used to support growth and development.

On the other hand, the pinpoint criticism of state ownership would be agency theory. Principle-agent problems occur when there is a conflict of interests between stakeholders and managers of a firm (Jensen & Meckling, 1976). Principles and agents have different motives for how they want

to operate a business. State-owned companies are more likely to have managers who profit satisfice, as there is less of an incentive to maximize profits. In support of this argument, Tonurist and Karo (2016) mention that self-interested managers from firms may have the incorrect agenda for their business and may be aiming for short-term profits rather than long term financial sustainability. In the same regard, Shleifer (1998) argue that state-owned firms, compared to privately owned firms, are more susceptible to agency problems due to lack of effective monitoring and incentives, and therefore likely to invest less in R&D. Other channels through which state ownership might negatively affect investment in R&D could be the lower transaction cost for the government to intervene in SOEs than for private firms (Grøgaard et al., 2019; Sappington & Stiglitz, 1987) and the soft budget constraints, caused by states' unwillingness to let SOEs go bankrupt, lower the stimulating effect of financial constraints (Berglof & Roland, 1998).

Furthermore, state ownership may be inferior to non-state ownership in the competitive market, since state ownership pursues social or political goals instead of maximizing firm value. In support of this notion, S. Chen et al. (2011) mention that the Chinese government intervenes in SOEs to help accomplish social and political goals such as employment, fiscal health, regional development, social stability, etc., which alters firms' investment behavior and leads to investment inefficiency. Furthermore, the efficiency view highlights the dual agency problem caused by state ownership. Politicians likely interfere with business operations for their own benefit and managers might lack the capabilities or motivations to run companies efficiently (Megginson & Netter, 2001). In such situations, state ownership might trigger more inefficiency problems leading to a negative impact on R&D initiatives.

Given the above competing arguments, we draw the following hypotheses:

H1(a): State ownership has a negative impact on R&D intensity in China.

H1(b): State ownership has a positive impact on R&D intensity in China.

Methodology

Empirical model and study variables

To test our hypotheses, we employ the following model:

$$R\&D\ intensity_{it} = a_0 + a_1 State_ownership + a_2 Control_Variables_{it} + \epsilon_{it}$$

Following prior studies (e.g. Chen, 2013; Jiang et al., 2020; Konno et al., 2018; Kuo et al., 2018), the R&D investment variable is measured as the ratio of R&D expenditure to sales. Given that R&D investment is strongly related to sales (Himmelberg & Petersen, 1994; Yoo & Sung, 2015), the ratio of R&D investment to sales helps to control for size effects and heteroskedasticity, and facilitate a comparison of R&D investment across firms (Hoskisson and Hitt, 1988). Following prior studies (e.g. S. Chen et al., 2011; Sapienza, 2004), the independent variable is measured as an indicator variable equals to one if the company is a state-owned, and zero otherwise. Prior studies argue that government has a power to exercise over executive management whatever the proportion of its ownership. We find consistent results when the regression is re-tested using the proportion of government ownership as an alternative measure to the independent variable.

To avoid model misspecification, we control for several variables that might affect R&D spending. These variables are leverage, firm size, firm age, return on equity, risk, pay growth, board meetings, busy board, Chair age, Chair tenure, busy chair, founder Chair, CEO tenure, CEO age, founder CEO, and CEO power (Chen, 2013; Finkelstein, 1992; Guldiken & Darendeli, 2016; Kao & Chen, 2020; Kor, 2006). Definition of the variables is presented in Table 1.

Sample

Our sample comprises of non-financial A-share companies traded on Shanghai and Shenzhen stock exchange between 2009 and 2018. China has different types of shares classified according to the residency of their owner, either domestic (A-shares) or foreign (B, H and N-shares). A-shares are available to Chinese domestic investors and are nominated in RMB. A-shares are the dominant shares traded in China. B-shares are nominated in foreign currencies and are available only to non-resident investors. The H and N-shares are listed on the Stock Exchange of Hong Kong and the U.S. stock markets in the form of American Depositary Receipts (ADRs), respectively.¹ These types of shares are subject to different and stricter listing requirements from A-shares. The Shanghai Stock Exchange and Shenzhen Stock Exchange are the main financial markets in China. Financial companies are excluded because they work under different and more stringent regulations. The final sample is comprised of a non-balanced panel of 15,138 observations across 11 years. Data are retrieved from China Stock Market and Accounting Research Database (CSMAR), China Center for Economic Research database (CCER), and firm annual reports.

Findings and Discussion

Descriptive summary

Table 2 provides an overview of the summary statistics of our variables. The statistics show that the average R&D ratio to sales is 3.1%. Compared with other contexts, prior studies report that the average R&D ratio to sales is 2.3% in the US (Bravo & Reguera-Alvarado, 2017) and 4.6% in Taiwan (Hsiang-Lan Chen et al., 2013). The statistics show that 29% of the firms in our sample are state-owned.

Collinearity test

The Pearson correlation test (Table 3) indicates that none of the correlations are sufficiently large to pose multicollinearity problem. Gujarati (2003) sets ± 0.80 as a threshold of harmful multicollinearity. The unreported results of the variance inflation factor (VIF) also show that all values are below the threshold of 10, suggesting no multicollinearity threats.

Regression results and discussion

Table 4 presents the regression results for the association between state ownership and R&D intensity. Consistent with H1b, the direction and the statistical significance level show that state ownership has a positive relationship with R&D investment. This result indicates that the bright side of government ownership (e.g. the horizon of investments and the availability of resources for state-owned firms to develop and become more innovative) significantly outweighs the dark side (e.g. the dual agency problem, the interference of politicians with business operations for their own benefit, and the potential lack of managers' capabilities or motivations to run companies efficiently). The findings support the conclusion made by Cao et al. (2020) that China's state sectors are the most important force in financing and carrying out research to spur innovations. Furthermore, the findings are consistent with Hess et al. (2010) who argue that state ownership has an incentive to closely monitor management, and in so doing reduce agency costs, and with Yi et al. (2017) and Zeng and Lin (2011) who convey that R&D intensity is high in state-owned firms owing to the ability of these firms to secure critical resources needed for R&D.²

Prior studies report that although government ownership can help protect a firm against competition, it has been found that corruption is positively related to government ownership (Boubakri et al., 2011). Corruption is a first-order concern when it comes to R&D subsidies in China because decisions to grant subsidies are typically in the hands of individual government officials rather than peer reviewers and expert panels, as in most western nations (Fang et al., 2018). Hence, our findings offer important evidence that state ownership has a positive impact on R&D investments, thereby do not support the common impression regarding the likely adverse impact of state ownership on business outcomes.

Table 1. Variable definition

Variables	Definition
R&D intensity	Research and development expenditures scaled by the total sales for firm <i>i</i> in year <i>t</i> .
State Ownership	Indicator variable equals to one if the company is a state-owned, and zero otherwise.
Firm Age	The natural logarithm of the number of years since the listed of the firm.
Firm Size	The natural logarithm of total assets for firm <i>i</i> in year <i>t</i> .
Leverage	The total debt for firm <i>i</i> in year <i>t</i> scaled by the total equity.
ROE	Net operating income divided by total equity for firm <i>i</i> in time period <i>t</i> .
Risk	Beta coefficient of firm's stock.
Pay Growth	The average salary growth rate of executive team.
Board Meeting	The annual meeting number of board.
Busy Board	Dummy variable that takes the value of one if at least 50% of the shareholder representatives hold three or more directorships, and zero otherwise.
Busy Chair	Dummy variable that takes a value of one if the chair of the supervisory board holds three or more directorships, and zero otherwise.
Chair Age	Chronological age of Chair.
CEO Age	Chronological age of CEO.
CEO Founder	Dummy variable set to one if the CEO is the founder of the company, and zero otherwise.
Chair Founder	Dummy variable set to one if the chairman is the founder of the company, and zero otherwise.
CEO Tenure	The number of continuous years CEO has been in his/her role for firm <i>i</i> in time period <i>t</i> .
Chair Tenure	The number of continuous years Chair has been in his/her role for firm <i>i</i> in time period <i>t</i> .
CEO Power	The total score of seven variables form principal component analysis. We use comprehensive and more objective measure following Finkelstein (1992) and construct CEO power index based on seven variables, including duality (P1), shareholding (P2), tenure (P3), education (P4), relatives (P5), political relationship (P6), and independence of board (P7). And use the factor analysis method to obtain the comprehensive score as the CEO power. P1 equals one if the CEO is also the chairman, and zero otherwise. P2 equals one if CEO holds shares, and zero otherwise. P3 equals one if CEO's tenure is higher than the median of the industry, and zero otherwise. P4 equals one if CEO has a master degree or above, and zero otherwise. P5 equals one if CEO has relatives in the board, and zero otherwise. P6 equals one if CEO is working in a relevant government institution, and zero otherwise. The independence of board is measured by the ratio of the number of independent directors to the number of board members. P7 equals one if the ratio of independent directors is less than the median of the industry, and zero otherwise

Table 2. Descriptive statistics

Variables	Mean	SD	Min	Max
Dependent variable				
R&D intensity	0.031	0.11	0.00	0.41
Independent variable				
State ownership	0.29	0.45	0.00	1.00
Control variables				
Firm Age (log)	2.58	0.50	0.00	3.20
Firm Size (log)	22.16	1.44	13.76	28.52
Leverage	0.490	0.21	0.069	1.00
ROE	0.068	0.084	-0.13	0.229
Risk	1.080	0.492	-2.86	14.13
Pay Growth	0.368	1.081	-0.75	6.94
Board Meeting	3.70	0.80	1.00	12
Busy Board	0.153	0.360	0.00	1.00
Busy Chair	0.123	0.328	0.00	1.00
CEO Power	-0.008	0.278	-0.360	0.79
Chair Age	52.7	6.957	26	85
CEO Age	49.0	6.32	24	80
CEO Founder	0.19	0.39	0.00	1.00
Chair Founder	0.53	0.49	0.00	1.00
Chair Tenure	3.82	2.87	0.08	28
CEO Tenure	3.53	3.02	0.078	18

It is worth to highlight the significant relationship between some control variables and R&D. Both chair tenure and CEO tenure show a negative relationship with R&D. This finding is supported with psychology and management literature which argue that longer tenure of Chair or CEO in a specific firm can result in less openness to outside information and increased commitment to a certain view of the firm, including its opportunities and challenges, and resistance to major changes (Boeker, 1997). Such adherence to the status quo results in that individuals might be more reluctant to change. This rigidity might be negative for R&D investment (Bravo & Reguera-Alvarado, 2017). With regard to Chair tenure, the agency theory posits that Chairs who stay in office for a longer period reduce their degree of independence and their ability to monitor (Hillman et al., 2011). In particular, they might become less effective in controlling and advising managers about identifying new growth opportunities.

We also find that risk, pay growth, frequency of board meetings, busy board and firm age have a significant positive relationship with R&D intensity, which is consistent with prior studies. Van and Le (2017) argue that risk can encourage investment in a growth option and report that firms invest more in R&D when they face higher uncertainty. Concerning pay growth, Wu and Tu (2007) state that executive pay is an effective way to encourage CEOs' risk-taking behavior including R&D expenditure (Wu and Tu, 2007). From agency theory perspective, they further argue that such financial motivation aligns managerial interest with that of shareholders, which helps constrain potential managerial opportunism and encourage managerial risk-taking behavior. The frequency of board meetings is considered as a key board characteristic helping the board of directors to effectively monitor CEO behavior, especially concerning strategic decisions such as R&D (Guldiken & Darendeli, 2016). Kor and Sundaramurthy (2009) find that directors with many directorships (i.e. busy directors) may benefit

Table 3. Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. R&D	1																
2. State Ownership	0.023	1															
3. Firm Age	-0.084	0.369	1														
4. Firm Size	-0.011	0.025	0.210	1													
5. Leverage	-0.009	0.257	0.112	0.142	1												
6. ROE	-0.002	0.141	0.307	0.218	0.252	1											
7. Risk	-0.087	0.176	0.141	0.018	0.166	0.008	1										
8. Pay Growth	-0.037	-0.008	-0.129	-0.139	-0.005	-0.172	0.216	1									
9. Board Meeting	-0.004	0.097	0.031	0.047	0.011	0.030	0.083	-0.195	1								
10. Busy Board	-0.023	0.054	0.014	-0.169	0.077	0.026	0.243	0.258	-0.114	1							
11. Busy Chair	0.016	0.039	0.036	0.014	0.026	-0.001	0.059	0.020	-0.163	0.038	1						
12. CEO Power	0.009	-0.065	-0.122	-0.126	-0.053	-0.051	-0.030	0.018	0.073	-0.107	-0.102	1					
13. Chair Age	-0.004	0.041	0.149	0.065	0.040	0.066	0.112	-0.027	0.100	0.194	0.066	-0.046	1				
14. CEO Age	0.008	0.024	0.019	-0.086	0.062	0.013	0.107	0.001	0.129	0.074	-0.025	-0.048	0.099	1			
15. CEO Founder	-0.012	-0.098	0.003	0.006	-0.036	-0.0431	0.135	0.163	-0.046	0.174	0.020	-0.029	0.084	0.040	1		
16. Chair Founder	-0.029	0.039	0.144	0.126	0.002	0.106	0.046	-0.054	0.030	-0.120	-0.031	0.093	0.142	-0.007	0.052	1	
17. CEO Tenure	-0.023	-0.051	0.056	0.104	-0.019	0.027	0.026	0.012	0.019	-0.012	0.051	-0.035	0.294	0.140	0.386	0.19	1

Table 4. State ownership and R&D intensity

Variables	Coef.	t-value
State Ownership	0.0094	1.95**
Firm Age	0.0100	11.62***
Firm Size	-0.0021	-8.57***
Leverage	-0.0014	-0.09
ROE	-0.0034	-1.45
Risk	0.0076	2.48**
Pay Growth	0.0011	7.07***
Board Meeting	0.0013	2.47**
Busy Board	0.012	2.85***
Busy Chair	-0.0014	-0.990
CEO Power	0.0065	0.550
Chair Age	0.0039	0.350
CEO Age	-0.0013	0.490
CEO Founder	0.001	0.680
Chair Founder	.000016	0.360
CEO Tenure	-0.0019	-2.42**
Chair Tenure	-0.0015	-1.69*
Constant	0.0330	6.62***
adj. R^2	0.058	
N	18,138	

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively

Table 5. State ownership and board meetings

Variables	Coef.	t-value
State Ownership	0.190	1.710*
Firm Age	0.110	12.8***
Firm Size	0.089	20.6***
Leverage	0.051	2.320
ROE	0.157	4.250
Risk	0.001	0.340
Pay Growth	0.0013	0.540
Busy Board	0.002	0.030
Busy Chair	0.098	0.870
CEO Power	0.0280	2.380
Chair Age	-0.005	-0.910
CEO Age	-0.0014	-2.47**
CEO Founder	0.0194	2.03**
Chair Founder	-0.0021	-0.300
CEO Tenure	-0.009	-6.58***
Chair Tenure	-0.006	-4.39***
Constant	-0.160	-1.80*
adj. R^2	0.093	
N	18,138	

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively

Table 6. State ownership and R&D intensity (measured by RD/TA)

Variables	Coef.	t-value
State Ownership	0.0072	2.08**
Firm Age	0.023	7.12***
Leverage	-0.0010	-0.08
ROE	-0.0051	-1.05
Risk	0.0029	1.70*
Pay Growth	0.0032	3.01***
Board Meeting	0.0025	1.90**
Busy Board	0.019	3.14***
Busy Chair	-0.009	-0.95
CEO Power	0.0011	0.230
Chair Age	0.029	0.480
CEO Age	-0.008	0.190
CEO Founder	0.045	0.620
Chair Founder	0.0005	0.730
CEO Tenure	-0.0074	-2.63**
Chair Tenure	-0.0081	-1.97**
Constant	0.0530	5.69***
adj. R^2	0.091	
N	18,138	

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively

R&D by offering timely information about environmental events and trends. Concerning firm age, prior studies argue that as time goes by, firms are able to accumulate resources, managerial knowledge and the ability to handle uncertainty, thereby positively affect innovation capabilities (Coad et al., 2016). Finally, our results show a negative relationship between firm size and R&D. This result is consistent with the argument that large firm size and the market power it produces may demotivate managers to invest in innovations that may upset the status quo (Barker & Mueller, 2002).

In order to strengthen our findings, we have carried out a supplementary test in which we examine whether state ownership affect monitoring intensity. Monitoring intensity is measured by the frequency of board meetings (Vafeas, 1999). If the effect of state ownership on R&D intensity was a result of strong monitoring, we would expect state ownership to positively affect board meetings too. The results presented in Table 5 reports a positive relationship between state ownership and board meetings, thereby confirm our expectations.

Sensitivity analysis

The analyses have been re-run using the R&D spending to total assets (R&D/TA). This measure is another common proxy for R&D intensity used by prior studies (Coles et al., 2006; Kor, 2006). The independent and control variables³ are the same as run in the primary analyses. Table 6 shows that the impact of state ownership on R&D intensity, using this new proxy, is still significant and positive. This thereby provides further confirmation to the main analyses' findings, as presented in Table 4.

Conclusion

The objective of this study is to examine the impact of state ownership on R&D intensity in China. The study uses a large sample comprised of 15,138 observations related to A-share firms traded on the Shanghai and Shenzhen stock exchange between 2009 and 2018. We find that government ownership has a positive impact on R&D investment decisions. In the same vein, the additional test

confirms that state-owned has a positive impact on monitoring intensity, as measured by the frequency of board meetings.

The empirical evidence for the relationship between state ownership and R&D has been mixed. Therefore, this result provides fresh evidence to understand the role of state ownership in R&D investment in the Chinese context as China continues to become a key player in the global economy, particularly following the SSSR – the most recent wave of privatization. This study has also implications for practice and to different stakeholders because it does not support the common impression regarding the likely negative impact of state ownership on business outcomes. Specifically, companies that are eager to maintain sustained innovation might look favorably to state ownership. In terms of theoretical implications, our results support the agency theory that government ownership considers an effective monitoring mechanism, especially in developing countries where decisions are in the hand of few dominant owners.

Many of China's listed firms are still closely linked to the government where politicians heavily intervene to achieve social and political goals. Such a situation limits the generalizability of the findings outside China. Hence, future studies could consider other countries where the government role is not as strong as in China in order to provide further recent evidence on this matter. Also, this study uses R&D only as an indication of innovation. Future studies might include patents as a real output of innovation.

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Notes

1. A, B, H, and N-shares represent 83%, 0.02%, 7.98%, and 9% of total market capitalisation of total Chinese shares, respectively.
2. It is worth highlighting that Yi et al. (2017) use dataset of the Chinese manufacturing firms for the period of 2005–2007, while Zeng and Lin (2011) employ dataset for the period 2000–2005.
3. Except firm size which is dropped from control variables to avoid multicollinearity with the dependent variable.

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