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State Capitalism, Agency Risk, and Firm Innovation: Evidence from State-Owned Enterprises in China

Nan Jia

**University of Southern California
Marshall School of Business
nan.jia@marshall.usc.edu**

Kenneth G. Huang

**National University of Singapore
Engineering & Technology Management and NUS Business School
kennethhuang@alum.mit.edu**

Cyndi Man Zhang

**Singapore Management University
Lee Kong Chian School of Business
cyndizhang@smu.edu.sg**

Abstract

This study contributes to the debate regarding whether state-owned enterprises (SOEs) can innovate effectively and examines the role of agency risk in shaping SOE innovation behaviors. We argue that without proper incentives or monitoring, SOE agents will prioritize the development of those innovations emphasized by the state principal's evaluation metrics over other innovations. Following China's implementation of a top-down pro-innovation policy that relies disproportionately on objective metrics to assess innovation performance, we found evidence of a multiplicative effect pursuant to which those SOEs with higher agency risk produced general patents at a higher rate but novel patents at a lower rate than before implementation of the pro-innovation policy and than their peer SOEs with lower agency risk. These findings are consistent with the agency-based hypotheses, and provide important policy and managerial implications.

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Keywords: State-owned enterprises (SOEs), innovation, agency risk, event history analysis, China

INTRODUCTION

State capitalism or corporate “statism”, i.e., state involvement in commercial enterprises, has experienced a resurgence in recent years, making state-owned enterprises (SOEs) a prominent form of ownership around the world (Musacchio et al. 2015). However, researchers disagree about how state involvement shapes firms' business outcomes and performance (Bruton, et al. 2015). On one hand, the traditional theoretical view of privatization argues that SOEs lack the proper incentives to achieve higher efficiency and performance (for a review, see Dharwadkar et al. 2000). In particular, as related to firm innovation—an activity regarded as an important driver of firm growth (Schumpeter 1943, Rosenberg 1972)—many researchers maintain that state control of the firm does not properly incentivize firm innovation and that SOEs innovate less as a result (e.g., Hart et al. 1997, Shleifer 1998). Thus, Shleifer (1998, page 138) posits, “[t]he underappreciation of the importance of innovation has bedeviled most advocates of government ownership.” On the other hand, scholars of emerging markets with less developed market institutions that are often characterized by “institutional voids” (Khanna and Palepu 2000) contend that state support can serve as a “helping hand” that assists firms in navigating these institutional voids and in creating value (e.g., Amsden 2001, Rodrik 2007). Thus, these scholars argue that the state's encouragement and support of firm innovation can help a developing economy jump-start

technological innovation (Liegsalz and Wagner 2013, Huang 2010). Therefore, as important as both state capitalism and firm innovation are to modern economies, there is considerable theoretical tension regarding how state capitalism affects firm innovation.

This paper aims to contribute to this debate from the theoretical perspective of SOEs' agency risk—the probability of loss due to an agent's pursuit of his/her own interests at the expense of the principal's interests—but not from the (perhaps more commonly held) notion that agents who are only minimally incentivized and monitored will shirk and thus engage in fewer innovation activities. Instead, we draw on another central insight of agency theory—that even when incentivized under a particular scheme, agents take only those actions that maximize the particular metrics used to evaluate innovation behaviors, disregard whether over-pursuing these types of actions may harm firm value, and ignore other actions that are not rewarded by the incentivization scheme's metrics, including those that might contribute to firm value (e.g., Kerr 1975, Holstrom and Milgrom 1991, Prendergast 1999, Daily et al. 2003, Bebchuk and Fried, 2004, Gibbons 2005). Therefore, an agent's innovation activities and their consequences for the firm hinge precisely on how effectively the metrics adopted by the principal to evaluate the agent induce the exact activities required to produce the “optimal” innovations that contribute the highest firm value. However, aligning evaluation metrics and the activities that are deemed optimal is notoriously difficult to achieve given both the inherent differences in the private interests of the agent and those of the principal and particular constraints (such as incomplete information) faced by the principal (these difficulties are demonstrated by a large body of research of economic mechanism design; for a summary, see, e.g., Gibbons and Roberts 2013). Drawing on this theory, this paper argues that agency risk does not necessarily drive SOEs to produce fewer innovations but to result in certain imbalanced innovation outcomes.

We investigate this research question in the context of the innovative activities of Chinese SOEs. China is an ideal context for this research for two reasons. First, China represents a paradigmatic example of “state capitalism” because the state plays a direct and powerful role in orchestrating economic development, including directing innovative activities in the country (e.g., Lu, Zhao, and Wu 2014) and

because SOEs constitute the main channels through which the state—as the principal of those SOEs—exercises its will (e.g., Bruton et al., 2015). Second, agency risk is prevalent and pronounced in Chinese SOEs (e.g., Xu 2011) and varies substantially across firms based on firm- and location-level factors. We exploit the variation generated by a major policy implemented by the central government in 2006 stipulating that governments should preference domestic firms that were quick to develop domestic patents when granting government procurement contracts regarding certain products. Using a longitudinal dataset covering listed SOEs in China, we find a multiplicative effect: after the 2006 policy change, affected SOEs that were characterized by higher agency risk—operationalized as less alignment of managerial private interests with those of the firm and less stringent monitoring by the state principal—produced patents at a higher rate compared with their production before the policy and other affected SOEs that were characterized by less severe agency risk. However, these same firms also produced patents that were regarded as “novel” at a lower rate than before the policy and than affected SOEs with less severe agency risk.

This study seeks to make the following contributions. First, we integrate the two seemingly conflicting theoretical perspectives on SOE innovations that are outlined above. On the one hand, the first theoretical perspective of the less innovative SOEs is built upon the assumption that state control ignores innovation—thus so do SOEs—but it does not consider what would occur if the state (as the controlling shareholder of these SOEs) purposefully pushed the SOEs to engage in innovation. We show that certain Chinese SOEs have actually become more active in producing patents in response to the state’s promotion of innovative activities, which is consistent with the second theoretical perspective that state promotion can indeed increase innovative behaviors in at least some SOEs. However, the second theory only paints a partial picture because it does not consider the varied response of different types of SOEs and the different types of innovation being produced, i.e., why the SOEs that are characterized by more severe agency risk became more active in producing patents in general—and why these same firms also became less active in producing patents that are deemed novel. The first theory may shed light on this point when combined with insights from agency theory: the SOEs that suffer from agency risk appear to continue to

lack inherent interest in firm value but exhibit greater interest in engaging in activities that maximize the evaluation metrics used by the state principal to assess their innovative behaviors.

Second, this study contributes to research on incentive issues in firm innovation. To understand why firms vary substantially in their innovativeness, most research has focused on the variation of firm capabilities to innovate as a result of organizational practices, firm characteristics, and/or the external environment (e.g., Cohen and Levinthal 1990; Stuart and Podolny 1995). Other studies have examined the incentives associated with innovations and have been primarily concerned with whether bureaucratization in larger firms dampens the incentives of individual engineers and scientists to innovate (e.g., Cohen and Levin 1989, Henderson and Cockburn 1994, Zenger 1994). Beyond the outcome of agents' shirking, this paper joins an emerging body of research that examines more nuanced outcomes produced by agency incentives. For example, Seru (2014) shows that managers of subdivisions may hold back information on certain innovations from headquarters to obtain more internal resources. This study contributes new insights regarding managerial incentives and external institutions that may lead to certain imbalanced innovation outcomes.

Third, this study sheds light on the context of indigenous innovative activities that are undertaken by SOEs in China. The nature of the revving engines of indigenous innovations in China should be better understood. It is inappropriate to assume that firms in China generate innovations like their counterparts in the U.S. because it ignores the direct and powerful role of the Chinese state in promoting indigenous innovations, particularly through SOEs. This is a pivotal factor that has created a different institutional environment for innovation. This key difference naturally begs a series of substantive questions, including how SOEs innovate in response to public policies. We aim to contribute to the understanding of these important issues.

THEORY AND HYPOTHESES

Theoretical Background: Agency Risk in Firm Innovation

Although firms are the context in which many innovations are produced, individuals in firms are ultimately responsible for producing innovations. These individuals include R&D personnel but equally important are the persons making strategic decisions that can substantially shape the innovation outcomes, such as boards of directors and firm managers (Kortum and Lerner 1999, Damanpour and Schneider 2006, Damanpour 1991). Such strategic decisions shape the processes in which innovations are pursued or terminated, the resources allocated among R&D activities, and the internal evaluation metrics used to evaluate and reward innovation outcomes (Rogers 1983, Zaltman et al. 1973). Although some firm owners directly engage in innovation decisions, many such decision makers are agents of firm owners (Damanpour and Schneider 2006). For these agents to further firms' interests and to create value by generating innovations, for example, these agents must have not only sufficient capabilities but also the correct incentives.

Providing the "right" incentives to agents of the firm is generally challenging, particularly when the principal of the firm intends to motivate the agents to engage in highly uncertain and complex tasks such as innovation, whose outcomes are confounded by both the agents' own efforts and other factors—such as luck—that are beyond the control of agents and firms, as demonstrated by the agency theory research (for a comprehensive review of agency theory, see, e.g., Gibbons and Roberts 2013; for an application to firm R&D, see Zenger 1994). Because it is difficult—and often impossible—to directly observe the efforts that agents exert to develop innovations or accomplish tasks that help build innovative capabilities, principals tend to use alternative metrics in evaluating agents' performance. These assessment metrics may be subjective or objective. Nonetheless, given that subjective assessment metrics suffer from the lack of credible commitment, which reduces their effectiveness at providing incentives (e.g., Gibbons 1987), principals in many cases employ objective, quantifiable but simplistic assessment metrics to evaluate agents' performances (Gibbons 2005).

However, using objective metrics to assess agents' performances in assigned tasks typically results in a classic agency risk that is termed "you get what you pay for" by agency theory scholars: when agency risk is severe, agents only undertake those actions that maximize the particular metrics used to evaluate them, disregarding whether over-pursuing these actions may harm long-term firm value and ignoring other actions that might contribute to firm value but that are not rewarded under the metrics (Kerr 1975, Holstrom and Milgrom 1991, Baker 1992, Lambert et al., 1993; Gibbons 1998; for a review see, e.g., Predergast 1999, Gibbons 2005). "Getting what you pay for" might sound like a positive outcome outside of this context, but the unsaid premise is that what the principal "pays for" may be misaligned with what she ultimately values, which is a common problem in corporate governance also described by Kerr (1975) as "rewarding A, while hoping for B". Despite many principals' intention to design the "right" metrics to provide agents with the correct incentives, economic theories of mechanism design have shown that it is tremendously challenging to design metrics that induce the exact actions from the relevant agents that lead to optimal firm value, particularly when the diverging interests of agents and various external and internal constraints (such as incomplete information) must also be accounted for (see, e.g., Gibbons and Roberts 2013). Therefore, it represents a classic type of agency risk in which misalignment does not come from agents shirking but emanates from agents strategically engaging in actions to maximize the metrics given to them with no regard for how these actions affect firm value.

Outside of the realm of firm innovations, researchers have demonstrated that this particular type of agency risk shapes firm outcomes, including production, sales, growth, and corporate governance decisions (for reviews of agency theory, see Gibbons and Roberts 2013; for reviews of its empirical applications, see, e.g., Daily et al. 2003, Bebchuk and Fried, 2004). We argue that this type of agency risk also affects firm's innovative activities. If the principal primarily relies on simplistic, quantifiable, and objective metrics to assess how well agents generated or promoted firm innovations, then the agent whose private interests are not aligned with firm value and/or who are not effectively monitored will prioritize developing those innovations that are weighted highly by the given metrics but will not prioritize those innovations that are not (including those that may be more likely to increase firm value). All else equal,

greater managerial effort and firm resources will shift into the more highly weighted innovation tasks from other less weighted innovation tasks (and possibly from other non-innovation related tasks). As a result, firms that suffer from more severe agency risk will more actively produce those innovation outcomes that are directly measured by the particular quantifiable metrics utilized by the principals than other innovation outcomes.

Hypotheses: Innovation by SOEs in China

We choose to examine the context of how agency risk shapes Chinese SOEs' innovation outcomes in response to the Chinese government's attempt at promoting innovations for several reasons. First, China follows a state capitalism model, and SOEs are a convenient and effective means for the state to influence the economy and society (e.g., Xu 2011, Deng et al. 2014). Second, the state ardently promotes innovations in firms to achieve the goal of enhancing innovativeness and thus long-term value for the firm and for the country, but the manner in which the state has incentivized SOE innovation has emphasized objective counts of innovation outcomes such as patents at the expense of subjective assessments of the true content of innovations. Third, managerial agency risk is rife in Chinese SOEs (e.g., Groves et al. 1994, Li 1997, Cull and Xu 2005, Xu 2011). These three conditions meet the key assumptions of the theory and make it appropriate for generating testable hypotheses. We elaborate upon them below.

Agency risk in Chinese SOEs. Although agency risk is common in modern corporations, SOEs tend to be more likely to be characterized by a lack of managerial incentives to increase firm value relative to comparable privately owned enterprises (POEs). Since they reap the returns generated from a well-managed firm, private owners have stronger incentives to monitor their managers to enhance the likelihood that these managers take the appropriate actions to increase firm value. In particular, in many emerging markets, private owners have maintained tight control of their firms, allowing only limited autonomy to professional managers, which results in lower agency risk (but creates a different problem involving dominant family control of firms and the absence of professionalization of management, e.g., Young et al. 2008). By contrast, the public employees who represent the state's interests and exercise the

principal's authority with regard to SOEs do not directly reap the financial benefits generated by well-managed SOEs. Therefore, they have weaker incentives to monitor managers to promote the value of SOEs (e.g., Hart et al. 1997). In addition (and making matters worse), underdeveloped institutions in emerging economies hold public officials less accountable for advancing the interests of the state, which includes monitoring SOEs (Cai et al. 2011; Xu, 2011). In that sense, SOEs suffer from twofold agency risk: the managers of an SOE are agents of the representatives of the state—i.e., public employees (e.g., public officials) responsible for managing the state assets in the SOE—who themselves are also agents accountable to the interests of the state, i.e., to the collective interest of citizens. In other words, the state is the main principal in an SOE in which the state has made the lion's share of equity investments, but the interests of the principal in this firm must be tended to by persons acting on the principal's behalf. The agents of the state include two types of people: managers of the SOE and the public employees who represent the state's interest in the SOE and have the power to hire and evaluate those managers (for a review of agency risk in SOEs, see, e.g., Shleifer 1998, Megginson and Netter 2001). Consistent with the general case, it has been previously demonstrated that Chinese SOEs suffer from extensive and severe agency risk (e.g., Groves et al. 1994, Li 1997, Cull and Xu 2005, Xu 2011).

Scholars have largely turned a skeptical eye toward SOEs' behavior and their responses to public policies in general, due to concerns over agency risk. Moreover, SOEs' incentives and behaviors in response to public policies can unexpectedly create inefficiencies and adverse consequences. For example, because the Chinese state rewarded SOE managers more (or more immediately) for revenue generation than for cost or risk control, Chinese SOEs tended to over-invest, over-diversify, and over-expand (e.g., Groves et al. 1994, Zhang 1997, Zhang and Ma 2003). More generally, Kornai et al. (2003) has found that incentive alignment problems in SOEs around the world frequently lead to overinvestment in risky ventures and thus excessive economic expansion.

How did the Chinese state incentivize innovations? The manner in which agents of the state behave depends substantially on the specific institutions employed by the state to incentivize its agents and to

achieve its interests in SOEs, which in turn depends on the role of the government in the economy.

Therefore, it is important to understand how the Chinese state promotes innovation in SOEs.

Although patents resulting from indigenous innovation in China have been on the rise as its economy has developed (Hu and Jefferson 2009, Huang 2010), it was only in 2006 that the Chinese government (including all levels of governments) has fully implemented this policy goal and began to systematically build and implement an incentive system to promote domestic innovation, to achieve the goal of enhancing firm (SOE) innovativeness and to thus create greater long-term value for both firms and the country. Two of the most important overarching policy guidelines to promote indigenous innovations in China, titled “China’s National Medium- to Long-term Plan for the Development of Science and Technology (2006-2020)” (State Council of China 2006), and the follow-on National Intellectual Property Strategy (2008), call for enhanced overall innovation capability and for the transformation of China into “an innovative society” by 2020 (Abrami et al. 2014). These policies are contained in the 12th Five-Year Plan,¹ which stipulated that China pursue an ambitious program of technological development that will enable the country to “enter the ranks of innovative countries by 2020” and to become “a global scientific power by mid-century”.² These policies also explicitly encouraged indigenous inventions and patents that are filed with the State Intellectual Property Office (SIPO), which is China’s equivalent to the Patent and Trademark Office in the U.S. (USPTO). To implement these overarching general policy guidelines, subsequent policies specified channels to reach the goals, including the pro-indigenous innovation government procurement policy that we utilize later in our empirical analysis.

What innovation outcomes were specified to be valued in these policy guidelines and subsequent public policies? First and foremost, the state designed detailed and actionable plans to accumulate patents at a faster rate. The above-mentioned policy directives included specific clauses that mandated the overall

¹ The Five-Year Plans are the most important social and economic initiatives developed by the Communist Party of China that set goals and paths for the country’s development every five years.

² “China’s National Medium- to Long-term Plan for the Development of Science and Technology (2006-2020),” issued by the State Council of China (2006). Chinese version available at: http://www.gov.cn/jrzq/2006-02/09/content_183787.htm (English summary available at: http://www.most.gov.cn/eng/pressroom/200507/t20050706_22978.htm)

national rate of patenting targets—a set number of patents (or patent applications) within a given length of time. For example, the state has decreed that local firms will have to apply for two million patents by 2015.³ The overall targets were then allocated to the local governments, and accordingly, many local governments adopted policies to provide direct monetary incentives to apply for patents. As one specific example, the city of Zhangjiagang in Suzhou Municipality increased its patent subsidy in June 2006 for an invention patent application from RMB 1,500 to RMB 3,000 and added a reward of RMB 10,000 if the application is eventually granted (e.g., Lei et al. 2013). As documented in many media reports, the rate of patent production became a dominant metric in the incentive system that the Chinese state created to promote indigenous innovation.⁴

In theory, simplistic counts of patents alone might constitute a poor measure of firms' overall innovativeness because patents exhibit a large variance in the level of novelty and thus “the economic value of innovation is highly heterogeneous” (Cohen and Levin 1989, Page 1063). Novel patents often help build and enhance a firm's innovative capability by enhancing its performance and competitive advantages (Katila 2000, Mitchell 1989). In fact, in many technology industries, incumbents frequently generate incremental improvements and follow their core technologies to obsolescence and obscurity whereas firms that are able to generate novel and breakthrough innovations can become new industry leaders (e.g., Mitchell 1989, Henderson and Clark 1990). However, despite the importance of patent novelty to policymakers, there have been only limited checks into the quality or novelty of patents to accompany the metrics of patent counts in the implementation of pro-innovation public policies in China. Policy documents have failed to produce specific and actionable plans for quality checks, which stands in stark contrast to the various metrics implemented to assess the rate of patenting.

As a result, it appeared that the state adopted an imbalanced approach in which the state relied more heavily on directly measurable outcomes of the rate of producing these patents and exerted only minimum

³ “Patent fiction.” *The Economist*, December 13th, 2014.

⁴ See, for example, “Chinese firms are filing lots of patents. How many represent good ideas?” *The Economist*, October 14, 2010, and “Patent fiction.” *The Economist*, December 13th, 2014.

efforts to evaluate the quality or novelty of the patents obtained (e.g., Liang 2012). This imbalanced approach dominated the formulation and implementation of many follow-up policies, including the 2006 pro-indigenous-innovation government procurement policy examined in this study.

This imbalanced approach is unlikely to be consistent with the goal of enhancing the innovative capabilities and ultimately the competitiveness of firms. According to theories involving balancing exploration and exploitation in firm innovation (e.g., Katila and Ahuja, 2002), a more balanced mix of incremental and novel patents helps build greater firm innovative capabilities and create higher firm value.⁵ Chinese SOEs were previously not typically overproducing novel innovations; thus, as new metrics that promoted faster production of innovation in general were added, checks on the novelty of the innovations should have increased at least in proportion to maintain this balance, which did not occur.

Why did the state adopt this imbalanced approach? The first conjecture relates to state capacity. The quality or novelty of a patent is more difficult to assess, evaluate and justify than counting the number of patents—particularly for policymakers and bureaucrats who tend not to be technology experts—and it is generally challenging to design subjective metrics that closely align the interest of the agents (see the discussion on the challenges in mechanism design, Gibbons and Roberts 2013). Moreover, reliance on objective, measurable metrics as assessment tools is deeply rooted in the norm of Chinese political governance. The political governance literature has demonstrated that objective criteria have become increasingly important to the Chinese state in evaluating and/or rewarding (or punishing) officials (e.g., Li and Zhou 2005). For example, leaders of local governments are typically assessed primarily based on the metric of local GDP development, and there is substantial public outcry that these officials pursue GDP development in a lopsided fashion and ignore other important social and economic factors that contribute to local citizens' welfare, including social security, environmental protection, and long-term sustainability

⁵ For example, Google implemented the rule of devoting 70% of its efforts into developing incremental innovation and 30% into developing novel innovation and regarded this approach as that which would generate optimal value for the firm (e.g., Harvard Business School Case #9-910-036, "Google Inc. 2010"). The 3M Corporation follows a similar rule of thumb (e.g., Harvard Business School Case #699-012, "Innovation at 3M Corp.").

(e.g., Fisman and Wang 2014; this is another manifestation of the agency risk of “getting what you pay for”).

A second, but very different, conjecture is that, for a variety of reasons, the Chinese state as the principal of SOEs simply sought to quickly accumulate a larger body of patents but cared less about the novelty of these patents. If so, SOEs that acted in an imbalanced fashion were simply conforming to these requests rather than acting in accordance with underlying agency conflicts. In connection with (and in support of) the foregoing proposition, the strategic patenting literature rationalized some firm behaviors that involved patenting trivial innovations to stall competitors’ R&D development (e.g., Levin et al. 1987, Ziedonis 2004). However, this speculation is inconsistent with the empirical evidence that the state clearly and explicitly specified strong desires to promote “better innovation” and “stronger innovative capabilities” in various policy documents. To the best of our knowledge, the Chinese state has never even hinted that the quantity of patents is more important than the quality or that the latter can or should be sacrificed in pursuit of the former. The first conjecture appeared to be more consistent with the content of policy documents and a vast array of in-context anecdotal evidence. Nonetheless, we acknowledge that we cannot entirely rule out the second conjecture. We will, however, be able to distinguish the two based on the results of the interaction effects, a point to which we will return subsequently.

Hypotheses: Interaction effects of public policy and agency risk. First, for all agents, their “private benefits” that are generated by quickly developing any general innovation are quite high because they are directly rewarded by the state for developing a larger number of innovations within a given time frame to hit the state-established quantitative targets. However, the private costs of cranking out just any innovation are not the same for all agents: they tend to be higher for those agents whose interests are more aligned with firm value (i.e., who are characterized by lower agency risk), than for the agents whose interests are less aligned with those of the firm (i.e., who are characterized by higher agency risk). These costs mainly occur in the form of the opportunity costs of engaging in innovation. Some fungible resources devoted to innovation (such as financial resources) may be invested in other activities that also contribute to firm value, such that some unviable innovations can be wasteful compared with the

alternative uses of the resources (Cockburn 2004). Agents will consider a greater portion of these opportunity costs in their innovation decisions when their personal interests are more aligned with firm value. As a result, when agency risk is higher, agents will derive higher net gain (due to lower private costs) of quickly producing any patents than when agency risk is lower, which suggest that the higher the agency risk, the greater incentives that agents have to develop any innovations that come to fruition sooner (i.e., to generate any patents more quickly).

Second, the benefit-cost analysis of developing novel versus less novel patents also varies based on the degree of agency risk. All agents face the same private costs of engaging in innovative activities that aim to develop more novel technologies, which will be notably higher than those of general innovations because novel innovations frequently take longer to create and are riskier to develop because they have higher failure rates than general patents (e.g., Fleming 2001, 2007). However, the private benefits of developing novel patents are not the same for all agents. For those agents whose interests are less aligned with firm value (i.e., who are characterized by higher agency risk), their private benefits—either personal financial or career reward—for developing more novel innovations are not much higher than the private benefits derived from developing any general innovation because the state’s evaluation metrics do not evaluate a less novel patent much differently from a more novel patent. By contrast, for those agents whose interests are more aligned with firm value (i.e., who are characterized by lower agency risk), producing novel patents leads to additional private benefits beyond the state’s reward for any general patents because novel patents contribute to greater firm innovativeness and value than just any general patent, which in turn further enhances the agents’ share of firm value. As a result, when agency risk is greater, agents will derive lower net gain (due to lower private benefits) by producing novel patents than they would when agency risk is lower, which suggests that, the higher the agency risk, the less incentive that agents have to produce novel patents.

Therefore, our central proposition is that, after the pro-innovation public policy was implemented, the Chinese SOEs characterized by more severe agency risk produce patents at a higher rate but produce patents that are deemed novel at a lower rate than what they produced before the implementation of the

policies and than SOEs characterized by less severe agency risk. Following this central proposition, we search for observable proxies for the severity of agency risk to generate testable hypotheses. We again draw on the insights of agency theory regarding the circumstances under which agency risk is lower, including when the agent's personal interests are more aligned with the firm's interest or when the principal more efficiently monitors the agent (Prendergast 1999). We examine each proxy in turn.

First, when agents are given greater private incentives that are correlated with the firm's interest, they should have greater a personal stake in preserving or enhancing firm value, thus reducing agency risk. A common way to accomplish such an alignment is to give shares of the firm to the agents. An agent who owns more shares of the firm captures a larger share of the firm's value as personal financial remuneration and thus has a greater stake in increasing firm value, which aligns their incentives with the interests of the principals (e.g., Holmstrom and Tirole 1989, Shleifer and Vishny 1997, Jensen and Meckling 1976). For example, it has been shown that in private firms in which managers are the main agents, managerial shareholding helps align managerial incentives with those of the owners, thus reducing agency risk (e.g., Flath and Knoeber 1985, Daily et al. 2003, Alessandri and Seth 2014). Therefore, we predict as follows:

H1a: After the pro-innovation policy was implemented, the SOEs whose agents own fewer firm shares have a higher rate of producing patents in general than before the policy and than the SOEs whose agents own more firm shares. Thus, the SOE *agents' ownership of* firm shares and the post-policy indicator generate a negative interaction effect on the *SOEs' rates of producing patents in general*.

H1b: After the pro-innovation policy was implemented, the SOEs whose agents own fewer firm shares have a lower rate of producing novel patents than before the policy and than the SOEs whose agents own more firm shares. Thus, the SOE *agents' ownership of* firm shares and the post-policy indicator generate a positive interaction effect on the *SOEs' rates of producing novel patents*.

The second factor that shapes the extent of the agency risk is the degree of monitoring exerted by the principal. When principals can more effectively monitor agents' actions, agents tend to exert greater efforts that approach the optimal level (e.g., Hart and Holmstrom 1986), and the misaligned incentives and the associated problem of "you get what you pay for" are less likely to occur (Gibbons 2005). In our

setting of promoting innovations, the ultimate goal of the state is to create greater firm value by making the firms more innovative. When the state monitors its agents more closely, it is more likely to detect and correct the agents' actions that are suboptimal and to instruct agents to undertake those actions that maximize firm value in terms of enhancing innovative capabilities. For example, with closer monitoring and supervision, the state is more likely to be able to curb agents' actions in "gaming" the metrics that cannot be justified from an efficiency perspective, such as accelerating the rate of patent production at the cost of novelty.

Many factors determine the extent to which principals monitor agents. In our application, a critical factor determining how well the agents of the state are monitored by the state principal is the accountability of the government bureaucracy: when a government is held more accountable to the collective interests of citizens (which includes the state's interest in SOEs), it tends to more closely monitor SOE behaviors. As discussed above, managers of state-controlled firms in China are monitored and evaluated by public officials of the relevant government ministries, who, in turn, should be held accountable for fulfilling their monitoring roles to advance the interest of the state—the collective interest of the citizens. Therefore, SOEs are more effectively monitored when the bureaucracy as a whole—which consists of public officials and managers of state-controlled firms—is held more accountable to the interests of the state. In other words, when the government bureaucracy is held less accountable for advancing the interests of the state, SOE managers have more opportunities to get away with actions that game the metrics and fail to advance—or even harm—the true value of SOEs, in which the state has much stake.

At the root of government accountability is the quality of external institutions that discipline government behavior. Although China generally lacks the institution of partisan competition in democracy to enhance government accountability (e.g., Przeworski et al. 1999), substantial regional variation remains in the extent to which local government officials are held accountable to the public interest and constrained from straying off to pursue private interests (e.g., Cai et al. 2011, Cull and Xu 2005, Xu 2011). This variation occurs because China's reforms have essentially adopted a model of

regional decentralization, wherein “the governance of the national economy is delegated to subnational governments... subnational governments have overall responsibility for initiating and coordinating reforms, providing public services, and making and enforcing laws within their jurisdictions” (Xu 2011, Page 1078). Therefore, in regions of greater government accountability, the agents of the state will be more effectively monitored. Thus, we posit the following hypotheses:

H2a: After the pro-innovation policy was implemented, SOEs located in regions with less government accountability have a higher rate of producing patents in general than before the policy and than those SOEs located in regions with higher government accountability. Thus, the degree of government accountability in the regions in which the SOEs are located and the post-policy indicator generate a negative *interaction effect on the SOEs’ rate of producing patents in general.*

H2b: After the pro-innovation policy was implemented, the SOEs located in regions with less government accountability have a lower rate of producing novel patents than before the policy and than those SOEs located in regions with higher government accountability. Thus, the degree of government accountability in the regions in which the SOEs are located and the post-policy indicator generate a positive interaction effect on the *SOEs’ rate of producing novel patents.*

DATA AND METHOD

Data

We focus on the major top-down policy that was implemented in 2006 that was formulated under two overarching policy guidelines. It was a pro-indigenous innovation government procurement policy specifically targeted at firms in certain industries. This policy mandated that governments should only purchase given categories of products from firms that are active in developing “Chinese indigenous innovations.” It is important to note that the goal of his policy is not to secure suppliers of government contracts, but to increase firms’ financial incentives to produce innovations in designated fields or industries by at least temporarily increasing government demand for their products.

In our main analysis, we restrict the sample to those SOEs that produced any product based on their SIC3 that was designated in the 2006 government procurement catalogues. There are two advantages of exploiting this policy change. First, the details and product categories were unknown to the public until

the policy issuance in 2006. Second, we focus only on “affected” SOEs that produce the products listed in the government procurement catalogue but not the remaining firms. This focus helps ensure that we examine a set of firms that are facing generally comparable demand to develop patents by this policy.

We obtained from the SIPO all the “invention patents”⁶ that were filed by all listed firms in China from 2001 to 2009 and eventually granted by the SIPO. Thus, we interpret the application date of a patent as the date on which the firm generated the patent. The selection of the beginning and ending dates helps maintain a balance of years before and after the 2006 policy change. All other firm variables are drawn from WIND, a comprehensive database that compiles all public information disclosed by listed firms in China. The government procurement catalogue is obtained from the relevant offices of the central and provincial governments. Province year-level information is obtained from the China Statistical Yearbooks (various years) and the annual report of the National Economic Research Institute of China (NERI) index of marketization in Chinese provinces (published as Fan et al. 2011), an index commonly used to proxy for the varying degree of market development in Chinese provinces annually (e.g., Li et al. 2006, Jia 2014). In an average year from 2001 to 2009, there were 1,027 “affected” listed firms, of which 385 are “affected” SOEs (including 224 “affected” local SOEs).

Estimation Method and Dependent Variables

Our main empirical approach uses the continuous-time event history analysis, which allows us to analyze firms’ patenting behavior in terms of the rate of their patenting activities because it takes full advantage of the exact application date of a patent as provided by the SIPO (e.g., Gans et al. 2008; Wu, 2013). Our first hypothesis focuses on the impact of the policy change on SOEs with respect to certain firm-level or location-level characteristics on the rate that a firm produces patents. As we interpreted filing for a patent application that was eventually granted as producing the patent, we coded the application for a patent at any given date as an event, named Event_SIPOfiling, which is denoted by 1, and 0 otherwise. Our second hypothesis

⁶ The SIPO grants three types of patents: invention, utility model, and design patents. The invention patents face the strictest scrutiny in terms of quality and novelty than the other two types in the approval process.

focuses on the impact of the policy on the rate that firms produce novel patents. To measure the events of producing novel patents, we adopt a conventional approach to assess the novelty of patents based on the concentration of patent technology classes (Trajtenberg et al. 1997; for a related application, see Huang and Murray 2009).⁷ Following this approach, we first constructed a Herfindahl Hirschman index (HHI) using the concentration of patent technology classes. When a particular patent is spread across many different technology classes, rather than being concentrated in just a few classes, researchers regard that the patented invention draws from and builds upon a more diverse set of technological fields (i.e., a low HHI). These patents are taken to be more novel. Conversely, a higher concentration of patent technology classes with respect to a particular patent (i.e., a high HHI) indicates a less novel patent. We coded the occurrence of a patent filed being among the lowest quartile⁸ HHI of diverse patent classes as an event of high-novelty patent application, named Event_HighNovelty, which is denoted by 1, and 0 otherwise. After splitting spells based on the patenting events, we obtained 3,899 spells for an average of 385 “affected” SOEs from year 2001 to 2009 in our main analysis.

We use the exponential model to estimate the effects of the observed covariates. In this continuous-time event history method, the strategy to control the influence of time is important. We chose the exponential model because we assume no change in hazard rate over historical time as our baseline so that the potential time period effect resulting from the policy change is captured in the covariates we specified. The time axis we used was historical time because it accounts for the possibility that applications may come in waves over historical time. The model is specified below. Let h equal the hazard rate of an outcome occurring: in models that test H1a and H2a, the outcome is generating patent j by firm i at date t conditional on the fact that this outcome did not occur by time t (Event_SIPOfiling); in models that test H1b and H2b, the outcome generates a

⁷ Another commonly used proxy of patent quality or novelty is patent citations, but the SIPO does not provide this information for the patents it grants because this information is not required of the patent applicants. Another proxy is whether a patent is renewed, based on the assumption that firms are more likely to renew more valuable patents. However, this measure is noisy and is a coarser measure (e.g., due to low renewal fees, some lower quality patents may also be renewed).

⁸ It is a common practice to use the top and bottom quartiles to compare the differences in the distribution (e.g., Meyer 1995, Page 154), such as more innovative versus less innovative inventions. Using the lowest 10th percentile of HHI yields consistent results.

novel patent j by firm i at date t that is conditional on the fact that this outcome did not occur by time t (Event_HighNovelty). The exponential model estimates

$$(1) h(Post_policy_{jt}, Z) = \exp\{\beta_0 + \beta_1 Post_Policy_{jt} \cdot y_{it} + ZB_z\}$$

where $Post_Policy_{jt}$ equals 1 for the time in and after the 2006 government procurement policy release, and equals 0 otherwise, and y_{it} denotes the measure of agents' shareholders when testing H1a and H1b and denotes the measure of government accountability in the region when testing H2a and H2b. Thus, β_1 can be interpreted as the interaction effect between the pro-innovation government procurement policy and firm or regional location characteristics, respectively, on the patent hazard rate (or novel patent hazard rate). The baseline hazard rate equals β_0 , a constant, and Z is a vector of firm and location characteristics.

Explanatory and Control Variables

The indicator variable $Post_policy$ denotes the procurement policy shock of 2006, which equals 1 for all years from 2006 to 2009 (the end of our observation period) and 0 otherwise. We generate two measures for agents' shareholding. The primary measure is $Board_share$, the percentage of firm shares owned by board members, because the incentives of board members shape how they monitor firm management and make important decisions for the firms (Hillman and Dalziel 2003). Key decisions of the firm must be communicated to or approved by the board. In particular, in Chinese SOEs, the most important type of agents in Chinese SOEs to the state (the ultimate principal) are those public employees that act on behalf of the state to manage the state's assets in the SOEs and to supervise the top management team, and a prominent channel for these representatives to exercise the state's power is to sit on the boards of SOEs and influence board decisions (e.g., Calomiris et al. 2010). $Board_share$ accounts for the personal stakes of these agents in the Chinese SOEs. As a supplementary analysis, we use a second measure, TMT_share , following the approach of measuring the percentage of firm shares owned by the top management team (e.g., Alessandri and Seth 2014). Managerial shareholding is a conventional measure of the alignment of agency incentives in researching firms in many contexts, but we consider

board members' shareholding a more accurate proxy for the alignment of interests of the agents of the state in Chinese SOEs.⁹

For a measure of government accountability that tests the moderating hypotheses of H2a and H2b, we use the variable constructed by NERI to assess the degree of constraining government inference. In the NERI database, *Government_accountability* is constructed based on a nationwide survey that asked firms' key managers to rank the importance of interacting with government officials to overcome bureaucratic red tape in their business operations relative to other business tasks, and the firm-level responses were aggregated at the province level. According to the NERI database, bureaucratic red tape in China does not simply represent cumbersome administrative procedures or minor annoyance but also represent the main channels through which public officials seek rents from firms and private citizens for the officials' private interests. Less time spent interacting with public officials and fighting through red tape is considered an indicator of more efficient and accountable government (Fan et al. 2011). Thus, a higher value on *Government_accountability* indicates greater government accountability in a province.

At the firm level, we control for *Firm_age* (age since the firm's formation), *Firm_size* (total assets), *Tobin's Q* (market value potential). We also control for *Cumulative_patent* which is the number of the firm's patents applied for and eventually granted—up to the previous year—to proxy for the firm's innovative capability or capacity, and *Private Ownership*, which is the percentage of private equity in the firm, in addition to industry fixed effects. Furthermore, we have included the following province year-level control variables: *Prov_GDPCAP* captures the GDP per capita of a provincial-level region in a particular year. *Prov_R&Dexp* captures the R&D expenditures made by independent research institutions, institutes of higher learning or universities, and large and medium enterprises of a provincial-level region (in 10,000 Yuan). *Prov_mktdev* denotes the overall NERI index measuring how well product markets, factor markets, and market-supporting legal institutions are developed in each province relative to other

⁹ Some top managers also serve on the board (accounting for more than 39% of the board members, on average).

provinces in each year. With the exception of Post_policy, all the explanatory and control variables are lagged by one year. Table 1 summarizes these variables and their pairwise correlations.

[INSERT TABLE 1 HERE]

RESULTS

Table 2 reports the results of estimating the interaction effect of Post_policy×Board_share. Models 2-1 and 2-2 examine the rate of patenting in general. Model 2-2 shows that the coefficient estimate of the interaction term Post_policy×Board_share is negative and significant ($p < 0.01$), which suggests that the higher rate of producing patents after the public policy is less pronounced among those firms whose board members hold more firm shares. This result is consistent with H1a. Using the estimates from Model 2-2, for firms whose board members do not hold any equity shares of the firm (i.e., higher agency risk), the rate of patenting after implementation of the innovation policy is 2.6 percentage points higher than that before the policy. By contrast, for firms whose board members' shareholding is at the mean value (i.e., lower agency risk), the rate of patenting after the policy is lower by 22.9 percentage points than before the policy, suggesting a substantial decrease compared with the case with high agency risk. Thus the difference in the likelihood of patenting between firms with higher versus low agency is larger after the policy, which support H1a.

Models 2-3 and 2-4 examine the rate of developing novel patents. Model 2-4 shows that the coefficient estimate of the interaction term Post_policy×Board_share is positive and significant ($p < 0.01$). This result indicates that the lower rate of producing novel patents by SOEs after implementation of the policy is also less pronounced among firms whose board members hold more shares (and have private incentives that are thus more aligned with the interests of the firm), thus lending support to H1b. For firms whose board members do not hold any firm share (i.e., higher agency risk), the rate of producing patents that were deemed novel after the policy implementation is 2.7 percentage points lower than that before the policy. By contrast, for firms whose board members' shareholding is at the mean value (i.e., lower agency risk), the rate of producing novel patents after the policy is 99.9 percent higher than before

the policy. A comparison of the changes in the rate of producing novel patents after implementation of the policy between the two groups of firms shows that the estimated magnitude of this interaction effect is quite substantial, thus lending support to H1b.

Combined with the estimated effect in support of H1a, this set of results suggests that the Chinese SOEs whose board members' private financial incentives are more aligned with firm value are less likely to experience an increased rate of producing general patents and a decreased rate of producing novel patents after implementation of the pro-innovation policy than before the policy and than those SOEs whose board members' interests are less aligned with the firm value. We consider this evidence consistent with agency theory in innovation.

[INSERT TABLE 2 HERE]

Table 3 reports the results of estimating the moderating effect of local government accountability. We limit our sample to local SOEs that are controlled by local governments because of the concern that central SOEs—those directly controlled by the central government—may be less susceptible to local institutional conditions, as central SOEs are neither controlled nor monitored by any local government. Nonetheless, including central SOEs yields consistent results. Models 3-1 and 3-2 examine the rate of developing patents in general. In Model 3-2, the interaction term $\text{Post_policy} \times \text{Government_accountability}$ is negative and significant ($p < 0.01$), indicating that local SOEs' higher post-policy rate of developing patents is less pronounced in regions in which local governments are more accountable to the public interest. This result is consistent with H2a. To illustrate, using the estimates from Model 3-2, the rate of patenting after implementation of the policy is 22.8 percentage points higher than the rate before the policy for firms located in lower government accountability regions (i.e., $\text{Government_accountability}$ is one standard deviation below the mean). By contrast, for firms located in regions with greater government accountability (i.e., $\text{Government_accountability}$ is one standard deviation above the mean value), the rate of patenting after implementation of the policy is 16.3 percentage points lower than prior to implementation of the policy. Comparing the change in the patenting rate after implementation of the policy between the two groups of firms suggests that firms in locations of low accountability—and

therefore high agency risk—tend to experience a greater increase in the rate of (general) patenting than in the case of low agency risk. Thus, H2a is supported.

Models 3-3 and 3-4 examine the rate of developing novel patents, as opposed to patents in general. In Model 3-4, although the estimated interaction effect of Post_policy× Government_accountability is positive, as predicted by H2b, it is not statistically significant. Taken together, these results suggest that the general accountability of the local government plays a notable role in curbing SOEs' tendency to over-produce patents after implementation of the policy, but its impact might not be sufficiently large to boost SOEs' tendency to produce novel patents following policy implementation.

[INSERT TABLE 3 HERE]

Discussion of Alternative and Competing Explanations

Did the state simply seek to quickly accumulate incremental patents? The first potential alternative explanation is that, as discussed above, it might simply happen to be in the best interests of the Chinese state to quickly develop less novel patents. Thus, SOEs might simply be following the state's instructions to increase the rate of general patent production and decrease the rate of producing novel patents.

However, first, we have presented rich background evidence above that it is not the intention of the state to maintain this unbalanced focus. The ultimate goal of the Chinese state is to make firms more innovative such that the innovations will create more value for firms and society over the long term.

More importantly, focusing on the interaction effect of the post-policy indicator and measures of agency incentives helps address this concern. These alternative explanations cannot account for the interaction effects that this study has focused on. If indeed the state is emphasizing the rate of patenting more than the novelty of patents, then this mandate should affect all SOEs across the board, but this proposition is not supported by the findings. Instead, the results show that agents' shareholding that increases the agents' personal financial stake in increasing firm value and regional location accountability—both of which help curb agency conflicts in the firm—slow down the trend that SOEs

increase the rate of patenting after implementation of the policy change. These interaction results are more consistent with the agency-based explanation than the alternative explanations.

Can government contracts nullify the firm's need to become truly innovative? The second challenge to the agency-based explanation is that, even if the agent's interests were fully aligned with those of the firm (i.e., the absence of agency risk), the agent (or the firm) does not have to care about achieving a balance between incremental and novel patents to improve the firm's innovative capabilities and competitiveness (which contributes to firm value in market competition) as long as the firm can be shielded entirely from market competition. Such insulation from market competition may be achieved by obtaining, through this public policy, all business from government contracts, which, after all, was the "carrot", used by the state in this very policy instrument.

However, it is notable that, first, this explanation does not explain the main findings, i.e., that innovation behavior differs for SOEs with varying degree of agency risk. Second, the need to compete in the market is not annihilated for most firms in our sample. For the products included in the government procurement catalogues, there were significant growth opportunities as the result of large and growing market demand beyond government contracts. These were not just any type of products, but many belonged to core manufacturing industries for which there were large domestic and international markets, and a notable proportion were technology-intensive products in fast-growing markets.

CONCLUSION

Can state capitalism foster innovation? Tension arises as long-standing beliefs about SOEs' innovation meet a global trend. Scholars have long held that SOEs lack the incentives to innovate and that state control does not incentivize SOEs to engage in innovative activities (Hart et al. 1997; Shleifer, 1998). However, others argue that SOEs can serve as a conduit for the state to promote innovation (Amsden, 2001; Liegsalz and Wagner, 2013). For example, recent years have witnessed a surge of Chinese governmental interest in fostering domestic innovations to enhance the country's competitiveness, and indigenous patents in China have indeed surged. Therefore, this fact pattern raises the question as to what

happens when the state as the principal of SOEs imposes a clear goal of promoting innovations, and whether the state's pro-innovation policy remedies SOEs' weaker incentives to innovate.

We address this question from the perspective of agency risk known as “get what you pay for.” We propose that when the agents' incentives are less aligned with firm value and their actions are less effectively monitored by the principal, agents will exert greater efforts to develop innovation outcomes that are valued higher by the metrics used to assess SOE innovation but devote less to developing other innovation outcomes that are not measured by the metrics (including those that contribute more to firm value). Our empirical context is the major public policy issued and implemented in 2006 in China that aimed to promote innovation of Chinese domestic firms using government procurement programs. The policy required governments across all levels to prioritize more innovative domestic firms in government procurement decisions. In implementing the policy, governments assessed the innovativeness of firms based much more heavily on the rate of building a body of patents than on the novelty of those patents. We find that, among the affected Chinese SOEs that were at risk to be most influenced by this policy (i.e., those that produce the products listed in the government procurement catalogs), after the implementation of the policy, those with more severe agency risk achieved a higher rate of developing patents in general—but a lower rate of developing more novel patents—than they did prior to the policy and than affected SOEs with less severe agency risk.

These findings have profound implications. A higher rate of developing patents in itself may not be bad for a firm's innovativeness and value; however, when combined with a lower rate of producing novel patents, the entire picture seems to be one that the SOEs suffering from more severe agency risk responded to the public policy by increasing the rate of producing less novel, more incremental patents at the expense of more novel patents. Whereas scholars and practitioners believe that firms must achieve a balanced mix of incremental and novel innovations, most Chinese SOEs were unlikely to have previously been in the position of overproducing novel patents prior to the policy change, so scaling back novel-patents—or developing them at disproportionately slower rates than incremental patents—is unlikely to be the optimal way to achieve the highest firm innovativeness and value.

We thus conclude that it is difficult for the state to replicate the market for innovation. The root of the problem consists of two issues: SOE agents' divergent interests and the states' inability to design evaluation metrics that induce those types of managerial actions that contribute to the highest firm value. There is no clear, easy solution for the latter. One may suggest a solution that includes more metrics to measure the novelty of patents—which are certainly required, but it does not readily eradicate the problem because it is difficult to find the objective metrics that proxy perfectly for the novelty of the innovations and the true innovativeness of the firm (for example, there is room to strategically manipulate the development of an innovation to claim more patent classes without enhancing the true novelty or quality of the technology). Others suggest including more subjective assessments of patent quality or novelty; however, as discussed in the agency theory literature, the risks are that the subjectivity that raises concerns over the fairness of the assessment, the state principal's commitment to its promises, and potential corruption in the evaluation process will all weaken the agent's incentives to undertake actions to respond to the policies. More broadly, this is not a unique challenge facing state principals in promoting innovation, but economic mechanism designs are inherently difficult (Gibbons and Roberts, 2013). Therefore, although we acknowledge that the state can play an active role in promoting innovation through public policies, it faces many challenging obstacles if it intends to replicate the market for innovation.

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Table 1. Summary Statistics and Pairwise Correlations

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Event_SIPOfiling	0.47	0.50														
2 Event_HighNovelty	0.08	0.27	0.31													
3 SOE	0.44	0.50	0.16	0.11												
4 Post_policy	0.52	0.50	0.08	0.07	-0.04											
5 TMT_share	2.94	8.57	0.08	-0.01	-0.40	0.16										
6 Board_share	2.97	10.95	0.08	-0.02	-0.35	0.10	0.84									
7 Constraint_government	6.34	2.72	0.14	0.11	-0.06	0.32	0.10	0.04								
8 Firm_age	5.18	6.04	0.08	0.03	0.36	0.23	-0.29	-0.17	0.04							
9 Firm_size	21.79	1.55	0.44	0.29	0.39	0.15	-0.27	-0.20	0.28	-0.01						
10 Private_ownership	0.16	0.22	-0.06	-0.10	-0.55	-0.08	-0.04	-0.06	0.00	0.05	-0.28					
11 Tobin's_Q	1.62	1.34	-0.15	-0.09	-0.16	-0.13	0.17	0.12	-0.06	-0.19	-0.41	0.12				
12 Cumulative_patents	32.89	92.80	0.25	0.22	0.28	0.17	-0.05	-0.10	0.30	0.09	0.70	-0.17	-0.16			
13 Prov_GDPCAP	23985.3	15604.57	0.13	0.11	0.05	0.38	0.11	0.03	0.65	0.05	0.36	-0.09	-0.03	0.47		
14 Prov_R&Dexp	2.12E+06	5.47E+06	-0.04	0.00	-0.07	0.21	0.08	0.04	0.27	0.02	0.00	0.01	-0.03	0.01	0.27	
15 Prov_mktdev	7.61	1.93	0.15	0.08	-0.18	0.42	0.23	0.14	0.82	0.06	0.21	0.06	-0.09	0.23	0.72	0.32

Notes: All magnitudes equal to or above 0.03 are significant at $p < 0.01$.

Table 2. Event History Analysis of the Interaction Effects of Post-Policy and Board Shareholding

Model	2-1	2-2	2-3	2-4
Dependent Variable	Event_SIPOfiling	Event_SIPOfiling	Event_HighNovelty	Event_HighNovelty
Sample	SOEs	SOEs	SOEs	SOEs
Post_policy × Board_share		-0.086** (0.030)		20.545** (7.270)
Board_share	-0.004 (0.023)	0.038* (0.016)	-0.052 (0.080)	-20.557** (7.271)
Post_policy	0.019 (0.046)	0.026 (0.029)	0.088 (0.105)	-0.027 (0.110)
Firm_age	-0.097*** (0.006)	-0.098*** (0.003)	-0.120*** (0.013)	-0.122*** (0.013)
Firm_size	0.843*** (0.025)	0.843*** (0.015)	1.016*** (0.059)	1.034*** (0.060)
Private_ownership	0.810*** (0.175)	0.823*** (0.131)	1.014* (0.455)	0.972* (0.461)
Tobin's_Q	0.029 (0.019)	0.031** (0.011)	-0.037 (0.050)	-0.030 (0.050)
Cumulative_patents	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Prov_GDPCAP	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Prov_R&Dexp	-0.000*** (0.000)	-0.000*** (0.000)	-0.000+ (0.000)	-0.000+ (0.000)
Prov_mktdev	0.293*** (0.020)	0.294*** (0.012)	0.339*** (0.047)	0.346*** (0.047)
Industry fixed effects	YES	YES	YES	YES
Constant	-23.915*** (0.541)	-23.952*** (0.330)	-29.258*** (1.300)	-29.446*** (1.305)
Spells	3,899	3,899	3,899	3,899
Log-likelihood	-8,455.58	-8,453.71	-2,563.93	-2,558.11

Notes: All tests are two tailed. + p < 0.1; * p < 0.05; ** p < 0.01; and *** p < 0.001.

Table 3. Event History Analysis of the Interaction Effects of Post-Policy and Local Government Accountability

Model	3-1	3-2	3-3	3-4
Dependent Variable	Event_SIPOfiling	Event_SIPOfiling	Event_HighNovelty	Event_HighNovelty
Sample	Local SOEs	Local SOEs	Local SOEs	Local SOEs
Post_policy × Constraint_government		-0.072** (0.026)		0.008 (0.066)
Constraint_government	0.012 (0.019)	0.048* (0.023)	0.129* (0.051)	0.124+ (0.064)
Post_policy	0.082 (0.078)	0.489** (0.165)	0.494* (0.200)	0.446 (0.439)
Firm_age	-0.090*** (0.010)	-0.090*** (0.010)	-0.074** (0.025)	-0.074** (0.025)
Firm_size	0.744*** (0.045)	0.740*** (0.045)	0.879*** (0.106)	0.879*** (0.106)
Private_ownership	2.860*** (0.334)	2.713*** (0.338)	2.814** (0.869)	2.829** (0.878)
Tobin's_Q	-0.041 (0.030)	-0.042 (0.030)	-0.207* (0.095)	-0.207* (0.095)
Cumulative_patents	0.017*** (0.001)	0.017*** (0.001)	0.012*** (0.003)	0.012*** (0.003)
Prov_GDPCAP	-0.000 (0.000)	-0.000 (0.000)	-0.000* (0.000)	-0.000* (0.000)
Prov_R&Dexp	-0.000*** (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000 (0.000)
Prov_mktdev	0.167*** (0.039)	0.158*** (0.039)	0.011 (0.100)	0.012 (0.100)
Industry fixed effects	YES	YES	YES	YES
Constant	-23.081*** (1.035)	-23.082*** (1.037)	-41.985 (1,282.862)	-41.974 (1,281.135)
Spells	1,696	1,696	1,696	1,696
Log-likelihood	-3,532.62	-3,528.80	-922.92	-922.91

Notes: All tests are two tailed. + p < 0.1; * p < 0.05; ** p < 0.01; and *** p < 0.001.