Journal of Corporate Finance 67 (2021) 101919

Contents lists available at ScienceDirect

Journal of Corporate Finance

journal homepage: www.elsevier.com/locate/jcorpfin

Varieties in state capitalism and corporate innovation: Evidence from an emerging economy

Yongjia Lin (Rebecca)[a], Xiaoqing Fu (Maggie)[b,*], Xiaolan Fu[c]

[a] School of Business, Macau University of Science and Technology, Avenida Wai Long, Taipa, Macao, China
[b] Faculty of Business Administration, University of Macau, Avenida da Universidade, Taipa, Macao, China
[c] Department of International Development, University of Oxford, 3 Mansfield Road, Oxford, UK

ARTICLE INFO

JEL code:
D73
G32
G34
M14
O31
O38

Keywords:
Innovation
State capitalism
ESG
Economic policy uncertainty
Corruption
Ultimate controlling ownership

ABSTRACT

This paper contributes to the literature by examining the impact of different forms of state ownership on corporate innovation and the moderating effects of environmental, social, and governance (ESG) practices, economic policy uncertainty (EPU), and corruption in this ownership–innovation nexus. Building on both agency theory and institutional theory, we identify and divide the ultimate controlling shareholders into three types: central government, local government, and private shareholders. This study draws on data from 2629 listed firms in China between 2007 and 2015. Our results suggest that state-owned enterprises (SOEs) controlled by the central government show the strongest innovation performance in all scenarios. In addition, private firms outperform local SOEs in terms of patent quantity in both manufacturing and nonmanufacturing sectors and in high-economic-development regions, whereas local SOEs outperform their private peers with respect to patent quality, mainly in the manufacturing sector and high-economic-development regions. Such an ownership–innovation nexus is then found to be more pronounced for firms engaging in more ESG practices, during periods of higher EPU, and when less corruption is present. These findings demonstrate the value of diversity in state capitalism in guiding SOEs' heterogeneous innovation activities in emerging economies.

1. Introduction

State governments in emerging economies have undertaken a series of reforms to restructure their state-owned enterprises (SOEs) in an attempt to improve firm competencies, including those in innovation (Stiglitz and Lin, 2013; Liang et al., 2015; Musacchio et al., 2015; Genin et al., 2020). These reforms have primarily led to state capitalism, a regime characterized by the co-existence of hierarchy-based and market-based institutions, with the state strongly influencing firms (Bruton et al., 2015; Musacchio et al., 2015; Hu et al., 2019; Mariotti and Marzano, 2019; Genin et al., 2020). Whereas an increasing number of studies has investigated how these reforms affect firm innovation performance in emerging economies (Ayyagari et al., 2012; Fang et al., 2017; Zhou et al., 2017; Li et al., 2018; Jia et al., 2019; Cao et al., 2020; Tan et al., 2020, among others), relatively less attention has been paid to how the underlying modes of control over SOEs imposed by different state government levels have shaped SOEs' motivations, resources, and capabilities for innovation through reforms that ultimately affect their innovation performance.

Varieties in state capitalism have important implications for corporate innovation in emerging economies because SOEs may follow

* Corresponding author.
E-mail address: maggiefu@um.edu.mo (X. Fu).

https://doi.org/10.1016/j.jcorpfin.2021.101919
Received 16 March 2020; Received in revised form 16 February 2021; Accepted 19 February 2021
Available online 27 February 2021

different development pathways as a result of heterogeneous reform treatments. Specifically, different reform measures can be implemented at different government levels, generating organizational heterogeneity in terms of resources, logic, and behavior between SOEs controlled by central and local governments (Li et al., 2014). According to institutional theory (Scott, 2004), such institutionally derived organizational differences can motivate central and local SOEs to adopt varying innovation strategies, resulting in different innovation performance and providing the basis for our main research questions. What implications do the emergence of varieties in state capitalism hold for SOEs' innovation performance? What are the underlying mechanisms through which the varieties in state capitalism affect corporate innovation?

As the largest emerging economy globally, China provides a valuable platform for investigating these critical issues. Recognizing that innovation is a major driver of sustainable economic growth, the Chinese government has made the development of indigenous innovation the top priority in its national development plan since 2006. A series of new policies have then been implemented for this purpose (Fu, 2015). As a result, China's average annual real growth in research and development (R&D) spending approached 20% during the past decade, making it the world's second largest R&D performer (Organization for Economic Cooperation and Development, 2020). Meanwhile, China has witnessed substantial growth in patent applications and has become the largest originator of patent applications globally (World Intellectual Property Organization, 2019).

On the other hand, as indicated by Xu (2011), China's institutional system is a regionally decentralized authoritarian regime that features a combination of political centralization and economic regional decentralization. In this regime, the central government maintains substantial control over political and personnel governance structures, whereas local officials have overall responsibility and various resources for running the economy within their jurisdictions. Consequently, SOEs controlled by the central government (hereafter referred to as "central SOEs") have become national policy instruments for sustainable macro-level growth and social welfare maximization. SOEs controlled by local governments (hereafter referred to as "local SOEs") are relatively more market-driven and equipped with strong commercial logic to pursue development goals set by local governments (Li et al., 2014). Given that indigenous innovation is a national strategy put forward by the Chinese central government, central SOEs may innovate to fulfill this national policy objective. However, local SOEs may innovate to primarily satisfy local fiscal needs. Their diverging motives, together with heterogeneous resources and institutional logic, may result in different innovation performance.

In addition, as emphasized in Poon (2009), the Chinese government has promulgated its national policy to foster "national champions" and indigenous core technologies since the late 1990s. Central SOEs, acting as the "national champions," are clustered into sectors of "strategic importance," such as mining, energy, transportation, telecommunications, banking, and public utilities. Various measures have been adopted by the central government to nurture these "national champions." Through the steady provision of natural resources, raw materials, technologies, and experts, these central SOEs have become vehicles accumulating independent productive and technological capabilities. The ultimate goal of this "national champions" strategy is to catch up to the global technological frontier and lay the foundations for future sustainable growth. As a result, China now has the largest number (124) of Fortune Global 500 companies globally, the majority of which are central SOEs. Among the top ten, for example, three companies are Chinese central SOEs, including Sinopec Group (#2), State Grid (#3), and China National Petroleum (#4).[1] Therefore, China's experiences with innovation and diversity in state capitalism have become the subject of widespread interest among various stakeholders in economics and politics.

An increasing number of studies considered the impact of state ownership on corporate innovation performance in China but yielded mixed results (Jefferson et al., 2003; Li and Xia, 2008; Xu and Zhang, 2008; Guan et al., 2009; Dong and Gou, 2010; Choi et al., 2011; Jiang et al., 2013; Fang et al., 2017; Xu and Yano, 2017; Yi et al., 2017; Zhou et al., 2017; Li et al., 2018; Jia et al., 2019; Kroll and Kou, 2019; Cao et al., 2020; Jiang et al., 2020; Kong et al., 2020; Genin et al., 2020; Tan et al., 2020; Zhang et al., 2020). In addition, none of the extant research has investigated the ownership–innovation nexus from the perspective of diversity in state capitalism.[2] This study uses a large sample of listed firms in China for the 2007–2015 period in an attempt to fill the void by examining the impact of different forms of state ownership on corporate innovation and the underlying mechanisms through which the varieties in state capitalism affect corporate innovation.

Inspired by the advocacy of Judge (2010) on developing a theory of corporate governance that is accurate for the economy, we identify ultimate controlling shareholders in China, divide them into three types—central government, local government, and private shareholders—and examine whether their impacts on firm innovation performance differ.[3] Meanwhile, to obtain a more comprehensive picture of corporate innovation, we consider two dimensions of innovation performance, including the number of patents granted to a company as a measure of patent quantity and the number of citations received by the patents granted to a company as a measure of patent quality (Tan et al., 2020). In addition, we estimate the moderating effects of environmental, social, and governance (ESG) practices, economic policy uncertainty (EPU), and corruption in this ownership–innovation nexus. Finally, we split our sample into four paired subsamples representing manufacturing versus nonmanufacturing firms and firms in high- versus low-economic-development regions with an attempt to explore whether there are any heterogeneous industry and/or regional effects in this ownership–innovation nexus.

[1] Retrieved January 13, 2021, from https://fortune.com/global500/.

[2] Focusing on investigating the innovative efficiency of SOEs in China, Cao et al. (2020) argue that minority SOEs are more innovatively efficient than non-SOEs and majority SOEs, supporting partial state ownership. They also find that central SOEs are more innovatively efficient than local SOEs in the further tests presented in the online appendix. Innovation efficiency is defined as patent output per dollar of R&D spending.

[3] Because the number of firms with foreign ultimate controlling ownership is very small (223 of the 15,436 in our sample), we do not divide private ownership into domestic private ownership and foreign ownership.

We find that the central SOEs outperform their local and private peers in innovation creation in all scenarios. Private firms outperform local SOEs in terms of patent quantity in nonmanufacturing industries and high-economic-development regions. However, local SOEs outperform their private peers with respect to patent quality in the manufacturing sector and high-economic-development regions. Furthermore, local SOEs and private firms in low-economic-development regions exhibit no significant difference in innovation performance. Finally, such ownership–innovation nexus is found to be more pronounced for firms with more ESG practices, during periods of higher EPU, and when less corruption is present. Our findings are robust to endogeneity concerns.

This study contributes to the literature in the following ways. First, we adopt a more nuanced approach to investigate how varieties in state capitalism shape the institutional logic and patterns of resource allocation that determine SOEs' innovation performance by distinguishing the impact of institutional change between different forms of government ownership. Second, we highlight the importance of separating exploratory innovation from exploitative innovation in capturing the crucial impact of risk tolerance on corporate innovation. Third, we provide a systematic examination of the important contingencies related to the role of different forms of state ownership that may have heterogeneous impacts on innovation across various institutional environments. Finally, given that Chinese firms confront very severe Type II agency problems, we employ the method of La Porta et al. (1999) to identify the ultimate controlling shareholders of these firms, enabling us to reveal the true mechanism of the ownership–innovation nexus in emerging economies and, hence, contributing to the global understanding of corporate governance.

In general, our study delves beneath the surface of SOEs to show how their roles may have evolved along different economic reform trajectories, generating heterogeneous impacts on innovation creation in emerging economies. This further classification contributes to the ongoing debate on the role of the state in the innovation process in emerging economies (Belloc, 2014) by offering insights into whether central and local government ownership should be considered separately when formulating the national innovation plan and, if so, how. This separation may be particularly interesting to current policymakers in emerging economies. As highlighted in the latest Transition Report released by the European Bank for Reconstruction and Development (EBRD), for example, emerging economies in the EBRD regions face difficult choices to determine whether an increase in the state's role has positive or negative long-term consequences because the COVID-19 pandemic sparks calls for more government intervention (EBRD, 2020).

The remainder of this paper is organized as follows. Section 2 provides the institutional background and hypothesis development. Section 3 describes the data and the econometric methodology. Section 4 presents the empirical results, and Section 5 concludes the study.

2. Institutional background and hypothesis development

2.1. *Institutional background and the ownership–innovation nexus*

The substantial reforms undertaken by China during the past four decades have transformed the world's largest developing country from a centrally planned economy into a mixed market economy characterized by political centralization and regional economic decentralization. On the one hand, the central government focuses on macro-level growth and social welfare maximization and has substantial control over political and personnel governance structures. On the other hand, local governments are granted considerable control rights and resources to run the bulk of the economy within their jurisdictions. By linking regional performance to local officials' promotions, the central government has introduced a tournament-like regional competition mechanism that provides high-powered incentives to local officials to undertake market-oriented measures to develop the local economy (Xu, 2011). Consequently, these reforms have led to varieties in China's state capitalism, a regime characterized by the co-existence of central SOEs, local SOEs, and private firms.

Specifically, central SOEs include (1) SOEs managed by the State-owned Assets Supervision and Administration Commission of the State Council (SASAC-SC) and (2) SOEs supervised by the Ministry of Finance (MF) (Unirule Institute of Economics, 2011). As indicated on its official website, the SASAC-SC performs investors' responsibilities, supervises and manages enterprises' state-owned assets under the supervision of the central government, and enhances the management of state-owned assets. The SASAC-SC is also responsible for preserving and increasing the value of the supervised enterprises' state-owned assets and for managing wages, remunerating the supervised enterprises, formulating policies to regulate the income distribution of the supervised enterprises' top executives, and organizing the implementation of these policies. Moreover, the SASAC-SC appoints and removes the supervised enterprises' top executives and evaluates their performance through legal procedures; it either grants rewards or imposes punishments based on their performance. This mechanism enables the SASAC-SC to impose stringent and effective monitoring over central SOEs.[4]

In contrast, local SOEs include (1) SOEs managed by the State-owned Assets Supervision and Administration Commission of Local Governments (SASAC-LG) and (2) SOEs supervised by other units of the local governments (ULGs). Although the basic functions of the SASAC-SC and the SASAC-LG are similar, they differ from each other substantially because the Law of the People's Republic of China on the State-owned Assets of Enterprises, issued in October 2008, states that the two tiers of government owners manage SOEs on behalf of and with the authorization of the corresponding government. Therefore, the SASAC-SC and the MF must follow the central government's policies and instructions, whereas the SASAC-LG and the ULGs should stick to local governments' policies and

[4] The industrial industry and part of the financial industry are the main industries managed by the SASAC-SC. As for the MF, as indicated on its official website, its main functions include supervising state-owned financial institutions and state-owned assets affiliated with other central government ministries, such as the Ministry of Commerce, the Ministry of Education, and the Ministry of Science and Technology. Thus, the MF complements the SASAC-SC by focusing on non-industrial sectors.

instructions.

According to institutional theory (Scott, 2004), different government levels exert differential impacts on their associated SOEs' institutional logic, priorities, and access to resources. Such institutionally derived organizational differences can motivate these SOEs to pursue different innovation approaches, resulting in heterogeneous innovation performance (Haveman and Rao, 2006). In China, the central government maintains its control over central SOEs via the SASAC-SC and the MF to serve national strategic interests and fulfill social obligations. In other words, central SOEs become the central government's national policy instruments (Zhou et al., 2017). Therefore, central SOEs are strongly motivated to engage in innovation creation, particularly exploratory innovation because the central government views indigenous innovation as one of the top national priorities in its national development plan (Fu, 2015). In addition, to ensure the central government's control over strategically important sectors, central SOEs have been converted into "national champions" by retaining monopolistic dominance over the strategically important sectors for serving national policy objectives during the reforms. As a result, central SOEs have become corporate conglomerates combined through cross shareholding, intragroup trade, and cross subsidization (Child and Tse, 2001). This resilient structure facilitates the creation of internal markets that enable intragroup transactions, such as technology sharing, management personnel rotation, and risk pooling (Yiu, 2011). Furthermore, central SOEs enjoy more preferential policies, such as more inexpensive access to credit and easier access to the talent pool, than their local and private peers (Li et al., 2014).

In contrast, the local governments gain significant autonomy to run their local SOEs via the SASAC-LG and the ULGs with the aim to promote local economic development and policy objectives. Consequently, local SOEs are increasingly profit-driven, innovating primarily for commercial purposes to serve local economic development objectives (Li et al., 2014). Moreover, political economists argue that local governments may engage in the selective implementation of national high-priority mandates because they are usually assigned a long list of high-priority and binding targets. Unless these multiple competing tasks are integrated into a single index, local governments usually focus their efforts on what they perceive as the most influential priorities in their career paths, such as higher GDP growth and lower unemployment (Holmstrom and Milgrom, 1991; O'Brien and Li, 1999; Li and Zhou, 2005; Guo, 2007; Minzner, 2009). This logic implies that local SOEs have relatively weaker incentives for innovation enhancement than central SOEs. In addition, economic decentralization motivates local governments to enhance local SOEs' financial performance to maximize profits and restricts the resources that can be provided by local governments to local SOEs because extra budgets beyond their budgetary capability require the central government's further approval. Furthermore, local SOEs are scattered across nonstrategic industries, such as manufacturing and services. Hence, unlike central SOEs that can claim monopolistic privileges, local SOEs are less able to mobilize resources to promote innovation.

Private firms must innovate to survive in the competitive market because innovation is the lifeline of firms' sustainable development in the current knowledge-based global economy. In other words, private firms have a strong motivation to innovate. Compared with SOEs in general, private firms typically possess larger social networks in the home market, in addition to their family, kin, and other interpersonal relationships. These social relationships have been found to be more reliable in weak institutional environments in which formal, contractual relations are difficult to build (Filatotchev et al., 2011). They enable private firms to be quickly informed about local trends and, in turn, be more responsive to local environments. Thus, private firms are more capable of finding timely and accurate information relevant to technology localization and local innovation opportunities than their state peers, especially in niche markets (Carney, 2005). In addition, private firms' local knowledge is difficult to purchase from the market because China lacks a competitive market with professional consultants who specialize in technology localization and local market intelligence (Khanna et al., 2005). As a public administrator, the state does not view the development of local business intelligence as its primary task. These unique resources, together with the strong motivations for innovation, enable private firms to compete with SOEs, especially local SOEs in China.

However, as indicated in Holmstrom (1989), innovative activities require exceptional failure tolerance because the innovation process is unpredictable and idiosyncratic, involving a high probability of failure. Ericson and Pakes (1995) and Fernandes and Paunov (2015) further point out that innovation may expose firms to survival risk because uncertainties are inherent to innovation and its commercialization. Innovation usually involves sunk R&D costs that may be higher than the payoff because of low demand for the new products/services, or the products/services may be copied or substituted quickly by other new products/services developed by competitors. In short, a high level of failure tolerance can foster innovation (Tian and Wang, 2014), particularly exploratory innovation that entails a major departure from existing technologies and products (Manso, 2011). On the other hand, it is well documented in the literature that SOEs in general are better able to tolerate failure than private firms (Ramasamy et al., 2012; Belloc, 2014; Cuervo-Cazurra et al., 2014; Belloc et al., 2016, among others). SOEs benefit from favorable fiscal and lending policies and can fund research activities regardless of the necessary revenues from research output and/or the uncertainty inherent in risky innovative projects. In addition, governments have control over laws and regulations, enabling them to enforce contracts and reduce risks for their SOEs' innovation activities. Thus, compared with private firms, SOEs are both more likely and more willing to take the risk to finance basic and less-applied research that have a higher probability of generating exploratory innovation because "visionary thinking can open up promising avenues towards powerful new technologies."[5]

Furthermore, as highlighted in Belloc (2014), compared with private owners, governments have a higher capacity to lead knowledge networks that are vital to innovation, especially exploratory innovation via two channels. First, SOEs can engage more easily than private firms in inter-firm collaborations (including patent sharing and cross-licensing) for innovation production because

[5] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/future-and-emerging-technologies

control rights are wholly and partly concentrated in the hands of one owner—the state. Second, SOEs' superior access to information about economic performance and trends enables them to more easily coordinate intra-industrial change, thereby leading industrial districts and local systems of innovation. In addition to the long-term capital and knowledge networks enjoyed by the previously mentioned SOEs, Chinese governments can provide other key resources, such as resident status and related public benefits, that are critical to attract the talent needed for exploratory innovation (Tan, 2006; Choi et al., 2011; Cumming et al., 2016; Firth et al., 2011).[6]

In summary, a firm's innovation performance depends not only on its motivation for innovation but also on its resources and capabilities, particularly its risk tolerance level if exploratory innovation is involved. Compared with both local SOEs and private firms, central SOEs are not only strongly motivated for innovation but also have more resources and capability for innovation, particularly a higher tolerance for risk. Compared with local SOEs, private firms typically have stronger motivations for innovation; however, their tolerance for failure may not surpass that of local SOEs when exploratory innovation projects are involved. Given that exploratory innovation is closely related to patent quality rather than patent quantity (Manso, 2011), we propose the following three hypotheses.

Hypothesis 1a. Central SOEs are associated with the best innovation performance measured by both patent quantity and quality.

Hypothesis 1b. Private firms outperform local SOEs in terms of patent quantity.

Hypothesis 1c. Local SOEs outperform private firms in terms of patent quality.

2.2. ESG, economic policy uncertainty, and corruption

We then analyze the underlying mechanisms through which varieties in state capitalism affect corporate innovation. The first movement in this symphony is firms' ESG activities. A growing number of extant studies show that firms' ESG engagement is related to their innovation capacity (Oh et al., 2011; Bocquet et al., 2013; Deng et al., 2013; Costa et al., 2015; Friede et al., 2015; Broadstock et al., 2019, among others). There are two opposing views in this regard in the literature, namely, the shareholder expense view and the stakeholder value maximization view (Deng et al., 2013). Based on the agency theory developed by Friedman (1970), the shareholder expense view argues that firms' ESG activities may negatively affect their innovation performance because managers may engage in ESG activities at the expense of shareholders. For example, managers adopting too stringent pollution control standards may force firms to spend too many resources on nonproductive ESG projects; hence, fewer resources could be allocated to innovation projects, reducing firms' competitive advantages.

In contrast, the stakeholder value maximization view developed by Freeman (1984) suggests that ESG has a positive effect on innovation performance because increasing ESG activities can improve firms' relationships with their various stakeholders, such as the government, local communities, clients, and even competitors. In turn, these improved relationships can reduce firms' social and financial costs, enabling them to access diverse external information, knowledge, and support and, hence, encouraging their innovation performance (McWilliams and Siegel, 2000; Choi and Wang, 2009; Costa et al., 2015; Broadstock et al., 2019). A small number of extant studies estimate the association between government ownership and ESG engagement, but none of them distinguishes central SOEs from local SOEs. For example, using a sample of companies from the manufacturing industry in 2007, Li and Zhang (2010) find a positive relationship between government ownership and ESG intensity in Chinese SOEs, arguing that Chinese SOEs' response to ESG is politically and economically driven. Based on a survey method and a small sample, Zu and Song (2009) also find that SOEs are more likely to have managers who opt for more ESG activities in China.

In China, during the past decade, the government has strongly encouraged Chinese firms to undertake ESG activities. For example, the China Securities and Regulatory Commission coordinates with the State Environmental Protection Administration to initiate the "green securities" scheme, under which firms in high-energy consumption and high-pollution industries are subject to environmental performance reviews when applying for initial public offerings or refinancing. Moreover, the Chinese government launched the Green Credit Policy in 2007, requiring banks to lend more to environmentally friendly projects and less to polluting projects. For example, the Industrial and Commercial Bank of China and China Development Bank, two major banks in China, recorded a combined green credit loan portfolio of approximately $200 billion as of 2011.[7] Therefore, undertaking more ESG activities is assumed to bring substantial benefits to both SOEs and private firms in China, supporting the stakeholder value maximization view.

In addition, as discussed in Section 2.1, central SOEs are obligated to advance national industrial and welfare priorities and are much more social-oriented than local SOEs and private firms. For example, SASAC-SC, the controlling owner of central SOEs, released in 2008 the opinion on social responsibility implementation for central SOEs (Li et al., 2013; Kao et al., 2018). Therefore, central SOEs are expected to be both more willing and more able to undertake more ESG activities than their local and private peers. Because local SOEs are more market-oriented than their central peers, the impact of ESG on their ownership–innovation nexus is expected to be similar to that for private firms. That said, their differences in terms of motivation for innovation and risk tolerance levels remain valid. Therefore, we propose the following three hypotheses.

Hypothesis 2a. Central SOEs deliver the best innovation performance as measured by both patent quantity and quality when more

[6] For instance, local resident status in China is associated with numerous public benefits, which is important for attracting highly skilled labor. In addition, access to land contributes to firm innovation because limited land availability and high estate prices remain major constraints on innovation activities that often require large R&D centers.

[7] Source: https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/china+takes+green+lending+to+a+new+level

ESG activities are undertaken.

Hypothesis 2b. Private firms outperform local SOEs in terms of patent quantity when more ESG activities are undertaken.

Hypothesis 2c. Local SOEs outperform private firms in terms of patent quality when more ESG activities are undertaken.

The second movement of this symphony is economic policy uncertainty (EPU). A growing body of literature argues that corporate innovation performance is affected by EPU (Cumming et al., 2016; Bhattacharya et al., 2017; Feng and Johansson, 2017; He et al., 2020; Jiang et al., 2020; Tajaddini and Gholipour, 2020; Xu, 2020). Similarly, there are two opposing views in this regard, including the real option view and the game theory view (Tajaddini and Gholipour, 2020). Based on the real option theory developed in Bernanke (1983), Pindyck (1991), and Dixit and Pindyck (1994), the real option view suggests that greater uncertainty negatively affects firms' willingness to spend on innovation. Investments in innovation are risky and irreversible because innovation usually involves substantial sunk R&D costs. In addition, returns on investments in innovation are usually spread over many years, and it often takes firms a long time to recover spending. As a result, firms prefer to wait and see instead of making a costly and irreversible decision regarding innovation that may have unexpected consequences during periods of high uncertainty (Gentry and Hubbard, 2000; Clarke, 2001; Hall, 2002).

However, according to the game theory view, firms may find that they will miss the opportunity to seize the market if they choose to wait and see, leading to losses that may be higher than the value of waiting. In other words, the value of waiting to undertake innovation activities is influenced by competitors' behavior. If delays in innovation investment because of uncertainty generate competitive advantages for competitors, firms will undertake innovation activities immediately to secure market share because the option to delay becomes not valuable if the delay is extremely costly (Bloom, 2014; Van Vo and Le, 2017; He et al., 2020; Tajaddini and Gholipour, 2020).

He et al. (2020) focus on the role of policy uncertainty in the ownership–innovation nexus in China and find that EPU is positively associated with corporate innovation in general. Moreover, EPU has a strong positive influence on SOEs and firms with fewer financial constraints. In contrast, Jiang et al. (2020) find that a more stable local policy environment is associated with more patent filings of listed firms. Moreover, the increased patent filings are primarily driven by SOEs and firms with lower financial constraints. In a paper closely related to this issue, Cumming et al. (2016) find that the adverse impact of political uncertainty on innovation is more profound when a firm has fewer political connections. They also find that political connections increase the probability that a firm has access to direct governmental support for innovation investments.

As analyzed in Section 2.1, both central and local SOEs are responsible for operating to accomplish social and political goals under government intervention. One key aspect of these goals is to stabilize the economy when it faces greater uncertainty. For example, as indicated in EBRD (2020), SOEs act as automatic stabilizers, providing more stable employment during the ongoing pandemic. That said, as national policy instruments, central SOEs are expected to play a more important role in this regard than are local SOEs, which are supposed to be more market-driven, such as are private firms. Private firms that face fierce competition from SOEs are more likely to support the game theory view by engaging in more innovation activities that are less risky during periods of higher economic policy uncertainty to keep their market shares to a certain extent. Their differences in terms of motivation for innovation and risk tolerance levels remain valid. Considering the differences between local SOEs and private firms in terms of motivation for innovation and risk tolerance levels, we propose the following three hypotheses.

Hypothesis 3a. Central SOEs demonstrate the best innovation performance as measured by both patent quantity and quality during periods of higher EPU.

Hypothesis 3b. Private firms outperform local SOEs in terms of patent quantity during periods of higher EPU.

Hypothesis 3c. Local SOEs outperform private firms in terms of patent quality during periods of higher EPU.

The last movement of this symphony is corruption. It is well documented in the literature that corruption has a detrimental effect on corporate innovation (Waldemar, 2012; Habiyaremye and Raymond, 2013; Paunov, 2016; Xu and Yano, 2017, among others). There are two views regarding this relationship. The expropriation view argues that the probability is higher that firms' revenue generated from innovation will be expropriated by corrupt bureaucrats when corruption is prevailing because various corrupting officials and authorities may be involved in firms' innovation process, increasing transaction costs and the uncertainty levels related to innovation activities. Hence, firms' motivation and capabilities for innovation are hampered. For example, the costs of government services, such as licenses, could be higher (Murphy et al., 1993; Paunov, 2016). In addition, it is quite difficult for firms to take actions on their own to guard against corruption because corruption is ex post opportunistic. By making corruption payments, the bribing firms are controlled by corrupting officials who may not perform the agreed service because they lack fears of countermeasures from the bribing firms. Therefore, such ex post risk related to corruption is formidable, which significantly aggravates the inherent risk of innovation activities (Luo, 2005; Xu and Yano, 2017).

On the other hand, the rent-seeking view suggests that firms with potential innovative capabilities are incentivized to choose rent seeking by building good relations with bureaucrats over innovation when the relative payoff of corruption is high. Hence, stronger anticorruption measures may increase the cost of corruption, resulting in less rent seeking and more innovation (Baumol, 1996; Murphy et al., 1991). This is exactly the case for Chinese SOEs that have no fear of government expropriation, such as prior to the massive anticorruption campaign launched in late 2012, when corruption could generate higher revenue at a lower cost (Bellettini et al., 2013; Kim, 2018; Xu and Yano, 2017).

As discussed in Section 2.1, central SOEs in China are concentrated on strategically important industries with very limited competition, whereas local SOEs face more competition from private firms. Such a monopolistic structure makes central SOEs more vulnerable to corrupt rent seeking than their local peers. In addition, although the heads of both central and local SOEs are not only corporate executives but also government officials, the heads of central SOEs usually enjoy a higher administrative rank than their local peers. Some have the equivalent of a vice-ministerial ranking, implying that central SOEs impose greater capabilities to engage in corruption activities (Brødsgaard, 2012; Chen, 2015; Leutert, 2018). Expropriation is a more serious concern for private firms. Private firms benefit from the strong anticorruption efforts in China (Xu and Yano, 2017; Gan and Xu, 2019). Again, we take into account the differences between local SOEs and private firms in terms of motivation for innovation and risk tolerance levels and propose the following three hypotheses.

Hypothesis 4a. Central SOEs demonstrate the best innovation performance as measured by both patent quantity and quality when less corruption is present.

Hypothesis 4b. Private firms outperform local SOEs in terms of patent quantity when less corruption is present.

Hypothesis 4c. Local SOEs outperform private firms in terms of patent quality when less corruption is present.

3. Methodology and data

3.1. Methodology

Using a sample of Chinese listed firms from 2007 to 2015, we first estimate the impacts of diversity in state capitalism on corporate innovation performance. Our model has the following general form:

$$Innovation_{i,t} = \alpha_0 + \alpha_1 UCS_{i,t} + \sum_{k=1}^{5} \alpha_k C_{i,t} + \varepsilon_{i,t} \tag{1}$$

where *innovation* is a proxy for a firm's innovation performance; *UCS* indicates a firm's ultimate controlling shareholders; *C* denotes the control variables; and the subscripts *i* and *t* represent the firm and time, respectively.

Then, we explore the moderating effect of ESG, EPU, and corruption on the ownership–innovation nexus. The model has the following general form:

$$Innovation_{i,t} = \alpha_0 + \alpha_1 UCS_{i,t} + \beta_1 Moderator_{i,t} + \gamma_1 UCS_{i,t}{*}Moderator_{i,t} + \sum_{k=1}^{5} \alpha_k C_{i,t} + \varepsilon_{i,t} \tag{2}$$

where *innovation* is a proxy for a firm's innovation performance; *UCS* indicates a firm's ultimate controlling shareholders; *Moderator* indicates the proposed moderators of the ownership–innovation nexus; *C* denotes the control variables; and the subscripts *i* and *t* represent the firm and time, respectively.

3.1.1. Innovation

We consider two dimensions of innovation performance. One is patent quantity (*PATENT*), which is measured as the number of patents granted to a company. The other is patent quality *(CITATION)*, which is a proxy of the number of future citations received by patents granted to a company. The latter is included to address the concern that firms may produce more patents at the expense of quality. Both indicators have been widely used in the innovation literature to capture innovation capacity (Griliches, 1990; Lerner and Wulf, 2007; Fan et al., 2017; Tan et al., 2020, among others). A possible drawback of patent data is that patents do not necessarily represent a commercially exploited innovation. However, as indicated by Choi et al. (2011), because patent data are collected via a uniform and rigorous process of examination and registration across firms, periods, and types of technology, they constitute the most detailed and systematically compiled and managed data on innovation in China. Moreover, following Choi et al. (2011), we apply the initial year (t) to three-year ($t + 3$) lags to both *PATENT* and *CITATION* to capture the lead-lag effect of explanatory variables. A variable for the total number of patents during the 4 years of interest is also generated to conduct a robust interpretation of the results. The same measures are also applied to the number of citations.

3.1.2. Ultimate controlling shareholder

The finance literature describes two types of agency problems: Type I agency problems for conflicts between owners and managers (Jensen and Meckling, 1976) and Type II agency problems for conflicts between controlling and minority shareholders (Dharwadkar et al., 2000). Type I agency problems prevail in developed economies because ownership and control are often separated and legal mechanisms protect owners' interests. However, in developing economies, Type II agency problems represent a more serious issue because of the prevalence of concentrated ownership and the absence of effective external governance mechanisms

(Young et al., 2008). In such cases, the controlling shareholder typically has power significantly in excess of its cash flow rights, causing the agent to latch onto controlling shareholders and ignore or even expropriate minority shareholders' interests (La Porta et al., 2000; Yao et al., 2010).[8]

As a developing economy, China encounters this exact type of agency problem. Compared with Western companies, Chinese firms face more severe Type II agency problems because of controlling shareholders' significant stock ownership and control over firms' boards of directors (Johnson et al., 2000; Jiang et al., 2010; Li and Zhang, 2010) as well as investors' poor legal protection and underdeveloped capital markets (Allen et al., 2005). In particular, Type II agency problems lie between the ultimate controlling shareholder and the minority shareholders because, in China, the divergence between the controlling owners' cash flow rights and voting rights is mostly maintained through pyramid structures (Liu and Sun, 2005; Gugler et al., 2008; Fan et al., 2011; Claessens and Yurtoglu, 2013). As detailed in La Porta et al. (1999) and Paligorova and Xu (2012), the pyramid structure is applied by the ultimate controlling shareholders to create a set of control chains within which a listed firm may be controlled by another firm whose controlling shares in turn lie in the hands of the ultimate controlling shareholders either directly or through several such similar chains. Liu and Sun (2005) highlight the importance of tracing the ultimate shareholding structure when studying corporate governance in China and argue that direct ownership data from listed Chinese firms may not be adequate to trace the real controlling shareholder.[9] Therefore, it is crucial to adopt the concept of ultimate controlling ownership rather than direct ownership when investigating the ownership–innovation nexus in China.

Following La Porta et al. (1999), we define ultimate controlling shareholders as the ultimate owner with the most control rights. Specifically, we calculate the ultimate controlling ownership for each listed firm and keep those who hold no less than 20% voting rights in our sample only. In other words, a firm has an ultimate controlling shareholder if this shareholder's direct and indirect voting rights in the firm exceed 20%. The rationale for using 20% voting rights as the cut-off point is that this is usually enough to have effective control of a firm (La Porta et al., 1999).[10] This approach allows us to classify a firm's ownership type based on the real identity of the owner with the largest ownership control in the firm. Based on this approach, we divide the ultimate controlling ownership into three types: central government, local government, and private ownership. We use dummy variables to distinguish the effects of these three types of ultimate controlling ownerships. A company controlled by the central government dummy (*DCENTRAL*) takes the value of one if the firm's ultimate controlling owner is the central government (i.e., ultimately controlled by the SASAC-SC and the MF) and zero otherwise. A company controlled by the local government dummy (*DLOCAL*) takes the value of one if the firm's ultimate controlling owner is a local government (i.e., ultimately controlled by the SASAC-LG and the ULGs) and zero otherwise. A company controlled by the private investor dummy (*DPRIVATE*) takes the value of one if the firm's ultimate controlling owner is a private investor and zero otherwise.

3.1.3. ESG, economic policy uncertainty, and corruption

As discussed in Section 2.2, we conjecture that firm ESG activities, economic policy uncertainty, and corruption are the underlying mechanisms through which the varieties in state capitalism affect corporate innovation. Firm ESG engagement (*ESG*) is measured by the ESG index developed by Sino-Securities Index Information Service (Shanghai) Co. Ltd. for all listed firms in China. *ESG* ranges between one and nine, with a higher score indicating a higher level of ESG engagement. Following Phan et al. (2021), *EPU* is measured by the Economic Policy Uncertainty Index constructed by Baker et al. (2016). A higher *EPU* score indicates a higher level of policy-related economic uncertainty. *LNEPU* is the logarithm of *EPU*. Following Chen et al. (2015), we use Transparency International's Corruption Perceptions Index (*CPI*) developed by Lambsdorff (2008) to quantify corruption. *CPI* indicates the perceived level of prevailing corruption on a scale of 0–10, with a higher score suggesting higher economic and political integrity.

3.1.4. Control variables

Following previous studies (Choi et al., 2011; Chen et al., 2014; Custódio and Metzger, 2014, among others), five control variables are included in the model. A firm's R&D effort (*RDTA*) is measured by the ratio of R&D expenditures to total assets. Profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of the book value of total assets. Time trend (*TREND*) is included to assess whether the movement of the dependent variable exhibits a significant trend during the sample period.[11] We also include dummy variables for industry to control unobservable fixed effects (or time-invariant effects) concerning issues such as regulation. Table 1 presents the variable definitions.

[8] Expropriation can be accomplished by (1) placing less-than-qualified family members, friends, and cronies in key positions (Faccio et al., 2001); (2) purchasing supplies and materials at above-market prices or selling products and services at below-market prices to organizations owned by or associated with controlling shareholders (Chang and Hong, 2000; Khanna and Rivkin, 2001); and (3) engaging in strategies, such as excessive diversification, that advance personal, family, or political agendas at the expense of firm performance (Backman, 1999).

[9] Please refer to Appendix A for further details on ultimate controlling ownership.

[10] Ultimate controlling shareholders are also labeled the largest ultimate owners. According to the Notice of the China Securities Regulatory Commission on Promulgating the Standards Concerning the Contents and Formats of Information Disclosure by Companies Offering Securities to the Public No. 1—Prospects (Revised 2006), all listed firms in China should provide information on their ultimate controlling shareholders.

[11] The time trend variable could also capture trends in omitted variables.

Table 1
Variable definitions.

Variable	Definition
PATENT	Firm patents, measured by the number of patents granted to a company
LNPATENT	The logarithm of one plus the number of patents granted to a company
CITATION	The number of future citations received by the patents granted to a company
LNCITATION	The logarithm of one plus the number of future citations received by the patents granted to a company
DCENTRAL	A dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise
DLOCAL	A dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise
DPRIVATE	A dummy variable that takes a value of one if a company is ultimately controlled by a private entity and zero otherwise
RDTA	The ratio of R&D expenditures to total assets
SIZE	Firm size, measured by the logarithm of operating income
LEVERAGE	Firm leverage, measured as the ratio of total liabilities to total assets
ROA	Return on assets
TREND	Time trend
ESG	Firm ESG engagement, measured by the ESG index developed by Sino-Securities Index Information Service (Shanghai) Co. Ltd. for all listed firms in China. *ESG* ranges between one and nine, with a higher score indicating a higher level of ESG engagement
EPU	Economic policy uncertainty, measured by the Economic Policy Uncertainty Index constructed by Baker et al. (2016). A higher *EPU* score indicates a higher level of policy-related economic uncertainty
LNEPU	The logarithm of *EPU*
CPI	The Transparency International's Corruption Perceptions Index, developed by Lambsdorff (2008) to measure corruption. *CPI* indicates the perceived level of prevailing corruption on a scale of 0–10, with a higher score suggesting a higher economic and political integrity

3.2. Data

The sample data initially focus on all companies (A shares) listed on the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) for the 2007–2015 period. We then exclude the following listed firms from the sample: (1) Special Treatment (ST) and Particular Transfer (PT) companies; (2) financial companies (e.g., banks, insurance companies, and securities companies) because they are heavily regulated and their return-generating processes differ from those of other companies; (3) companies with the ultimate controlling shareholder holding less than 20% voting rights; and (4) companies with missing values. The ultimate controlling shareholder, R&D expenditures, and financial statement data are collected from the CSMAR database and are supplemented with various annual financial reports from individual companies. Patent registration data are collected from the State Intellectual Property Office of China (SIPO).[12] Patent citation data are obtained from the Chinese Research Data Services Platform. *ESG* data are collected from the Sino-Securities Index Information Service (Shanghai) Co. Ltd. *EPU* data are obtained from Baker et al. (2016). *CPI* data are obtained from the official website of Transparency International (TI).

The final sample consists of 2629 listed firms with 15,436 firm-year observations, representing 92.6% of the listed firms in China. Table 2 provides descriptive statistics for our sample. Panel A shows that the average number of total patents owned by a listed firm (*PATENT*) in China is approximately 33, which is much higher than the average (6) reported for Chinese listed firms in 2001 by Choi et al. (2011). This finding is also consistent with the average number of patents presented by Boeing et al. (2016) for Chinese listed firms: approximately 6 for the 2001–2006 period and 32 for the 2007–2011 period. The average number of citations received by a firm (*CITATION*) is approximately 29. The average ratio of R&D expenditures to total assets (*RDTA*) is 1.282%, which is much lower than the average *RDTA* (3.4%) for S&P 1500 firms for the 1993–2007 period as reported by Custódio and Metzger (2014). These results echo the findings of Fu (2015); i.e., the R&D intensity (measured as the ratio of R&D spending to GDP) in China remains low compared with that in OECD countries, although it has remarkably increased. Among the sample firms, approximately 15% are ultimately controlled by the central government, 30% are controlled by local governments, and the remaining 55% are controlled by nonstate firms. The average *ESG, EPU,* and *CPI* indices are approximately 6.517, 151.666, and 3.691, respectively.[13]

Panel B presents the average number of patents (*PATENT*) and citations (*CITATION*) for listed firms with different types of ultimate controlling shareholders. Specifically, the average number of patents (*PATENT*) for central SOEs is approximately 69 per year, whereas the average number of patents for local SOEs is only 21 per year. The average number of patents for private firms is 30 per year, which is slightly higher than that for local SOEs but much lower than that for central SOEs. The same pattern is observed for *CITATION*. The results of the mean-difference *t*-test demonstrate that central SOEs take the leading role in innovation creation, followed by private firms and then local SOEs.

4. Empirical results

4.1. Main results

Since the dependent variable is left-censored at 0, the Tobit model for the panel data is employed to estimate Eq. (1) (Tobin, 1958),

[12] We manually collect patent data from the SIPO. First, we search the SIPO website using the full name of the listed firm as obtained from the CSMAR database. Second, we set the time frame and then obtain the number of patents granted to the firm during that time frame.

[13] The correlation matrix is presented in Appendix B.

Table 2
Descriptive statistics.

Panel A: Summary statistics					
	Obs.	Mean	Std. Dev.	Minimum	Maximum
PATENT	15,436	32.7961	229.3577	0	8918
LNPATENT	15,436	1.6608	1.6716	0	9.0959
CITATION	15,436	28.5203	298.2519	0	13,854
LNCITATION	15,436	1.4465	1.5483	0	9.5364
DCENTRAL	15,436	0.1500	0.3571	0	1
DLOCAL	15,436	0.3025	0.4593	0	1
DPRIVATE	15,436	0.5475	0.4978	0	1
RDTA (%)	15,436	1.2824	1.8181	0	40.9575
SIZE	15,436	20.8112	1.6990	12.4142	28.5236
LERVERAGE	15,436	0.4366	0.2176	0.0071	1.8973
ROA	15,436	0.0431	0.0649	−1.9877	2.1635
TREND	15,436	5.6421	2.4807	1.0000	9
ESG	15,436	6.5173	0.9678	1.0000	9
EPU	15,436	151.6655	48.4188	82.2452	244.3983
LNEPU	15,436	4.9715	0.3168	4.4097	5.4988
CPI	15,436	3.6906	0.1677	3.5000	4

Panel B: Comparison			
	Central	LOCAL	PRIVATE
PATENT	68.8320	20.5693	29.6754
CITATION	67.6092	13.2806	26.2276

Mean-difference t-test	CENTRAL vs. LOCAL	CENTRAL vs. PRIVATE	LOCAL vs. PRIVATE
PATENT	48.2628***	39.1566***	−9.1061**
CITATION	54.3286***	41.3817***	−12.9470**

Notes: Firm patents (*PATENT*) are measured by the number of patents granted to a company. *LNPATENT* is the logarithm of one plus the number of patents granted to a company. *CITATION* is the number of future citations received by the patents granted to a company. *LNCITATION* is the logarithm of one plus the number of future citations received by the patents granted to a company. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *DPRIVATE* is a dummy variable that takes a value of one if a company is ultimately controlled by a private entity and zero otherwise. *RDTA* is measured by the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. Firm ESG engagement (*ESG*) is measured by the ESG index developed by Sino-Securities Index Information Service (Shanghai) Co. Ltd. for all listed firms in China. *ESG* ranges between one and nine, with a higher score indicating a higher level of ESG engagement. Following Phan et al. (2021), economic policy uncertainty (*EPU*) is measured by the Economic Policy Uncertainty Index constructed by Baker et al. (2016). A higher *EPU* score indicates a higher level of policy-related economic uncertainty. *LNEPU* is the logarithm of *EPU*. Following Chen et al. (2015), a country's corruption index (*CI*) is measured by the Transparency International's Corruption Perception Index (Lambsdorff, 2008). *CI* indicates the perceived level of prevailing corruption on a scale of 0–10, with a higher score suggesting a higher economic and political integrity. Panel B presents t-values from the *t*-test of differences in means. *CENTRAL, LOCAL,* and *PRIVATE* refer to companies that are ultimately controlled by the central and local governments and private entities, respectively. ***, ** and * indicate statistically different from 0 in the *t*-test for means at the 1%, 5%, and 10% levels, respectively.

and the results are reported in Table 3. This table contains 10 specifications: (1)–(5) for models in which *LNPATENT* is the patent quantity measurement and (6)–(10) for models with *LNCITATION* as the patent quality indicator. Focusing on central SOEs, the estimated coefficients for *DCENTRAL* reported in Specifications (1) and (6) of Panel A are significantly positive. The results of the mean-difference *t*-tests presented in Specifications (1) and (6) of Panel B are also significant and positive. The finding suggests that central SOEs are significantly associated with the best innovation performance in terms of both patent quantity and quality, lending support to *Hypothesis 1a*. The results are consistent with Cao et al. (2020), who report that SOEs are more innovatively efficient than non-SOEs, and central SOEs are more innovatively efficient than local SOEs in China. Moreover, the finding is in favor of China's "national champions" strategy and partially explains why the Chinese central SOEs can climb "the world's league tables in every industry from oil to banking" (The Economist, 2011).

Comparing local SOEs with private firms, the estimated coefficients for *DLOCAL* reported in Specifications (1) and (6) of Panel A are significantly negative and positive, respectively. The results suggest that local SOEs are associated with lower patent quantity but higher patent quality relative to private peers. The result supports *Hypotheses 1b* and *1c*, which conjecture that local SOEs underperform private firms in terms of patent quantity but outperform private firms with respect to patent quality. The finding is consistent with that of the extant studies that show that SOEs invest more in basic areas of research in which innovative outcomes emerge only in the long-term, whereas private firms invest more in applied research in their quest for short-term financial returns (Stiglitz, 1999; Salter and Martin, 2001). This finding confirms that a high risk tolerance level is a key factor in fostering exploratory innovation. Local SOEs, even assigned with multiple competing tasks, can still play a significant albeit moderate role in stimulating indigenous

Table 3
Varieties in state capitalism and corporate innovation.

	Patent quantity					Patent quality				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel A: Main results										
DCENTRAL	0.1321**	0.2606***	0.3170***	0.4401***	0.1230	0.5682***	0.5610***	0.5855***	0.5243***	0.4555***
	(0.0596)	(0.0675)	(0.0733)	(0.0796)	(0.0846)	(0.0523)	(0.0583)	(0.0634)	(0.0680)	(0.0747)
DLOCAL	−0.1907***	−0.1741***	−0.1543***	−0.0426	−0.3134***	0.0863**	0.0669	0.0972*	0.0539	0.0873
	(0.0481)	(0.0543)	(0.0589)	(0.0636)	(0.0663)	(0.0421)	(0.0467)	(0.0507)	(0.0536)	(0.0582)
RDTA	0.1016***	0.0870***	0.0688***	0.0390***	0.0447***	0.1023***	0.0992***	0.0773***	0.0514***	0.0590***
	(0.0064)	(0.0071)	(0.0080)	(0.0091)	(0.0068)	(0.0051)	(0.0054)	(0.0057)	(0.0059)	(0.0056)
SIZE	0.0316***	−0.0070	−0.0111	−0.0241***	0.0069	0.0365***	0.0189***	0.0003	0.0093*	0.0038
	(0.0068)	(0.0072)	(0.0075)	(0.0082)	(0.0060)	(0.0054)	(0.0055)	(0.0053)	(0.0053)	(0.0049)
LEVERAGE	0.1173*	0.0536	−0.0077	−0.1353	−0.0391	0.3292***	0.2697***	0.1197*	0.0558	−0.0135
	(0.0708)	(0.0830)	(0.0940)	(0.1071)	(0.0951)	(0.0574)	(0.0654)	(0.0719)	(0.0785)	(0.0797)
ROA	−0.1545	0.3161*	0.8746***	0.8741***	0.5998***	0.1082	0.2519**	0.3205**	0.4137**	0.3794**
	(0.1410)	(0.1672)	(0.1889)	(0.2319)	(0.2169)	(0.1113)	(0.1265)	(0.1368)	(0.1659)	(0.1815)
TREND	0.0965***	0.0880***	0.0684***	0.0426***	0.1797***	0.2289***	0.2316***	0.2233***	0.1983***	0.3125***
	(0.0033)	(0.0040)	(0.0050)	(0.0065)	(0.0049)	(0.0026)	(0.0030)	(0.0035)	(0.0042)	(0.0040)
Constant	0.0346	1.0558***	1.2340***	1.5067***	1.5974***	−0.9900***	−0.4850***	0.1579	0.1867	0.6066***
	(0.1611)	(0.1735)	(0.1855)	(0.2074)	(0.1638)	(0.1291)	(0.1331)	(0.1352)	(0.1394)	(0.1359)
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	2289.36***	1357.60***	851.68***	632.33***	2139.89***	11,972.34***	8843.74***	5723.81***	3187.36***	8021.53***
Obs.	15,436	12,738	10,502	8421	8133	15,436	12,738	10,502	8421	8133
Panel B: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL vs. *DLOCAL*	30.11***	43.43***	43.68***	38.85***	33.37***	91.98***	80.28***	69.01***	57.87***	32.27***

Notes: This table shows the relationship between ultimate controlling ownership and innovation performance estimated using Tobit regression for panel data. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

innovation, favoring the tournament-like regional competition mechanism introduced by the central government in China. In contrast, the finding witnesses that private firms make significant efforts to enhance their competitive advantages by undertaking more less-risky innovation activities. The estimated coefficients reported in Specifications (2)–(5) and (7)–(10) are similar to those reported in Specifications (1) and (6), respectively, suggesting that this finding is robust after controlling for the lead–lag effect of the explanatory variables.

4.2. Endogeneity

A potential concern about these results is endogeneity. To address this critical issue, we employ two common approaches. One is the treatment effect model, and the other is propensity score matching (PSM).[14] As Lazzarini and Musacchio (2018) indicated, governments do not choose their ownership stakes at random. The firm controlled by the central or local government may be self-selected. To address the self-section bias problem, we use the treatment effect model with the Heckman (1979) two-stage approach. The first step of this model is a binary outcome equation estimated from a probit regression (see Eqs. 3, 4, and 5) on the probability of a firm being a central SOE in Specifications (1), (2), (4), and (5) and a local SOE in Specifications (3) and (6) in Table 4. Following Cao et al. (2020), we use product market competition (Herfindahl Index) and the proportion of SOEs in the local province (Provincial SOE Environment) as instrument variables, which appears to be important to the government in innovation activities. The Hausman test is used to validate potential over-identification issues. The central/local SOEs dummies are regressed against the same controls used in the second step, and two instrument variables distinguish whether or not a firm is a central/local SOE.

Central vs. Local

$$Central\ SOE = \begin{cases} 1\ if\ Central\ SOE^* > 0 \\ 0\ if\ Central\ SOE^* \leq 0 \end{cases}, Central\ SOE^* = \pi + \delta Z + \rho Controls + \mu \tag{3}$$

Central vs. Private

$$Central\ SOE = \begin{cases} 1\ if\ Central\ SOE^* > 0 \\ 0\ if\ Central\ SOE^* \leq 0 \end{cases}, Central\ SOE^* = \pi + \delta Z + \rho Controls + \mu \tag{4}$$

Local vs. Private

$$Local\ SOE = \begin{cases} 1\ if\ Local\ SOE^* > 0 \\ 0\ if\ Local\ SOE^* \leq 0 \end{cases}, Local\ SOE^* = \pi + \delta Z + \rho Controls + \mu \tag{5}$$

where Z is a set of instrument variables that could affect a firm's central state ownership in Eqs. (3) and (4) and local state ownership in Eq. (5). We choose two instrument variables: product market competition (Herfindahl Index) and the proportion of local SOEs in the local province (Provincial SOE Environment). Controls represent the control variables—the same controls used for the second step—including profitability (*ROA*), firm leverage (*LEVERAGE*), firm size (*SIZE*), time trend (*TREND*), and industry dummies.

In the second step, the inverse Mills ratio is included as the self-selection correction parameter. The results are presented in Panel A of Table 4. Unsurprisingly, the estimated coefficients for *DCENTRAL* are significant and positive in Specifications (1), (2), (4), and (5), providing strong evidence for *Hypothesis 1a*. The estimated coefficients for *DLOCAL* are significantly negative in Specification (3) and significantly positive in Specification (6), suggesting that local SOEs underperform private firms with respect to patent quantity but outperform private firms in terms of patent quality, offering full support of *Hypotheses 1b* and *1c*.

Furthermore, we use the PSM approach to alleviate the potential bias derived from the different characteristics among central SOEs, local SOEs, and private firms. This approach allows us to pair private firms with the most likely central and local SOEs with similar observed characteristics by selecting all control variables on the right-hand side from the main regression. Then, we select the matched central and local SOEs with the nearest propensity score (Abadie and Imbens, 2011). Common distribution requirements are also considered. We remove any central/local SOEs with a propensity score higher than the maximum level for private firms and delete private firms with a propensity score lower than the minimum level for central/local SOEs. We use all of the control variables in the main regression as covariates in the probit regression to compute the propensity score. We adopt the same approach to pair central SOEs with mostly likely local SOEs with similar observed attributes. The results estimated using a Tobit regression and PSM are reported in Table 5. The estimated coefficients for *DCENTRAL* in all specifications in both Panels A and B are significant and positive, confirming *Hypothesis 1a*. In Panel C, the estimated coefficients for *DLOCAL* reported in Specifications (1) and (6) of Panel A remain significantly negative and positive, respectively. The results are in line with the main results previously presented, supporting *Hypotheses 1b* and *1c*. The estimated coefficients reported in Specifications (2)–(5) and (7)–(10) are significantly negative and nonsignificant, respectively, suggesting that the finding shown in Specification (1) is robust after controlling for the lead-lag effect of the explanatory variables.

[14] We are very grateful for the two anonymous reviewers for making very constructive suggestions on how to address this critical issue.

Table 4
Varieties in state capitalism and corporate innovation – treatment effect model.

	Patent quantity			Patent quality		
	Dep. Var.: $LNPATENT_{t\sim t+3}$			*Dep. Var.: $LNCITATION_{t\sim t+3}$*		
	(1)	(2)	(3)	(4)	(5)	(6)
	CENTRAL vs. LOCAL	CENTRAL vs. PRIVATE	LOCAL vs. PRIVATE	CENTRAL vs. LOCAL	CENTRAL vs. PRIVATE	LOCAL vs. PRIVATE
Panel A: Second-stage regressions						
DCENTRAL	0.5433***	0.4663***		0.6291***	0.6765***	
	(0.0610)	(0.0626)		(0.0588)	(0.0603)	
DLOCAL			−0.1597***			0.0985**
			(0.0462)			(0.0445)
RDTA	0.2616***	0.2424***	0.2180***	0.2473***	0.2536***	0.1975***
	(0.0208)	(0.0145)	(0.0146)	(0.0201)	(0.0140)	(0.0140)
SIZE	0.3157***	0.3329***	0.2713***	0.2962***	0.2784***	0.2843***
	(0.0166)	(0.0185)	(0.0167)	(0.0160)	(0.0178)	(0.0160)
LEVERAGE	0.3454**	−0.2246	−0.0464	0.2695*	0.0932	0.6872***
	(0.1640)	(0.1403)	(0.1283)	(0.1581)	(0.1350)	(0.1233)
ROA	1.0882**	−0.7607*	0.2154	−0.1790	0.2802	−0.0747
	(0.4920)	(0.4033)	(0.3211)	(0.4743)	(0.3880)	(0.3087)
IMR	0.1413*	0.4519***	0.3356***	−0.1490*	−0.0150	0.5281***
	(0.0836)	(0.0661)	(0.0767)	(0.0805)	(0.0636)	(0.0737)
TREND	0.2122***	0.1256***	0.1418***	0.3092***	0.2812***	0.2405***
	(0.0156)	(0.0151)	(0.0125)	(0.0151)	(0.0146)	(0.0120)
Constant	−8.1072***	−9.0774***	−7.0450***	−6.1861***	−5.7277***	−8.9401***
	(0.7337)	(0.8438)	(0.8232)	(0.7073)	(0.8119)	(0.7914)
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Obs.	3967	5419	6880	3967	5419	6880

Panel B: First stage probit model						
Dep Var.:	(1)	(2)	(3)	(4)	(5)	(6)
	DCENTRAL	*DCENTRAL*	*DLOCAL*	*DCENTRAL*	*DCENTRAL*	*DLOCAL*
Province SOE structure	4.4742***	4.6466***	2.9660***	4.4742***	4.6466***	2.9660***
	(0.1660)	(0.1475)	(0.1042)	(0.1660)	(0.1475)	(0.1042)
Herfindahl Index	0.9236***	0.2427	−0.0713	0.9236***	0.2427	−0.0713
	(0.2010)	(0.2414)	(0.2185)	(0.2010)	(0.2414)	(0.2185)
Constant	−8.0350	−11.0667	−10.0472	−8.0350	−11.0667	−10.0472
	(87.0984)	(150.3495)	(147.6662)	(87.0984)	(150.3495)	(147.6662)
Controls	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Obs.	6985	10,767	13,120	6985	10,767	13,120

Notes: This table shows the relationship between ultimate controlling ownership and innovation performance estimated using the treatment effect model. In the first stage, *DCENTRAL* is used as a dependent variable in the probit regression for instrument variables of institutional environments associated with the likelihood of a firm to be ultimately controlled by the central government in models (1) and (2). Similarly, *DLOCAL* is used as a dependent variable in the probit regression for instrument variables of institutional environments associated with the likelihood of a firm to be ultimately controlled by the local government in model (3). In the second stage, an inverse Mills ratio from the first stage is included and $LNPATENT_{t\sim t+3}$ is used as dependent variable. $LNPATNET_{t\sim t+3}$ is the logarithm of one plus the number of patents granted to a company for 4 years from t to $t + 3$. Same procedures are followed for columns (4)–(6). $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t + 3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. Province SOE structure in models (1), (2), (4), and (5) is measured by the percentage of central SOEs in each province. Province SOE structure in models (3) and (6) is measured by the percentage of local SOEs in each province. Herfindahl Index is measured by Herfindahl Index of 2-digit Level-2 industry code, provided by the China Security Index Corporation (CSIC) for each firm measured at the end of fiscal year t based on sales. Controls is control variables, the same controls used for the second step, including profitability (ROA), firm leverage (LEVERAGE), firm size (SIZE), and time trend (TREND).We also control for industry fixed effects. *CENTRAL, LOCAL,* and *PRIVATE* refer to companies that are ultimately controlled by the central and local governments and private entities, respectively. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

4.3. Heterogeneous impacts across industries and regions

4.3.1. Manufacturing vs. nonmanufacturing industries

One concern about our results is that significant industry effects might exist because of regulation and risk. To address this issue, we follow Chen et al. (2009) and divide the full sample into two subsamples representing manufacturing and nonmanufacturing

Table 5
Varieties in state capitalism and corporate innovation – Tobit (PSM).

	Patent quantity					Patent quality				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel A: CENTRAL vs. LOCAL										
DCENTRAL	0.2589***	0.2916***	0.3487***	0.3554***	0.4641***	0.3515***	0.3467***	0.3839***	0.3856***	0.4429***
	(0.0465)	(0.0519)	(0.0570)	(0.0648)	(0.0728)	(0.0406)	(0.0453)	(0.0513)	(0.0588)	(0.0678)
RDTA	0.3179***	0.3049***	0.2725***	0.2703***	0.3289***	0.2257***	0.2248***	0.2223***	0.2415***	0.2701***
	(0.0230)	(0.0264)	(0.0284)	(0.0308)	(0.0344)	(0.0227)	(0.0261)	(0.0289)	(0.0321)	(0.0369)
SIZE	0.4189***	0.4464***	0.4563***	0.4700***	0.5609***	0.3971***	0.4098***	0.4149***	0.4398***	0.4871***
	(0.0217)	(0.0237)	(0.0257)	(0.0291)	(0.0309)	(0.0182)	(0.0203)	(0.0229)	(0.0264)	(0.0302)
LEVERAGE	−0.4424***	−0.5442***	−0.5615***	−0.2064	−0.3616	−0.3615***	−0.3468**	−0.2911*	−0.2335	−0.2894
	(0.1500)	(0.1671)	(0.1780)	(0.2057)	(0.2373)	(0.1277)	(0.1458)	(0.1694)	(0.1973)	(0.2342)
ROA	−1.0905***	−1.3320***	−0.4027	−0.2955	−1.3602	−0.9444**	−1.2912***	−0.7843	−1.2313*	−3.4416***
	(0.4105)	(0.4668)	(0.4239)	(0.5476)	(0.8462)	(0.3940)	(0.4535)	(0.5542)	(0.7445)	(0.9022)
Constant	−8.2759***	−8.7009***	−8.9844***	−9.5697***	−10.3549***	−7.0147***	−7.5185***	−8.0863***	−8.5482***	−8.8770***
	(0.4528)	(0.4973)	(0.5485)	(0.6141)	(0.6615)	(0.4000)	(0.4498)	(0.5150)	(0.5859)	(0.6503)
Year F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Province F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
F Statistics	116.79***	63.06***	56.37***	94.96***	83.73***	387.56***	57.56***	49.68***	54.26***	119.07***
Obs.	3300	2767	2364	1971	1879	3300	2767	2364	1971	1879
Panel B: CENTRAL vs. PRIVATE										
DCENTRAL	0.0869*	0.1573***	0.1333**	0.1833**	0.1209	0.3468***	0.3520***	0.3250***	0.2991***	0.3926***
	(0.0517)	(0.0575)	(0.0634)	(0.0720)	(0.0820)	(0.0464)	(0.0523)	(0.0593)	(0.0681)	(0.0781)
RDTA	0.2894***	0.3159***	0.3150***	0.3060***	0.3473***	0.2769***	0.3118***	0.3009***	0.2814***	0.3153***
	(0.0342)	(0.0274)	(0.0318)	(0.0346)	(0.0397)	(0.0305)	(0.0262)	(0.0299)	(0.0369)	(0.0418)
SIZE	0.3537***	0.3768***	0.3779***	0.4120***	0.4649***	0.3710***	0.3756***	0.3688***	0.4121***	0.4572***
	(0.0284)	(0.0315)	(0.0340)	(0.0384)	(0.0421)	(0.0260)	(0.0291)	(0.0328)	(0.0372)	(0.0413)
LEVERAGE	−0.3496**	−0.3124*	−0.2914	−0.8826***	−0.8761***	−0.0077	0.2264	0.2033	0.0048	0.0760
	(0.1633)	(0.1833)	(0.1976)	(0.2274)	(0.2748)	(0.1416)	(0.1636)	(0.1909)	(0.2288)	(0.2733)
ROA	−0.6390	−0.5242	0.5910	0.7402	−0.6563	−0.3331	0.1853	0.2577	0.5563	−0.3197
	(0.4123)	(0.5874)	(0.5751)	(0.7636)	(1.0032)	(0.3528)	(0.4647)	(0.5281)	(0.7156)	(0.9675)
Constant	−6.8973***	−7.6357***	−7.7962***	−8.2168***	−8.3670***	−6.6056***	−6.7626***	−6.5472***	−7.3317***	−7.5108***
	(0.5955)	(0.6706)	(0.7168)	(0.8053)	(0.8933)	(0.5622)	(0.6387)	(0.7148)	(0.7990)	(0.8813)
Year F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Province F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
F Statistics	62.02***	58.22***	55.85***	79.73***	152.90***	74.93***	100.12***	37.60***	92.44***	133.70***
Obs.	2870	2339	1942	1578	1507	2870	2339	1942	1578	1507
Panel C: LOCAL vs. PRIVATE										
DLOCAL	−0.0881***	−0.0883**	−0.0856**	−0.1181**	−0.1896***	0.0596*	0.0307	0.0154	−0.0036	0.0264
	(0.0340)	(0.0387)	(0.0434)	(0.0498)	(0.0578)	(0.0310)	(0.0354)	(0.0402)	(0.0467)	(0.0551)
RDTA	0.2899***	0.2668***	0.2306***	0.2091***	0.2500***	0.2585***	0.2453***	0.2381***	0.2169***	0.2480***
	(0.0561)	(0.0606)	(0.0591)	(0.0613)	(0.0728)	(0.0545)	(0.0577)	(0.0590)	(0.0632)	(0.0717)
SIZE	0.2928***	0.3258***	0.3370***	0.3379***	0.4417***	0.3117***	0.3300***	0.3421***	0.3579***	0.4213***
	(0.0179)	(0.0205)	(0.0229)	(0.0267)	(0.0308)	(0.0172)	(0.0199)	(0.0229)	(0.0272)	(0.0311)
LEVERAGE	−0.0541	−0.1508	−0.1908	−0.4100**	−0.4914**	−0.0293	0.0097	−0.0351	−0.1060	−0.2503

(*continued on next page*)

Table 5 (*continued*)

	Patent quantity					Patent quality				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
	(0.1156)	(0.1346)	(0.1522)	(0.1801)	(0.2105)	(0.1033)	(0.1188)	(0.1394)	(0.1679)	(0.2007)
ROA	0.4733	0.9658**	1.0213**	0.4146	0.2704	−0.1761	0.0562	−0.0802	−0.0966	−0.7653
	(0.3222)	(0.4141)	(0.4955)	(0.5811)	(0.7304)	(0.2956)	(0.3731)	(0.4675)	(0.5469)	(0.6862)
Constant	−5.7462***	−6.6085***	−6.9963***	−7.1161***	−8.3136***	−5.3337***	−5.8709***	−6.1283***	−6.5267***	−6.9834***
	(0.3904)	(0.4468)	(0.5006)	(0.5751)	(0.6712)	(0.3926)	(0.4473)	(0.5120)	(0.5936)	(0.6805)
Year F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Province F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
F Statistics	144.87***	70.18***	61.68***	49.09***	80.17***	652.30***	57.35***	48.51***	38.67***	52.67***
Obs.	5350	4421	3669	2978	2859	5350	4421	3669	2978	2859

Notes: This table shows the relationship between ultimate controlling ownership and innovation performance estimated using Tobit regression and propensity score matching (PSM). $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. *CENTRAL, LOCAL,* and *PRIVATE* refer to companies that are ultimately controlled by the central and local governments and private entities, respectively. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered at both firm and year levels.

Table 6

Varieties in state capitalism and corporate innovation: manufacturing vs. nonmanufacturing industry.

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	*$LNPATENT_{t+1}$*	*$LNPATENT_{t+2}$*	*$LNPATENT_{t+3}$*	*$LNPATENT_{t\sim t+3}$*	*$LNPATENT_t$*	*$LNPATENT_{t+1}$*	*$LNPATENT_{t+2}$*	*$LNPATENT_{t+3}$*	*$LNPATENT_{t\sim t+3}$*
Panel A: Patent quantity										
Panel A1: Main results										
DCENTRAL	0.1813**	0.3215***	0.3329***	0.4180***	0.2396**	0.1234	0.2410**	0.3893***	0.5135***	0.2834**
	(0.0769)	(0.0874)	(0.0953)	(0.1036)	(0.1029)	(0.0860)	(0.0967)	(0.1040)	(0.1128)	(0.1368)
DLOCAL	−0.1263**	−0.0526	−0.0379	0.0670	−0.1591**	−0.1784***	−0.2164***	−0.1744**	−0.1513*	−0.2336**
	(0.0639)	(0.0720)	(0.0779)	(0.0843)	(0.0806)	(0.0671)	(0.0748)	(0.0812)	(0.0874)	(0.1081)
RDTA	0.1139***	0.1049***	0.0889***	0.0591***	0.0319***	0.0658***	0.0456***	0.0340***	0.0065	0.0410***
	(0.0088)	(0.0099)	(0.0113)	(0.0126)	(0.0088)	(0.0088)	(0.0094)	(0.0102)	(0.0121)	(0.0105)
SIZE	0.0337***	−0.0153	−0.0181*	−0.0336***	0.0066	0.0422***	0.0229**	0.0127	0.0017	0.0168*
	(0.0090)	(0.0096)	(0.0100)	(0.0108)	(0.0074)	(0.0097)	(0.0103)	(0.0106)	(0.0117)	(0.0101)
LEVERAGE	0.2298**	0.1580	0.0855	−0.0461	0.0596	0.2211**	0.1760	0.0718	−0.1151	0.2048
	(0.0935)	(0.1106)	(0.1257)	(0.1429)	(0.1193)	(0.1030)	(0.1187)	(0.1330)	(0.1523)	(0.1546)
ROA	−0.0349	0.5185**	1.1352***	1.1004***	0.7252***	−0.1730	0.0722	0.2769	0.2044	0.3462
	(0.1830)	(0.2176)	(0.2454)	(0.3045)	(0.2570)	(0.2136)	(0.2505)	(0.2829)	(0.3399)	(0.3868)
TREND	0.1128***	0.0958***	0.0666***	0.0310***	0.2039***	0.0607***	0.0651***	0.0577***	0.0441***	0.1296***
	(0.0046)	(0.0057)	(0.0071)	(0.0092)	(0.0064)	(0.0045)	(0.0055)	(0.0067)	(0.0087)	(0.0076)
Constant	0.4852***	1.7017***	2.0374***	2.6528***	2.3766***	−0.5563***	0.0195	0.3052	0.5889**	0.3877
	(0.1790)	(0.1930)	(0.2047)	(0.2290)	(0.1642)	(0.2088)	(0.2226)	(0.2342)	(0.2630)	(0.2445)
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi2	1392.62***	682.55***	286.15***	94.92***	1426.97***	582.47***	427.58***	316.56***	308.61***	528.69***
Obs.	9989	8227	6756	5400	5207	5447	4511	3746	3021	2926
Panel A2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL vs. *DLOCAL*	15.73***	18.41***	15.30***	11.57***	18.87***	13.06***	24.13***	32.23***	38.76***	16.44***

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	*$LNCITATION_{t+1}$*	*$LNCITATION_{t+2}$*	*$LNCITATION_{t+3}$*	*$LNCITATION_{t\sim t+3}$*	*$LNCITATION_t$*	*$LNCITATION_{t+1}$*	*$LNCITATION_{t+2}$*	*$LNCITATION_{t+3}$*	*$LNCITATION_{t\sim t+3}$*
Panel B: Patent quality										
Panel B1: Main results										
DCENTRAL	0.6464***	0.6333***	0.6811***	0.5963***	0.5687***	0.5435***	0.5167***	0.4997***	0.5483***	0.5090***
	(0.0647)	(0.0726)	(0.0793)	(0.0848)	(0.0869)	(0.0841)	(0.0940)	(0.1024)	(0.1121)	(0.1312)
DLOCAL	0.2515***	0.2357***	0.2641***	0.2188***	0.2799***	0.0747	0.0438	0.0376	−0.0572	0.0536
	(0.0535)	(0.0593)	(0.0641)	(0.0676)	(0.0675)	(0.0659)	(0.0731)	(0.0806)	(0.0869)	(0.1035)
RDTA	0.0881***	0.0824***	0.0568***	0.0386***	0.0304***	0.0784***	0.0822***	0.0701***	0.0475***	0.0634***
	(0.0065)	(0.0071)	(0.0076)	(0.0078)	(0.0066)	(0.0077)	(0.0079)	(0.0081)	(0.0088)	(0.0093)
SIZE	0.0305***	0.0085	−0.0079	0.0062	−0.0018	0.0467***	0.0376***	0.0182**	0.0183**	0.0214**
	(0.0066)	(0.0068)	(0.0066)	(0.0066)	(0.0055)	(0.0086)	(0.0086)	(0.0084)	(0.0085)	(0.0089)
LEVERAGE	0.3689***	0.2814***	0.2227**	0.1397	0.1062	0.4581***	0.4547***	0.1382	0.1223	0.1177
	(0.0714)	(0.0827)	(0.0920)	(0.1013)	(0.0936)	(0.0923)	(0.1034)	(0.1124)	(0.1239)	(0.1391)
ROA	0.1815	0.4632***	0.6734***	0.6759***	0.5687***	0.1819	0.1828	−0.0754	−0.0182	0.3369
	(0.1346)	(0.1538)	(0.1677)	(0.2065)	(0.1992)	(0.1863)	(0.2107)	(0.2269)	(0.2771)	(0.3515)

(*continued on next page*)

Table 6 (*continued*)

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
TREND	0.2806***	0.2846***	0.2743***	0.2328***	0.3725***	0.1408***	0.1451***	0.1430***	0.1394***	0.2192***
	(0.0034)	(0.0040)	(0.0048)	(0.0056)	(0.0048)	(0.0039)	(0.0046)	(0.0052)	(0.0063)	(0.0067)
Constant	−1.0372***	−0.1991	0.5520***	0.8197***	1.1812***	−1.2088***	−0.9745***	−0.2657	−0.1450	−0.1037
	(0.1342)	(0.1391)	(0.1403)	(0.1443)	(0.1273)	(0.1871)	(0.1914)	(0.1923)	(0.2022)	(0.2203)
Industry F.E.	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi2	10,687.76***	7572.78***	4769.14***	2390.05***	7941.89***	2097.42***	1690.44***	1141.16***	763.41***	1404.87***
Obs.	9989	8227	6756	5400	5207	5447	4511	3746	3021	2926
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL vs. *DLOCAL*	40.04***	33.58***	32.36***	24.30***	15.48***	33.41***	27.55***	22.75***	33.70***	14.16***

Notes: This table shows the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) for manufacturing industry and Columns (6)–(10) for nonmanufacturing industry. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is measured by the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

industries. The results are reported in Table 6. The estimated coefficients for *DCENTRAL* reported in Specifications (1)–(10) of Panels A1 and B1 are significant and positive. The results of the mean-difference *t*-tests presented in Specifications (1)–(10) of Panels A2 and B2 are also significant and positive. The finding confirms that central SOEs, acting as "national champions," are significantly associated with the best innovation performance in terms of both patent quantity and quality in both manufacturing and nonmanufacturing industries, lending strong support to *Hypothesis 1a*.

The estimated coefficients for *DLOCAL* presented in Specifications (1)–(5) of Panels A1 and B1 are significantly negative and positive, respectively, whereas the estimated coefficients for *DLOCAL* presented in Specifications (6)–(10) of Panels A1 and B1 are significantly negative and nonsignificant, respectively. The results show that private firms outperform local SOEs in terms of patent quantity, mainly in the nonmanufacturing industry when the lead-lag effect of *LNPATENT* is considered, whereas local SOEs outperform private firms in terms of patent quality, mainly in the manufacturing industry. The results support *Hypotheses 1b* and *1c* in the nonmanufacturing and manufacturing sectors, respectively. The findings are not surprising because regulations in the manufacturing industry are assumed to be largely absent, resulting in local SOEs being less able to exert monopoly power in increasing patents. However, investments in innovative activities in the manufacturing industry usually involves higher sunk R&D costs than in the nonmanufacturing industry. Therefore, local SOEs with a stronger capability to tolerate failure are able to undertake more high-quality innovation activities than their private peers.

4.3.2. High- vs. low-economic-development regions

China's development is characterized by very large provincial disparities in economic development, natural resources, availability of infrastructure, education, and others (Démurger, 2001; Heilig, 2004). Consequently, firm innovation performance in China may also vary from province to province (Fu, 2008; Kroll and Frietsch, 2014). Therefore, we divide the full sample into two subsamples representing high- and low-economic-development regions, respectively. Following Bao et al. (2002), regional economic development is measured by the region's GDP per capita. The subsamples are partitioned based on the sample median. The regression results are reported in Table 7. Again, the estimated coefficients for *DCENTRAL* reported in Specifications (1)–(10) of Panels A1 and B1 are significant and positive, as are the results of the mean-difference *t*-tests presented in Specifications (1)–(10) of Panels A2 and B2. This finding further confirms that central SOEs, as national policy instruments, deliver the best innovation performance in terms of both patent quantity and quality in both high- and low-economic-development regions, which strongly supports *Hypothesis 1a*.

A focus on local SOEs shows that the estimated coefficients for *DLOCAL* presented in Specifications (1)–(5) of Panels A1 and B1 are primarily significantly negative and positive, respectively, whereas the estimated coefficients for *DLOCAL* presented in Specifications (6)–(10) of Panels A1 and B1 are primarily nonsignificant. This result suggests that, in a high-economic-development region, private firms outperform local SOEs in terms of patent quantity, whereas local SOEs outperform private firms with respect to patent quality, supporting *Hypotheses 1b* and *1c*. However, in the low-economic-development region, local SOEs are similar to private firms in both dimensions of innovation creation. As highlighted in Fu (2008), the key sources of regional disparities in innovation performance include foreign direct investment, human capital, universities, and clusters, implying that it would be more difficult for firms in low-economic-development regions to gain access to these vital innovation resources than for firms in high-economic-development regions, particularly for private firms, which adversely affects the increase in patent quantity. Local SOEs in low-economic-development regions may be more likely to place a lower unemployment rate and a higher GDP growth rate in the short term as their top priority than would local SOEs in high-economic-development regions. Hence, fewer resources could be allocated to riskier innovation projects, slowing the improvement in patent quality.

4.4. Underlying mechanisms

4.4.1. ESG engagement

Table 8 provides the regression results for the differences in innovation performance among central SOEs, local SOEs, and private firms conditional on firms' ESG engagement. The estimated coefficients for *DCENTRAL**ESG* presented in Panel A are significant and positive in all specifications. The results of the mean difference *t*-tests are also significantly positive in all specifications. This finding suggests that central SOEs undertaking more ESG activities can deliver the best innovation performance in terms of both patent quality and quantity, supporting *Hypothesis 2a*. This result is in line with Zu and Song (2009) and Li and Zhang (2010), who find that SOEs are more likely to undertake ESG activities than private firms. Given that ESG activities are usually new to these SOEs, they may enable these firms to tap new markets that require more innovative activities.

Moreover, the estimated coefficients for *DLOCAL**ESG* presented in Panel A are significant and negative, mainly in Specifications (1)–(5), whereas they become positive but nonsignificant in Specifications (6)–(10). This result suggests that private firms engaging in more ESG activities outperform local SOEs in terms of patent quantity, which supports *Hypothesis 2b*. However, no significant moderating effect is observed concerning patent quality, illustrating that local SOEs do not outperform private firms with respect to patent quality when more ESG activities are undertaken. One possible explanation could be that the stakeholder value maximization function of ESG engagement sounds more appealing for private firms because, relative to local SOEs, private firms often have less support from local governments. Undertaking more ESG activities could significantly improve their relationship with local governments and local communities, enabling them to access more resources and enhance their risk tolerance levels for engaging in exploratory innovation. From the perspective of local SOEs, more ESG engagements merely add to their existing social functions, which may consume their limited resources, thus slowing their pace of exploratory innovation.

Table 7
Varieties in state capitalism and corporate innovation: high vs. low economic development region.

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	*$LNPATENT_{t+1}$*	*$LNPATENT_{t+2}$*	*$LNPATENT_{t+3}$*	*$LNPATENT_{t\sim t+3}$*	*$LNPATENT_t$*	*$LNPATENT_{t+1}$*	*$LNPATENT_{t+2}$*	*$LNPATENT_{t+3}$*	*$LNPATENT_{t\sim t+3}$*
Panel A: Patent quantity										
Panel A1: Main results										
DCENTRAL	0.0779	0.2139***	0.3016***	0.4487***	0.0793	0.2653**	0.4288***	0.3919***	0.4684***	0.2699*
	(0.0712)	(0.0807)	(0.0875)	(0.0949)	(0.1033)	(0.1050)	(0.1187)	(0.1289)	(0.1417)	(0.1505)
DLOCAL	−0.2086***	−0.2003***	−0.1779**	−0.0754	−0.3212***	−0.1153	−0.1009	−0.0967	0.0536	−0.3026***
	(0.0590)	(0.0664)	(0.0716)	(0.0767)	(0.0813)	(0.0832)	(0.0936)	(0.1025)	(0.1129)	(0.1163)
RDTA	0.0889***	0.0727***	0.0577***	0.0275***	0.0361***	0.1842***	0.1857***	0.1418***	0.1277***	0.1048***
	(0.0069)	(0.0077)	(0.0085)	(0.0097)	(0.0072)	(0.0176)	(0.0198)	(0.0225)	(0.0279)	(0.0212)
SIZE	0.0321***	−0.0057	−0.0119	−0.0255***	0.0061	0.0417***	0.0042	0.0025	−0.0163	0.0104
	(0.0080)	(0.0084)	(0.0087)	(0.0095)	(0.0069)	(0.0131)	(0.0145)	(0.0150)	(0.0165)	(0.0121)
LEVERAGE	0.0260	−0.0416	−0.0601	−0.1393	0.0275	0.3258**	0.2739*	0.1643	−0.0193	−0.0730
	(0.0838)	(0.0983)	(0.1115)	(0.1261)	(0.1120)	(0.1344)	(0.1590)	(0.1781)	(0.2058)	(0.1842)
ROA	−0.0423	0.4964**	1.3184***	1.1344***	0.9255***	−0.0782	0.2614	0.4066	0.5163	0.1826
	(0.1840)	(0.2268)	(0.2597)	(0.3014)	(0.2665)	(0.2216)	(0.2533)	(0.2835)	(0.3671)	(0.3753)
TREND	0.0921***	0.0849***	0.0660***	0.0345***	0.1731***	0.1014***	0.0896***	0.0747***	0.0524***	0.1974***
	(0.0039)	(0.0048)	(0.0059)	(0.0077)	(0.0057)	(0.0067)	(0.0085)	(0.0106)	(0.0138)	(0.0105)
Constant	0.0267	1.0496***	1.2832***	1.4950***	1.6178***	−0.2805	0.6426*	0.6226	1.3087***	1.2534***
	(0.1854)	(0.1987)	(0.2114)	(0.2377)	(0.1862)	(0.3304)	(0.3657)	(0.3892)	(0.4296)	(0.3463)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi2	1540.86***	911.35***	603.60***	477.45***	1432.70***	779.54***	518.79***	333.71***	225.16***	736.58***
Obs.	11,516	9502	7827	6271	6072	3920	3236	2675	2150	2061
Panel A2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL vs. *DLOCAL*	15.07***	25.00***	28.86***	29.43***	16.50***	15.64***	23.87***	17.72***	10.89***	22.08***

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	*$LNCITATION_{t+1}$*	*$LNCITATION_{t+2}$*	*$LNCITATION_{t+3}$*	*$LNCITATION_{t\sim t+3}$*	*$LNCITATION_t$*	*$LNCITATION_{t+1}$*	*$LNCITATION_{t+2}$*	*$LNCITATION_{t+3}$*	*$LNCITATION_{t\sim t+3}$*
Panel B: Patent quality										
Panel B1: Main results										
DCENTRAL	0.6308***	0.5894***	0.6041***	0.5734***	0.4655***	0.4194***	0.5082***	0.6051***	0.5460***	0.5580***
	(0.0643)	(0.0720)	(0.0781)	(0.0835)	(0.0918)	(0.0835)	(0.0938)	(0.1034)	(0.1141)	(0.1276)
DLOCAL	0.1266**	0.0976*	0.1469**	0.0858	0.1049	0.0203	0.0307	0.0376	0.0857	0.1277
	(0.0530)	(0.0586)	(0.0633)	(0.0661)	(0.0714)	(0.0661)	(0.0737)	(0.0817)	(0.0899)	(0.0985)
RDTA	0.0864***	0.0822***	0.0644***	0.0427***	0.0484***	0.1734***	0.1805***	0.1447***	0.1053***	0.1230***
	(0.0055)	(0.0058)	(0.0061)	(0.0062)	(0.0057)	(0.0135)	(0.0145)	(0.0158)	(0.0184)	(0.0178)
SIZE	0.0359***	0.0267***	0.0024	0.0099*	0.0056	0.0395***	0.0014	0.0007	0.0052	−0.0024
	(0.0064)	(0.0063)	(0.0061)	(0.0059)	(0.0055)	(0.0100)	(0.0105)	(0.0104)	(0.0106)	(0.0101)
LEVERAGE	0.3023***	0.2365***	0.0799	0.0656	−0.0255	0.4529***	0.3929***	0.2575*	0.0809	0.1206
	(0.0685)	(0.0780)	(0.0859)	(0.0917)	(0.0918)	(0.1038)	(0.1199)	(0.1324)	(0.1495)	(0.1554)
ROA	0.2668*	0.3817**	0.5258***	0.7153***	0.6129***	−0.0249	0.1166	0.1068	−0.1597	0.0531
	(0.1456)	(0.1719)	(0.1893)	(0.2030)	(0.2141)	(0.1690)	(0.1848)	(0.2003)	(0.2777)	(0.3186)

(*continued on next page*)

Table 7 (*continued*)

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
TREND	0.2342***	0.2348***	0.2249***	0.1948***	0.3080***	0.2157***	0.2233***	0.2159***	0.2003***	0.3212***
	(0.0031)	(0.0036)	(0.0042)	(0.0048)	(0.0045)	(0.0051)	(0.0062)	(0.0074)	(0.0090)	(0.0088)
Constant	−0.9885***	−0.6611***	0.1143	0.2123	0.6398***	−1.1297***	−0.2136	0.0828	0.0367	0.4672
	(0.1497)	(0.1528)	(0.1542)	(0.1574)	(0.1511)	(0.2524)	(0.2684)	(0.2781)	(0.2897)	(0.2907)
Industry F.E	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Wald chi2	8565.88***	6225.78***	3984.77***	2211.05***	5818.79***	3202.04***	2440.68***	1588.04***	922.12***	2149.21***
Obs.	11,516	9502	7827	6271	6072	3920	3236	2675	2150	2061
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL vs. *DLOCAL*	59.94***	46.90***	35.39***	36.48***	18.05***	27.76***	32.25***	39.91***	23.36***	17.39***

Notes: This table shows the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) for high economic development region and Columns (6)–(10) for low economic development region. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is measured by the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 8
Varieties in state capitalism, corporate innovation, and ESG engagement.

	Patent quantity					Patent quality				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel A: Main results										
ESG	0.0275	0.0402**	0.0035	0.0575*	−0.0064	0.0666***	0.0409***	0.0106	0.0264	0.0137
	(0.0170)	(0.0195)	(0.0235)	(0.0306)	(0.0200)	(0.0127)	(0.0134)	(0.0152)	(0.0185)	(0.0153)
DCENTRAL	−0.5081**	−0.1996	−0.4232	0.1304	−0.5405**	0.2065	0.3724**	0.2811	0.6639***	0.6408***
	(0.2237)	(0.2574)	(0.2929)	(0.3567)	(0.2461)	(0.1688)	(0.1810)	(0.1938)	(0.2183)	(0.1928)
DLOCAL	−0.4645***	−0.5579***	−0.5391**	0.0270	−0.3392*	0.1400	0.0590	0.1344	0.2292	0.2542*
	(0.1785)	(0.2047)	(0.2379)	(0.2920)	(0.1956)	(0.1347)	(0.1438)	(0.1571)	(0.1782)	(0.1514)
DCENTRAL×ESG	0.0205**	0.0509***	0.0664***	0.0777***	0.0373**	0.0907***	0.0877***	0.0882***	0.0895***	0.0779***
	(0.0098)	(0.0112)	(0.0121)	(0.0133)	(0.0149)	(0.0087)	(0.0099)	(0.0109)	(0.0118)	(0.0131)
DLOCAL×ESG	−0.0332***	−0.0275***	−0.0121	0.0002	−0.0487***	0.0070	−0.0002	0.0051	0.0056	0.0012
	(0.0080)	(0.0091)	(0.0098)	(0.0108)	(0.0112)	(0.0070)	(0.0079)	(0.0087)	(0.0093)	(0.0097)
RDTA	0.1083***	0.1035***	0.1004***	0.0768***	0.0509***	0.1002***	0.0945***	0.0758***	0.0653***	0.0573***
	(0.0077)	(0.0088)	(0.0104)	(0.0127)	(0.0081)	(0.0058)	(0.0061)	(0.0068)	(0.0076)	(0.0061)
SIZE	0.0512***	0.0077	0.0013	−0.0257***	−0.0028	0.0255***	0.0213***	−0.0003	0.0003	−0.0063*
	(0.0072)	(0.0076)	(0.0079)	(0.0085)	(0.0050)	(0.0053)	(0.0052)	(0.0049)	(0.0048)	(0.0038)
LEVERAGE	0.1456*	0.0494	−0.1190	−0.1916	−0.0708	0.3978***	0.3773***	0.2216***	0.0468	0.0277
	(0.0789)	(0.0951)	(0.1095)	(0.1252)	(0.1047)	(0.0611)	(0.0705)	(0.0805)	(0.0909)	(0.0830)
ROA	−0.1754	0.2762	0.7279***	0.8353***	0.4485*	0.2096*	0.2781**	0.2797**	0.4244**	0.4522**
	(0.1551)	(0.1844)	(0.2110)	(0.2716)	(0.2391)	(0.1138)	(0.1250)	(0.1370)	(0.1899)	(0.1893)
TREND	0.0502***	0.0221***	−0.0165**	−0.0917***	0.1268***	0.2233***	0.1913***	0.1730***	0.1466***	0.2649***
	(0.0046)	(0.0060)	(0.0081)	(0.0114)	(0.0071)	(0.0034)	(0.0040)	(0.0051)	(0.0064)	(0.0054)
Constant	−0.4452**	0.7302***	1.2779***	1.5524***	2.0514***	−1.2579***	−0.6900***	0.3104*	0.4194**	0.9687***
	(0.2025)	(0.2227)	(0.2476)	(0.2985)	(0.1967)	(0.1525)	(0.1547)	(0.1616)	(0.1804)	(0.1522)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	1325.04***	781.48***	680.70***	738.75***	880.61***	7999.75***	4481.91***	2219.88***	1127.38***	3729.94***
Obs.	12,810	10,242	8107	6171	5926	12,810	10,242	8107	6171	5926
Panel B: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×ESG vs. *DLCOAL×ESG*	28.44***	46.56***	40.08***	33.45***	37.99***	91.82***	80.09***	59.92***	55.84***	42.45***

Notes: This table shows the moderating effect of firm ESG (environmental, social, and governance) engagement on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Firm ESG engagement (*ESG*) is measured by the ESG index developed by Sino-Securities Index Information Service (Shanghai) Co. Ltd. for listed firms in China. It ranges between one and nine; a higher score indicating a higher level of ESG engagement. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t + 3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t + 3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 9
Varieties in state capitalism, corporate innovation, and economic policy uncertainty.

	Patent quantity					Patent quality				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	*$LNPATENT_{t+1}$*	*$LNPATENT_{t+2}$*	*$LNPATENT_{t+3}$*	*$LNPATENT_{t\sim t+3}$*	*$LNCITATION_t$*	*$LNCITATION_{t+1}$*	*$LNCITATION_{t+2}$*	*$LNCITATION_{t+3}$*	*$LNCITATION_{t\sim t+3}$*
Panel A: Main results										
LNEPU	−0.0362	0.2668***	0.2678***	−0.4472***	−0.1932***	−0.0496**	0.0809***	0.1282***	−0.1110***	−0.0715***
	(0.0303)	(0.0317)	(0.0329)	(0.0441)	(0.0324)	(0.0237)	(0.0237)	(0.0231)	(0.0281)	(0.0265)
DCENTRAL	−0.4403	−0.2473	−0.4501	−0.4536	−1.2234***	−0.1338	0.1624	0.2470	0.1536	0.3824
	(0.3134)	(0.3316)	(0.3400)	(0.3744)	(0.2856)	(0.2460)	(0.2502)	(0.2410)	(0.2429)	(0.2348)
DLOCAL	−0.2456	−0.0095	−0.0938	−1.1094***	−0.5913***	0.4419**	0.3668*	0.3256*	0.0386	0.4639***
	(0.2442)	(0.2552)	(0.2620)	(0.2919)	(0.2183)	(0.1916)	(0.1924)	(0.1856)	(0.1891)	(0.1794)
DCENTRAL×LNEPU	0.0271**	0.0505***	0.0622***	0.0832***	0.0214	0.1156***	0.1132***	0.1173***	0.1043***	0.0916***
	(0.0120)	(0.0135)	(0.0147)	(0.0159)	(0.0170)	(0.0105)	(0.0117)	(0.0127)	(0.0137)	(0.0150)
DLOCAL×LNEPU	−0.0385***	−0.0373***	−0.0328***	−0.0112	−0.0654***	0.0167**	0.0118	0.0183*	0.0100	0.0167
	(0.0097)	(0.0109)	(0.0118)	(0.0127)	(0.0133)	(0.0085)	(0.0094)	(0.0102)	(0.0108)	(0.0117)
RDTA	0.1017***	0.0822***	0.0647***	0.0450***	0.0467***	0.1024***	0.0976***	0.0753***	0.0526***	0.0593***
	(0.0064)	(0.0071)	(0.0079)	(0.0091)	(0.0068)	(0.0051)	(0.0054)	(0.0057)	(0.0059)	(0.0056)
SIZE	0.0309***	0.0103	0.0035	−0.0198**	0.0090	0.0334***	0.0238***	0.0069	0.0106**	0.0047
	(0.0069)	(0.0074)	(0.0076)	(0.0081)	(0.0060)	(0.0055)	(0.0056)	(0.0054)	(0.0053)	(0.0049)
LEVERAGE	0.1168*	0.0332	−0.0269	−0.1372	−0.0294	0.3309***	0.2663***	0.1130	0.0555	−0.0142
	(0.0708)	(0.0826)	(0.0935)	(0.1064)	(0.0949)	(0.0574)	(0.0654)	(0.0717)	(0.0784)	(0.0795)
ROA	−0.1501	0.3254*	0.9172***	0.6422***	0.4649**	0.1122	0.2564**	0.3420**	0.3367**	0.2924
	(0.1410)	(0.1663)	(0.1876)	(0.2317)	(0.2180)	(0.1112)	(0.1264)	(0.1364)	(0.1668)	(0.1827)
TREND	0.0969***	0.0812***	0.0518***	0.0960***	0.1999***	0.2312***	0.2300***	0.2165***	0.2138***	0.3282***
	(0.0034)	(0.0041)	(0.0052)	(0.0086)	(0.0064)	(0.0027)	(0.0031)	(0.0037)	(0.0055)	(0.0052)
Constant	0.2259	−0.5518**	−0.2878	3.4408***	2.4461***	−0.6930***	−0.9670***	−0.5678***	0.6574***	0.8914***
	(0.2304)	(0.2465)	(0.2550)	(0.2825)	(0.2161)	(0.1825)	(0.1878)	(0.1833)	(0.1858)	(0.1782)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	2293.60***	1502.78***	995.96***	743.72***	2200.03***	12,023.82***	8883.46***	5812.13***	3216.65***	8079.69***
Obs.	15,436	12,738	10,502	8421	8133	15,436	12,738	10,502	8421	8133
Panel B: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×LNEPU vs. *DLCOAL×LNEPU*	30.68***	43.90***	44.17***	37.12***	32.80***	95.80***	83.27***	70.34***	57.61***	33.14***

Notes: This table shows the moderating effect of economic policy uncertainty on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Following Phan et al. (2021), economic policy uncertainty (*EPU*) is measured by the Economic Policy Uncertainty Index constructed by Baker et al. (2016). A higher *EPU* score indicates a higher level of policy-related economic uncertainty. *LNEPU* is the logarithm of *EPU*. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

4.4.2. Economic policy uncertainty

Table 9 shows the regression results for the differences in innovation performance among central SOEs, local SOEs, and private firms conditional on firms' exposure to EPU. The estimated coefficients for *DCENTRAL*LNEPU* presented in Panel A are significant and positive in almost all specifications. The results of the mean difference *t*-tests are also significantly positive in all specifications. This result suggests that central SOEs demonstrate the best innovation performance in terms of both patent quality and quantity during periods of higher EPU, supporting *Hypothesis 3a*. This result is in line with Jiang et al. (2020) and He et al. (2020), who find that better innovation performance caused by a higher level of EPU is primarily driven by SOEs. In addition, the estimated coefficients for *DLOCAL*LNEPU* presented in Panel A are significant and negative, mainly in Specifications (1)–(5), and become significant and positive, mainly in Specifications (6)–(10). This result demonstrates that during periods of higher EPU, private firms outperform local SOEs in terms of patent quantity, whereas local SOEs outperform private firms in terms of patent quality, lending support to *Hypotheses 3b* and *3c*. This finding not only favors the game theory view but also provides vivid evidence showing that SOEs are economic stabilizers, as argued in EBRD (2020).

4.4.3. Corruption

Table 10 presents the regression results for the differences in innovation performance among central SOEs, local SOEs, and private firms conditional on firms' exposure to corruption. Again, the estimated coefficients for *DCENTRAL*CPI* presented in Panel A are significant and positive in almost all specifications. Moreover, the results of the mean difference *t*-tests are also significantly positive in all specifications. This result suggests that central SOEs deliver the best innovation performance measured by both patent quantity and quality when they are subject to less corruption, supporting *Hypothesis 4a*. In addition, the estimated coefficients for *DLOCAL*CPI* presented in Panel A are significant and negative in Specifications (1)–(5) and become significant and positive only in Specification (6). The result suggests that private firms produce more patents than local SOEs when they are subject to less corruption, supporting *Hypothesis 4b*. However, local SOEs are associated with better patent quality when they are exposed to less corruption, but such an effect becomes nonsignificant when the lead–lag effect of *LNCITATION* is in place, providing weak support to *Hypothesis 4c*. This result is partially in line with Xu and Yano (2017), who find that private firms rather than SOEs can benefit from the stronger anticorruption efforts. That said, in central SOEs, the risk of corruption could be higher than for their local and private peers because their managers enjoy much greater political power than their local and private counterparts, making central SOEs more vulnerable to corruption.

4.5. Further tests

To test the robustness of our results, we further examine the moderating effect of ESG, EPU, and corruption on the ownership–innovation nexus across different industries and regions. Tables 11–13 report the corresponding results for the manufacturing versus nonmanufacturing industries. The results show a very similar pattern across the three moderators. That is, the estimated coefficients for *DCENTRAL*ESG*, *DCENTRAL*LNEPU*, and *DCENTRAL*CPI* presented in both Panels A1 and B1 of these three tables are significant and positive in almost all specifications. Meanwhile, the results of the mean difference *t*-tests reported in both Panels A2 and B2 of these three tables are also significantly positive in all specifications. The finding confirms *Hypotheses 2a*, *3a*, and *4a*, suggesting that central SOEs are associated with the best innovation performance in both manufacturing and nonmanufacturing sectors when more ESG activities are engaged, during periods of higher economic policy uncertainty, and when less corruption is present.

Comparing local SOEs with private firms, the estimated coefficients for *DLOCAL*ESG*, *DLOCAL*LNEPU*, and *DLOCAL*CPI* presented in Specifications (1)–(5) of Panels A1 and B1 are significantly negative and positive, respectively, whereas the estimated coefficients for *DLOCAL*ESG*, *DLOCAL*LNEPU*, and *DLOCAL*CPI* presented in Specifications (6)–(10) of Panels A1 and B1 are significantly negative and nonsignificant, respectively. The results show that under each of the three scenarios (i.e., when more ESG activities are engaged, during periods of higher economic policy uncertainty, and when less corruption is present), private firms outperform local SOEs in terms of patent quantity, mainly in the nonmanufacturing industry when the lead-lag effect of *LNPATENT* is considered. Local SOEs outperform private firms in terms of patent quality, mainly in the manufacturing industry. In general, the findings provide full support for *Hypotheses 2b*, *3b*, and *4b*, as well as partial support for *Hypotheses 2c*, *3c*, and *4c*.

Tables 14–16 present the corresponding results for high- versus low-economic-development regions. Again, very similar results are observed under the three scenarios. The estimated coefficients for *DCENTRAL*ESG*, *DCENTRAL*LNEPU*, and *DCENTRAL*CPI* presented in both Panels A1 and B1 of these three tables are significant and positive in almost all specifications. Meanwhile, the results of the mean difference *t*-tests reported in both Panels A2 and B2 of these three tables are also significantly positive in all specifications. This finding confirms *Hypotheses 2a*, *3a*, and *4a*, suggesting that central SOEs are associated with the best innovation performance in both high- and low-economic-development regions when more ESG activities are engaged, during periods of higher economic policy uncertainty, and when less corruption is present.

Comparing local SOEs with private firms, the estimated coefficients for *DLOCAL*ESG*, *DLOCAL*LNEPU*, and *DLOCAL*CPI* presented in Specifications (1)–(5) of Panels A1 and B1 are significantly negative and positive, respectively, whereas the estimated coefficients for *DLOCAL*ESG*, *DLOCAL*LNEPU*, and *DLOCAL*CPI* presented in Specifications (6)–(10) of Panels A1 and B1 are primarily nonsignificant. The only exception is that the estimated coefficients for *DLOCAL*ESG* are nonsignificant in Specifications (1)–(5) of Panel B1, illustrating that in high-economic-development region, local SOEs do not outperform private firms with respect to patent quality when more ESG activities are undertaken. The results show that in the high-economic-development region, private firms outperform local SOEs in terms of patent quantity under each of the three scenarios. Moreover, during periods of higher economic uncertainty and when less corruption is present, local SOEs outperform private firms with respect to patent quality. However, in the low-economic-development region, local SOEs are similar to private firms in both dimensions of innovation creation. In general, the

Table 10
Varieties in state capitalism, corporate innovation, and corruption.

	Patent quantity					Patent quality				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel A: Main results										
CPI	0.3674***	0.5732***	−1.5373***	−1.8528***	−0.8436***	0.1331***	0.1552***	−0.7034***	−0.6451***	−0.5247***
	(0.0579)	(0.0599)	(0.0969)	(0.1129)	(0.0849)	(0.0455)	(0.0454)	(0.0685)	(0.0729)	(0.0694)
DCENTRAL	−1.7536***	−2.2212***	−1.2487**	−0.3545	−2.5980***	−0.9411***	−0.2260	0.4494	0.1975	0.6414
	(0.4472)	(0.4580)	(0.4849)	(0.6847)	(0.5212)	(0.3516)	(0.3474)	(0.3426)	(0.4407)	(0.4260)
DLOCAL	−0.1748	−0.7951**	−1.2825***	−1.5777***	−0.7524*	1.0220***	0.9292***	1.0796***	0.5828*	1.1853***
	(0.3494)	(0.3533)	(0.3770)	(0.5312)	(0.3958)	(0.2747)	(0.2679)	(0.2664)	(0.3423)	(0.3234)
DCENTRAL×CPI	0.0384**	0.0728***	0.0629***	0.0984***	0.0309	0.1562***	0.1535***	0.1505***	0.1356***	0.1168***
	(0.0162)	(0.0184)	(0.0195)	(0.0212)	(0.0228)	(0.0142)	(0.0158)	(0.0171)	(0.0184)	(0.0202)
DLOCAL×CPI	−0.0510***	−0.0453***	−0.0548***	−0.0191	−0.0919***	0.0218*	0.0172	0.0213	0.0077	0.0146
	(0.0131)	(0.0148)	(0.0157)	(0.0169)	(0.0179)	(0.0114)	(0.0127)	(0.0136)	(0.0145)	(0.0157)
RDTA	0.0949***	0.0773***	0.0775***	0.0522***	0.0494***	0.0996***	0.0966***	0.0800***	0.0557***	0.0623***
	(0.0064)	(0.0071)	(0.0079)	(0.0090)	(0.0068)	(0.0051)	(0.0054)	(0.0057)	(0.0059)	(0.0056)
SIZE	0.0217***	−0.0281***	0.0579***	0.0452***	0.0376***	0.0334***	0.0150***	0.0396***	0.0380***	0.0305***
	(0.0069)	(0.0073)	(0.0087)	(0.0090)	(0.0068)	(0.0055)	(0.0056)	(0.0062)	(0.0059)	(0.0056)
LEVERAGE	0.1243*	0.0804	−0.0659	−0.2143**	−0.0511	0.3300***	0.2712***	0.0794	0.0266	−0.0403
	(0.0705)	(0.0824)	(0.0929)	(0.1050)	(0.0946)	(0.0573)	(0.0653)	(0.0715)	(0.0780)	(0.0792)
ROA	−0.1091	0.4211**	0.4715**	0.3105	0.2360	0.1247	0.2774**	0.1075	0.1503	0.0645
	(0.1404)	(0.1654)	(0.1886)	(0.2299)	(0.2189)	(0.1111)	(0.1264)	(0.1372)	(0.1668)	(0.1833)
TREND	0.0850***	0.0595***	0.1797***	0.1549***	0.2253***	0.2264***	0.2281***	0.2886***	0.2442***	0.3556***
	(0.0035)	(0.0044)	(0.0090)	(0.0093)	(0.0070)	(0.0027)	(0.0034)	(0.0063)	(0.0060)	(0.0057)
Constant	−1.0264***	−0.4555*	5.0442***	6.4370***	3.8832***	−1.3851***	−0.9460***	1.6934***	1.7869***	1.8254***
	(0.2489)	(0.2561)	(0.3092)	(0.3802)	(0.2877)	(0.1969)	(0.1953)	(0.2192)	(0.2475)	(0.2360)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	2410.02***	1612.52***	1124.25***	948.38***	2274.37***	12,079.23***	8909.09***	5946.89***	3331.19***	8229.08***
Observations	15,436	12,738	10,502	8421	8133	15,436	12,738	10,502	8421	8133
Panel B: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×CPI vs. *DLCOAL×CPI*	31.32***	43.49***	38.37***	32.07***	36.01***	97.12***	82.84***	66.81***	58.13***	33.85***

Notes: This table shows the moderating impact of corruption on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Following Chen et al. (2015), we use the Transparency International's Corruption Perceptions Index (CPI) developed by Lambsdorff (2008) to measure corruption. *CPI* indicates the perceived level of prevailing corruption on a scale of 0–10, with a higher score suggesting a higher economic and political integrity. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 11
Varieties in state capitalism, innovation, and ESG engagement: manufacturing vs. nonmanufacturing industry.

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$
Panel A: Patent quantity										
Panel A1: Main results										
ESG	0.0453**	0.0622**	0.0283	0.0669*	0.0134	0.0248	0.0413	−0.0066	0.0669	−0.0016
	(0.0218)	(0.0251)	(0.0302)	(0.0388)	(0.0232)	(0.0256)	(0.0293)	(0.0354)	(0.0477)	(0.0378)
DCENTRAL	−0.2535	−0.2639	−0.7202*	−0.4527	−0.6697**	−0.9167***	0.0143	0.0211	0.9293*	0.0325
	(0.3049)	(0.3577)	(0.4048)	(0.4949)	(0.3172)	(0.3101)	(0.3487)	(0.4015)	(0.4942)	(0.4018)
DLOCAL	−0.7059***	−0.7169**	−0.5070	0.1761	−0.0735	−0.1435	−0.3168	−0.5866*	−0.2267	−0.4126
	(0.2504)	(0.2828)	(0.3246)	(0.3976)	(0.2409)	(0.2434)	(0.2811)	(0.3320)	(0.4154)	(0.3338)
DCENTRAL×ESG	0.0147	0.0467***	0.0581***	0.0636***	0.0448***	0.0355**	0.0600***	0.0874***	0.1024***	0.0921***
	(0.0126)	(0.0144)	(0.0157)	(0.0174)	(0.0173)	(0.0141)	(0.0163)	(0.0174)	(0.0193)	(0.0252)
DLOCAL×ESG	−0.0213**	−0.0045	0.0081	0.0212	−0.0126	−0.0322***	−0.0403***	−0.0245*	−0.0240*	−0.0435**
	(0.0107)	(0.0121)	(0.0132)	(0.0147)	(0.0134)	(0.0110)	(0.0124)	(0.0133)	(0.0145)	(0.0182)
RDTA	0.1306***	0.1372***	0.1453***	0.1356***	0.0483***	0.0703***	0.0447***	0.0415***	0.0041	0.0411***
	(0.0107)	(0.0124)	(0.0151)	(0.0180)	(0.0110)	(0.0106)	(0.0114)	(0.0130)	(0.0159)	(0.0115)
SIZE	0.0593***	0.0037	−0.0033	−0.0328***	−0.0013	0.0479***	0.0254**	0.0146	−0.0125	0.0012
	(0.0095)	(0.0101)	(0.0104)	(0.0113)	(0.0061)	(0.0103)	(0.0108)	(0.0113)	(0.0121)	(0.0085)
LEVERAGE	0.2974***	0.2388*	0.0317	−0.0336	0.1356	0.1361	0.0218	−0.1179	−0.2574	0.0265
	(0.1030)	(0.1241)	(0.1418)	(0.1622)	(0.1273)	(0.1167)	(0.1389)	(0.1632)	(0.1863)	(0.1756)
ROA	−0.1454	0.3936	0.9509***	1.1567***	0.5403*	−0.0850	0.0713	0.1785	0.1460	0.3923
	(0.2028)	(0.2395)	(0.2728)	(0.3556)	(0.2816)	(0.2288)	(0.2740)	(0.3175)	(0.3924)	(0.4281)
TREND	0.0502***	0.0090	−0.0453***	−0.1473***	0.1307***	0.0389***	0.0298***	0.0098	−0.0312**	0.1064***
	(0.0062)	(0.0083)	(0.0113)	(0.0159)	(0.0093)	(0.0063)	(0.0082)	(0.0110)	(0.0151)	(0.0111)
Constant	0.0834	1.3942***	2.1209***	3.0003***	2.7890***	−0.7311***	−0.0499	0.5895*	0.8160**	0.9206***
	(0.2229)	(0.2451)	(0.2733)	(0.3361)	(0.2013)	(0.2727)	(0.2993)	(0.3349)	(0.4110)	(0.3306)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	542.54***	234.15***	145.10***	149.26***	417.62***	446.51***	302.50***	273.62***	308.07***	297.19***
Obs.	8307	6629	5228	3972	3807	4503	3613	2879	2199	2119
Panel A2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×ESG vs. *DLCOAL×ESG*	7.01***	10.94***	8.71***	5.26**	11.51***	24.41***	40.52***	45.29***	48.76***	34.14***

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel B: Patent quality										
Panel B1: Main results										
ESG	0.0670***	0.0396**	0.0013	0.0396*	0.0065	0.0646***	0.0465**	0.0441*	0.0082	0.0436
	(0.0154)	(0.0165)	(0.0186)	(0.0219)	(0.0159)	(0.0211)	(0.0228)	(0.0258)	(0.0345)	(0.0337)
DCENTRAL	0.1394	0.3520	0.2241	0.7335**	0.7089***	0.2256	0.3528	0.4684	0.7216**	0.9222**
	(0.2182)	(0.2399)	(0.2557)	(0.2849)	(0.2243)	(0.2585)	(0.2778)	(0.3009)	(0.3613)	(0.3648)
DLOCAL	0.1817	0.0454	0.2240	0.4923**	0.4821***	0.0377	0.0306	0.0823	−0.2091	0.1482
	(0.1786)	(0.1886)	(0.2030)	(0.2254)	(0.1679)	(0.2036)	(0.2235)	(0.2487)	(0.3029)	(0.2998)
DCENTRAL×ESG	0.0936***	0.0881***	0.0905***	0.0839***	0.0757***	0.1075***	0.1047***	0.1039***	0.1294***	0.1306***

(*continued on next page*)

Table 11 (*continued*)

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
	(0.0108)	(0.0122)	(0.0136)	(0.0145)	(0.0144)	(0.0139)	(0.0163)	(0.0179)	(0.0203)	(0.0249)
DLOCAL×ESG	0.0280***	0.0260***	0.0288***	0.0358***	0.0358***	0.0082	−0.0070	0.0007	−0.0175	−0.0074
	(0.0090)	(0.0100)	(0.0110)	(0.0117)	(0.0108)	(0.0110)	(0.0123)	(0.0136)	(0.0149)	(0.0177)
RDTA	0.0967***	0.0880***	0.0709***	0.0737***	0.0411***	0.0775***	0.0830***	0.0643***	0.0435***	0.0582***
	(0.0076)	(0.0082)	(0.0095)	(0.0104)	(0.0075)	(0.0087)	(0.0088)	(0.0093)	(0.0109)	(0.0102)
SIZE	0.0199***	0.0177***	−0.0054	−0.0037	−0.0111***	0.0356***	0.0310***	0.0123	0.0087	0.0080
	(0.0067)	(0.0065)	(0.0062)	(0.0059)	(0.0041)	(0.0084)	(0.0082)	(0.0079)	(0.0080)	(0.0075)
LEVERAGE	0.4387***	0.4039***	0.3802***	0.1616	0.1874**	0.4999***	0.5391***	0.1654	0.1873	0.0259
	(0.0762)	(0.0889)	(0.1011)	(0.1141)	(0.0930)	(0.0990)	(0.1144)	(0.1328)	(0.1517)	(0.1594)
ROA	0.2261	0.3721**	0.6052***	0.6822***	0.6538***	0.3177*	0.3292	−0.2183	−0.0178	0.2914
	(0.1410)	(0.1550)	(0.1704)	(0.2368)	(0.2027)	(0.1851)	(0.2103)	(0.2308)	(0.3171)	(0.3932)
TREND	0.2678***	0.2246***	0.1998***	0.1548***	0.3010***	0.1399***	0.1300***	0.1218***	0.1175***	0.2069***
	(0.0043)	(0.0053)	(0.0068)	(0.0085)	(0.0063)	(0.0051)	(0.0062)	(0.0077)	(0.0101)	(0.0098)
Constant	−1.1825***	−0.2928*	0.8603***	1.0936***	1.6562***	−1.4487***	−1.1174***	−0.3531	0.0538	−0.0410
	(0.1596)	(0.1631)	(0.1701)	(0.1897)	(0.1422)	(0.2290)	(0.2375)	(0.2501)	(0.2993)	(0.2974)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	6652.35***	3394.41***	1590.32***	679.70***	3471.66***	1610.43***	1088.63***	588.20***	375.10***	745.85***
Obs.	8307	6629	5228	3972	3807	4503	3613	2879	2199	2119
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×ESG vs. *DLCOAL×ESG*	34.18***	24.59***	19.68***	11.36***	9.12***	55.03***	51.14***	37.50***	62.39***	37.38***

Notes: This table shows the moderating effect of firm ESG (environmental, social, and governance) engagement on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) for manufacturing industry and Columns (6)–(10) for nonmanufacturing industry. Firm ESG engagement (*ESG*) is measured by the ESG index developed by Sino-Securities Index Information Service (Shanghai) Co. Ltd. for listed firms in China. It ranges between one and nine; a higher score indicating a higher level of ESG engagement. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 12
Varieties in state capitalism, innovation, and ESG engagement: high vs. low economic development region.

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$
Panel A: Patent quantity										
Panel A1: Main results										
ESG	0.0321*	0.0291	−0.0125	0.0344	−0.0213	0.0204	0.0835*	0.0624	0.1367**	0.0457
	(0.0190)	(0.0218)	(0.0264)	(0.0344)	(0.0226)	(0.0377)	(0.0439)	(0.0511)	(0.0674)	(0.0436)
DCENTRAL	−0.4146	−0.3025	−0.4413	0.0439	−0.6307**	−0.8251*	0.0224	−0.4325	0.4352	−0.1870
	(0.2569)	(0.2937)	(0.3331)	(0.4018)	(0.2793)	(0.4607)	(0.5384)	(0.6071)	(0.7777)	(0.5331)
DLOCAL	−0.4136*	−0.5123**	−0.6237**	−0.0640	−0.4657*	−0.3118	−0.2077	0.0014	0.6547	0.2156
	(0.2167)	(0.2493)	(0.2888)	(0.3509)	(0.2384)	(0.3347)	(0.3862)	(0.4393)	(0.5548)	(0.3605)
DCENTRAL×ESG	0.0160	0.0453***	0.0644***	0.0883***	0.0435**	0.0342*	0.0647***	0.0675***	0.0521**	0.0306
	(0.0115)	(0.0132)	(0.0143)	(0.0157)	(0.0182)	(0.0181)	(0.0204)	(0.0220)	(0.0247)	(0.0254)
DLOCAL×ESG	−0.0374***	−0.0295***	−0.0196*	−0.0086	−0.0569***	−0.0073	−0.0044	0.0111	0.0277	−0.0270
	(0.0097)	(0.0110)	(0.0119)	(0.0128)	(0.0137)	(0.0142)	(0.0161)	(0.0176)	(0.0202)	(0.0199)
RDTA	0.0971***	0.0897***	0.0892***	0.0580***	0.0429***	0.1769***	0.1907***	0.1643***	0.2020***	0.1101***
	(0.0084)	(0.0096)	(0.0113)	(0.0137)	(0.0087)	(0.0203)	(0.0233)	(0.0269)	(0.0342)	(0.0222)
SIZE	0.0500***	0.0091	0.0003	−0.0251**	−0.0023	0.0583***	0.0112	0.0080	−0.0304*	−0.0044
	(0.0084)	(0.0088)	(0.0091)	(0.0099)	(0.0059)	(0.0140)	(0.0154)	(0.0156)	(0.0167)	(0.0096)
LEVERAGE	0.0831	−0.0451	−0.1519	−0.2428*	−0.0663	0.3075**	0.2901	0.0230	0.0777	−0.0087
	(0.0925)	(0.1111)	(0.1292)	(0.1467)	(0.1231)	(0.1539)	(0.1857)	(0.2053)	(0.2385)	(0.1984)
ROA	−0.1744	0.3432	1.1707***	1.0831***	0.7541**	0.0005	0.3043	0.3301	0.5306	−0.1627
	(0.2038)	(0.2558)	(0.3020)	(0.3635)	(0.2962)	(0.2446)	(0.2736)	(0.2992)	(0.4010)	(0.4034)
TREND	0.0472***	0.0189***	−0.0163*	−0.0887***	0.1264***	0.0604***	0.0342***	−0.0082	−0.1125***	0.1275***
	(0.0053)	(0.0070)	(0.0095)	(0.0133)	(0.0083)	(0.0092)	(0.0124)	(0.0163)	(0.0225)	(0.0140)
Constant	−0.4212*	0.8387***	1.4974***	1.6965***	2.1604***	−0.6824	0.0757	0.1782	0.9517	1.2551***
	(0.2294)	(0.2501)	(0.2793)	(0.3381)	(0.2232)	(0.4420)	(0.5003)	(0.5374)	(0.6506)	(0.4340)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	956.08***	543.33***	495.31***	573.29***	635.36***	433.42***	320.38***	250.80***	238.83***	315.93***
Obs.	9637	7715	6104	4653	4484	3173	2527	2003	1518	1442
Panel A2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×ESG vs. *DLCOAL×ESG*	18.89***	28.34***	30.58***	34.57***	31.37***	5.70**	12.47***	7.34***	1.17	7.17***

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel B: Patent quality										
Panel B1: Main results										
ESG	0.0776***	0.0466***	0.0106	0.0245	0.0132	0.0251	0.0203	0.0151	0.0306	0.0169
	(0.0142)	(0.0151)	(0.0170)	(0.0207)	(0.0167)	(0.0273)	(0.0296)	(0.0334)	(0.0408)	(0.0359)
DCENTRAL	0.4465**	0.4532**	0.3292	0.8067***	0.7255***	−0.3761	0.2137	0.1687	0.5294	0.6053
	(0.1956)	(0.2087)	(0.2211)	(0.2456)	(0.2159)	(0.3363)	(0.3677)	(0.4046)	(0.4794)	(0.4412)
DLOCAL	0.3652**	0.4163**	0.4700**	0.4337**	0.4771***	−0.3018	−0.4323	−0.2487	0.0361	0.0898
	(0.1650)	(0.1765)	(0.1912)	(0.2146)	(0.1803)	(0.2442)	(0.2642)	(0.2907)	(0.3362)	(0.2978)
DCENTRAL×ESG	0.1032***	0.0955***	0.0932***	0.1119***	0.0926***	0.0605***	0.0648***	0.0737***	0.0580***	0.0592***

(*continued on next page*)

Table 12 (*continued*)

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LNCITATION$_t$	*LNCITATION*$_{t+1}$	*LNCITATION*$_{t+2}$	*LNCITATION*$_{t+3}$	*LNCITATION*$_{t\sim t+3}$	*LNCITATION*$_t$	*LNCITATION*$_{t+1}$	*LNCITATION*$_{t+2}$	*LNCITATION*$_{t+3}$	*LNCITATION*$_{t\sim t+3}$
	(0.0106)	(0.0120)	(0.0134)	(0.0146)	(0.0164)	(0.0146)	(0.0166)	(0.0182)	(0.0196)	(0.0216)
DLOCAL×ESG	0.0073	0.0036	0.0122	0.0048	0.0023	0.0077	0.0006	−0.0007	0.0218	0.0160
	(0.0089)	(0.0098)	(0.0107)	(0.0114)	(0.0119)	(0.0113)	(0.0130)	(0.0146)	(0.0160)	(0.0169)
RDTA	0.0895***	0.0834***	0.0641***	0.0553***	0.0479***	0.1521***	0.1499***	0.1353***	0.1209***	0.1126***
	(0.0063)	(0.0066)	(0.0073)	(0.0081)	(0.0064)	(0.0148)	(0.0159)	(0.0179)	(0.0210)	(0.0182)
SIZE	0.0256***	0.0307***	−0.0005	0.0009	−0.0047	0.0262***	−0.0044	0.0022	−0.0039	−0.0112
	(0.0063)	(0.0060)	(0.0057)	(0.0055)	(0.0043)	(0.0100)	(0.0102)	(0.0099)	(0.0095)	(0.0079)
LEVERAGE	0.3419***	0.3346***	0.2348**	0.1224	0.1097	0.5155***	0.4788***	0.2443	−0.1245	−0.1198
	(0.0722)	(0.0830)	(0.0952)	(0.1067)	(0.0956)	(0.1154)	(0.1364)	(0.1526)	(0.1709)	(0.1654)
ROA	0.3417**	0.4257**	0.4428**	0.7035***	0.7676***	0.0646	0.0791	0.0671	−0.1614	−0.3654
	(0.1505)	(0.1750)	(0.1999)	(0.2337)	(0.2220)	(0.1748)	(0.1812)	(0.1947)	(0.3080)	(0.3428)
TREND	0.2252***	0.1913***	0.1759***	0.1582***	0.2666***	0.2211***	0.1982***	0.1634***	0.1145***	0.2574***
	(0.0040)	(0.0048)	(0.0059)	(0.0075)	(0.0061)	(0.0066)	(0.0082)	(0.0103)	(0.0130)	(0.0115)
Constant	−1.2966***	−0.8954***	0.3321*	0.3824*	0.9742***	−1.1716***	−0.2245	0.1266	0.3001	0.7090**
	(0.1741)	(0.1746)	(0.1820)	(0.2033)	(0.1685)	(0.3210)	(0.3400)	(0.3574)	(0.3959)	(0.3587)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	5836.91***	3278.63***	1613.98***	896.02***	2803.42***	2141.21***	1251.86***	647.13***	316.12***	983.60***
Obs.	9637	7715	6104	4653	4484	3173	2527	2003	1518	1442
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×ESG vs. *DLCOAL×ESG*	75.82***	54.42***	34.67***	52.61***	34.27***	14.61***	17.26***	19.94***	4.72**	5.66**

Notes: This table shows the moderating effect of firm ESG (environmental, social, and governance) engagement on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) and (6)–(10) for high and low economic development regions, respectively. Firm ESG engagement (*ESG*) is measured by the ESG index developed by Sino-Securities Index Information Service (Shanghai) Co. Ltd. for listed firms in China. It ranges between one and nine; a higher score indicating a higher level of ESG engagement. *LNPATENT*$_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. *LNPATENT* $_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. *LNCITATION*$_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. *LNCITATION*$_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for four years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 13
Varieties in state capitalism, innovation, and economic policy uncertainty: manufacturing vs. nonmanufacturing industry.

	Manufacturing industry					*Nonmanufacturing industry*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_{t}$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNPATENT_{t}$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$
Panel A: Patent quantity										
Panel A1: Main results										
LNEPU	−0.0347	0.2921***	0.2832***	−0.4844***	−0.2356***	−0.0461	0.1930***	0.2368***	−0.3241***	−0.1207**
	(0.0377)	(0.0395)	(0.0413)	(0.0568)	(0.0386)	(0.0496)	(0.0517)	(0.0526)	(0.0692)	(0.0589)
DCENTRAL	−0.3714	−0.1430	−0.2619	−0.0359	−0.8470**	−0.5819	−0.4906	−0.7101	−0.7633	−1.5904***
	(0.4197)	(0.4484)	(0.4612)	(0.5118)	(0.3628)	(0.4432)	(0.4609)	(0.4685)	(0.5277)	(0.4596)
DLOCAL	−0.5121	−0.3849	−0.4325	−1.0461***	−0.9845***	−0.0010	0.2055	0.3167	−0.9052**	−0.0449
	(0.3405)	(0.3582)	(0.3683)	(0.4060)	(0.2798)	(0.3392)	(0.3518)	(0.3574)	(0.4153)	(0.3618)
DCENTRAL×LNEPU	0.0363**	0.0624***	0.0656***	0.0774***	0.0420**	0.0258	0.0476**	0.0766***	0.1002***	0.0564**
	(0.0155)	(0.0175)	(0.0191)	(0.0208)	(0.0207)	(0.0173)	(0.0194)	(0.0208)	(0.0226)	(0.0274)
DLOCAL×LNEPU	−0.0252*	−0.0099	−0.0072	0.0121	−0.0336**	−0.0357***	−0.0467***	−0.0380**	−0.0330*	−0.0477**
	(0.0129)	(0.0144)	(0.0156)	(0.0169)	(0.0162)	(0.0135)	(0.0150)	(0.0163)	(0.0175)	(0.0217)
RDTA	0.1137***	0.0974***	0.0829***	0.0632***	0.0334***	0.0655***	0.0431***	0.0310***	0.0119	0.0408***
	(0.0089)	(0.0099)	(0.0112)	(0.0125)	(0.0087)	(0.0088)	(0.0094)	(0.0102)	(0.0122)	(0.0106)
SIZE	0.0342***	0.0055	−0.0012	−0.0283***	0.0095	0.0403***	0.0348***	0.0244**	0.0031	0.0178*
	(0.0092)	(0.0097)	(0.0101)	(0.0108)	(0.0074)	(0.0099)	(0.0104)	(0.0106)	(0.0116)	(0.0101)
LEVERAGE	0.2278**	0.1265	0.0567	−0.0367	0.0805	0.2219**	0.1612	0.0578	−0.1276	0.2028
	(0.0935)	(0.1100)	(0.1250)	(0.1421)	(0.1189)	(0.1030)	(0.1183)	(0.1321)	(0.1517)	(0.1539)
ROA	−0.0292	0.5384**	1.1869***	0.8027***	0.5334**	−0.1644	0.0714	0.3025	0.1223	0.3458
	(0.1830)	(0.2161)	(0.2437)	(0.3043)	(0.2588)	(0.2135)	(0.2495)	(0.2807)	(0.3393)	(0.3860)
TREND	0.1123***	0.0885***	0.0486***	0.0961***	0.2282***	0.0623***	0.0602***	0.0443***	0.0756***	0.1406***
	(0.0047)	(0.0057)	(0.0073)	(0.0120)	(0.0082)	(0.0047)	(0.0055)	(0.0069)	(0.0115)	(0.0099)
Constant	0.6523**	−0.1042	0.3863	4.7336***	3.4115***	−0.3019	−1.1285***	−1.0233***	2.0512***	0.9201**
	(0.2749)	(0.2949)	(0.3040)	(0.3360)	(0.2347)	(0.3357)	(0.3565)	(0.3616)	(0.4131)	(0.3643)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	1395.31***	797.85***	386.15***	175.93***	1477.06***	588.27***	466.85***	375.45***	334.92***	561.12***
Obs.	9989	8227	6756	5400	5207	5447	4511	3746	3021	2926
Panel A2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×LNEPU vs. *DLCOAL×LNEPU*	15.46***	17.05***	14.66***	10.01***	16.82***	13.41***	25.52***	33.20***	38.82***	16.62***

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_{t}$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_{t}$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel B: Patent quality										
Panel B1: Main results										
LNEPU	−0.0582**	0.0964***	0.1312***	−0.1653***	−0.1690***	−0.0715*	0.0407	0.0740*	−0.0602	0.0019
	(0.0273)	(0.0276)	(0.0271)	(0.0341)	(0.0288)	(0.0428)	(0.0428)	(0.0409)	(0.0493)	(0.0518)
DCENTRAL	0.2488	0.4419	0.4580	0.5152*	0.7557***	−0.9216**	−0.4143	−0.3788	−0.4814	−0.5319
	(0.3057)	(0.3159)	(0.3064)	(0.3130)	(0.2740)	(0.3835)	(0.3837)	(0.3680)	(0.3823)	(0.4066)
DLOCAL	0.1383	0.1677	0.0795	−0.4921**	−0.2012	0.4510	0.4246	0.2039	0.3068	0.6734**
	(0.2479)	(0.2520)	(0.2442)	(0.2473)	(0.2107)	(0.2936)	(0.2931)	(0.2813)	(0.3014)	(0.3202)

(*continued on next page*)

Table 13 (*continued*)

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
DCENTRAL×*LNEPU*	0.1303***	0.1268***	0.1360***	0.1163***	0.1121***	0.1111***	0.1067***	0.1013***	0.1100***	0.1027***
	(0.0130)	(0.0146)	(0.0159)	(0.0170)	(0.0174)	(0.0169)	(0.0189)	(0.0206)	(0.0225)	(0.0263)
DLOCAL×*LNEPU*	0.0505***	0.0477***	0.0537***	0.0442***	0.0567***	0.0151	0.0072	0.0063	−0.0113	0.0110
	(0.0108)	(0.0119)	(0.0129)	(0.0136)	(0.0135)	(0.0133)	(0.0147)	(0.0162)	(0.0175)	(0.0208)
RDTA	0.0885***	0.0799***	0.0540***	0.0401***	0.0323***	0.0778***	0.0810***	0.0690***	0.0466***	0.0609***
	(0.0065)	(0.0071)	(0.0076)	(0.0078)	(0.0066)	(0.0077)	(0.0079)	(0.0080)	(0.0089)	(0.0093)
SIZE	0.0282***	0.0157**	0.0004	0.0083	0.0002	0.0440***	0.0406***	0.0232***	0.0189**	0.0220**
	(0.0068)	(0.0069)	(0.0067)	(0.0066)	(0.0055)	(0.0087)	(0.0088)	(0.0085)	(0.0084)	(0.0089)
LEVERAGE	0.3694***	0.2725***	0.2104**	0.1441	0.1153	0.4584***	0.4501***	0.1295	0.1141	0.1111
	(0.0713)	(0.0826)	(0.0917)	(0.1010)	(0.0933)	(0.0920)	(0.1034)	(0.1121)	(0.1235)	(0.1386)
ROA	0.1826	0.4718***	0.7007***	0.5477***	0.3744*	0.1994	0.1862	−0.0591	−0.0194	0.3707
	(0.1345)	(0.1536)	(0.1671)	(0.2078)	(0.2006)	(0.1858)	(0.2104)	(0.2263)	(0.2769)	(0.3513)
TREND	0.2820***	0.2823***	0.2661***	0.2519***	0.3956***	0.1430***	0.1440***	0.1376***	0.1486***	0.2229***
	(0.0035)	(0.0041)	(0.0049)	(0.0072)	(0.0062)	(0.0041)	(0.0046)	(0.0055)	(0.0082)	(0.0087)
Constant	−0.7091***	−0.8008***	−0.2208	1.5394***	1.9064***	−0.8163***	−1.2249***	−0.7026**	0.1069	−0.1375
	(0.2025)	(0.2102)	(0.2043)	(0.2070)	(0.1784)	(0.2941)	(0.3006)	(0.2891)	(0.3038)	(0.3239)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	10,701.15***	7616.86***	4854.21***	2431.58***	8068.83***	2139.29***	1710.96***	1167.85***	787.01***	1438.88***
Obs.	9989	8227	6756	5400	5207	5447	4511	3746	3021	2926
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×*LNEPU* vs. *DLCOAL*×*LNEPU*	40.24***	32.66***	31.19***	21.98***	14.16***	34.73***	30.09***	23.89***	33.62***	14.30***

Notes: This table shows the moderating effect of economic policy uncertainty on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) for manufacturing industry and Columns (6)–(10) for nonmanufacturing industry. Following Phan et al. (2021), economic policy uncertainty (*EPU*) is measured by the Economic Policy Uncertainty Index constructed by Baker et al. (2016). A higher *EPU* score indicates a higher level of policy-related economic uncertainty. *LNEPU* is the logarithm of *EPU*. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from t to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 14
Varieties in state capitalism, innovation, and economic policy uncertainty: high vs. low economic development region.

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LNPATENT$_t$	*LNPATENT*$_{t+1}$	*LNPATENT*$_{t+2}$	*LNPATENT*$_{t+3}$	*LNPATENT*$_{t\sim t+3}$	*LNPATENT*$_t$	*LNPATENT*$_{t+1}$	*LNPATENT*$_{t+2}$	*LNPATENT*$_{t+3}$	*LNPATENT*$_{t\sim t+3}$
Panel A: Patent quantity										
Panel A: Main results										
LNEPU	−0.0379	0.2794***	0.2936***	−0.4180***	−0.1587***	−0.0005	0.2281***	0.1750**	−0.5246***	−0.2709***
	(0.0336)	(0.0350)	(0.0362)	(0.0498)	(0.0362)	(0.0694)	(0.0743)	(0.0780)	(0.0995)	(0.0732)
DCENTRAL	−0.4831	−0.3183	−0.5797	−0.1276	−1.0751***	0.1416	0.2191	0.1499	−0.6637	−1.0160*
	(0.3627)	(0.3841)	(0.3915)	(0.4328)	(0.3295)	(0.6293)	(0.6789)	(0.7033)	(0.7887)	(0.5978)
DLOCAL	−0.2706	0.0621	−0.0278	−0.8401**	−0.3500	−0.0919	−0.2273	−0.4069	−1.7566***	−1.2212***
	(0.2902)	(0.3027)	(0.3088)	(0.3454)	(0.2576)	(0.4752)	(0.5085)	(0.5288)	(0.5954)	(0.4445)
DCENTRAL×*LNEPU*	0.0161	0.0402**	0.0585***	0.0865***	0.0133	0.0536**	0.0852***	0.0779***	0.0873***	0.0496
	(0.0143)	(0.0162)	(0.0175)	(0.0190)	(0.0207)	(0.0211)	(0.0239)	(0.0259)	(0.0284)	(0.0302)
DLOCAL×*LNEPU*	−0.0421***	−0.0421***	−0.0371***	−0.0163	−0.0658***	−0.0233	−0.0213	−0.0202	0.0077	−0.0633***
	(0.0119)	(0.0133)	(0.0143)	(0.0153)	(0.0163)	(0.0167)	(0.0188)	(0.0206)	(0.0227)	(0.0233)
RDTA	0.0890***	0.0679***	0.0531***	0.0332***	0.0377***	0.1841***	0.1798***	0.1392***	0.1325***	0.1072***
	(0.0069)	(0.0076)	(0.0085)	(0.0097)	(0.0072)	(0.0176)	(0.0198)	(0.0224)	(0.0277)	(0.0212)
SIZE	0.0313***	0.0127	0.0043	−0.0213**	0.0080	0.0417***	0.0179	0.0125	−0.0130	0.0122
	(0.0081)	(0.0085)	(0.0087)	(0.0094)	(0.0069)	(0.0133)	(0.0146)	(0.0152)	(0.0163)	(0.0120)
LEVERAGE	0.0249	−0.0517	−0.0729	−0.1348	0.0296	0.3263**	0.2316	0.1342	−0.0438	−0.0647
	(0.0838)	(0.0978)	(0.1107)	(0.1254)	(0.1118)	(0.1345)	(0.1588)	(0.1778)	(0.2050)	(0.1840)
ROA	−0.0373	0.5146**	1.3864***	0.8553***	0.7978***	−0.0776	0.2685	0.4311	0.3703	0.0572
	(0.1840)	(0.2255)	(0.2576)	(0.3013)	(0.2681)	(0.2218)	(0.2524)	(0.2827)	(0.3669)	(0.3769)
TREND	0.0926***	0.0781***	0.0479***	0.0913***	0.1926***	0.1013***	0.0833***	0.0620***	0.1015***	0.2191***
	(0.0041)	(0.0048)	(0.0061)	(0.0102)	(0.0075)	(0.0070)	(0.0085)	(0.0110)	(0.0177)	(0.0133)
Constant	0.2307	−0.6412**	−0.3911	3.2651***	2.3057***	−0.2800	−0.6938	−0.3668	3.6601***	2.4635***
	(0.2618)	(0.2793)	(0.2871)	(0.3195)	(0.2423)	(0.4890)	(0.5340)	(0.5557)	(0.6174)	(0.4750)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	1543.92***	1026.93***	732.47***	557.17***	1468.90***	779.62***	548.18***	352.62***	255.15***	755.37***
Obs.	11,516	9502	7827	6271	6072	3920	3236	2675	2150	2061
Panel B: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×*LNEPU* vs. *DLCOAL*×*LNEPU*	15.34***	24.56***	28.58***	28.27***	15.98***	15.69***	23.81***	17.63***	9.99***	21.39***

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LNCITATION$_t$	*LNCITATION*$_{t+1}$	*LNCITATION*$_{t+2}$	*LNCITATION*$_{t+3}$	*LNCITATION*$_{t\sim t+3}$	*LNCITATION*$_t$	*LNCITATION*$_{t+1}$	*LNCITATION*$_{t+2}$	*LNCITATION*$_{t+3}$	*LNCITATION*$_{t\sim t+3}$
Panel B: Patent quality										
Panel B1: Main results										
LNEPU	−0.0530**	0.0984***	0.1545***	−0.0663**	−0.0168	0.0125	0.0547	0.0538	−0.2136***	−0.2078***
	(0.0263)	(0.0262)	(0.0253)	(0.0311)	(0.0287)	(0.0525)	(0.0539)	(0.0536)	(0.0643)	(0.0615)
DCENTRAL	0.0356	0.4247	0.2574	0.1929	0.5108*	−0.1879	−0.2518	0.3763	0.2647	0.2372
	(0.2857)	(0.2902)	(0.2781)	(0.2764)	(0.2640)	(0.4774)	(0.4935)	(0.4865)	(0.5147)	(0.5021)
DLOCAL	0.5532**	0.5463**	0.5217**	0.3978*	0.9374***	0.3973	0.0410	−0.1327	−0.6398*	−0.5026
	(0.2285)	(0.2284)	(0.2190)	(0.2200)	(0.2058)	(0.3605)	(0.3696)	(0.3659)	(0.3880)	(0.3734)

(*continued on next page*)

Table 14 (*continued*)

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
DCENTRAL×LNEPU	0.1281***	0.1182***	0.1206***	0.1154***	0.0952***	0.0859***	0.1041***	0.1216***	0.1065***	0.1092***
	(0.0129)	(0.0145)	(0.0157)	(0.0168)	(0.0184)	(0.0168)	(0.0189)	(0.0208)	(0.0229)	(0.0256)
DLOCAL×LNEPU	0.0247**	0.0179	0.0283**	0.0169	0.0206	0.0033	0.0055	0.0073	0.0164	0.0247
	(0.0107)	(0.0118)	(0.0127)	(0.0133)	(0.0143)	(0.0133)	(0.0148)	(0.0164)	(0.0180)	(0.0198)
RDTA	0.0866***	0.0805***	0.0619***	0.0431***	0.0475***	0.1729***	0.1782***	0.1437***	0.1079***	0.1258***
	(0.0055)	(0.0058)	(0.0061)	(0.0062)	(0.0057)	(0.0135)	(0.0146)	(0.0158)	(0.0184)	(0.0177)
SIZE	0.0323***	0.0319***	0.0102*	0.0106*	0.0057	0.0392***	0.0058	0.0045	0.0068	−0.0008
	(0.0065)	(0.0065)	(0.0062)	(0.0059)	(0.0055)	(0.0101)	(0.0107)	(0.0106)	(0.0106)	(0.0101)
LEVERAGE	0.3015***	0.2374***	0.0763	0.0605	−0.0404	0.4592***	0.3840***	0.2455*	0.0643	0.1121
	(0.0685)	(0.0780)	(0.0856)	(0.0917)	(0.0916)	(0.1038)	(0.1200)	(0.1326)	(0.1494)	(0.1552)
ROA	0.2742*	0.3916**	0.5658***	0.6716***	0.5782***	−0.0244	0.1231	0.1188	−0.2535	−0.0703
	(0.1455)	(0.1718)	(0.1886)	(0.2042)	(0.2154)	(0.1689)	(0.1847)	(0.2002)	(0.2789)	(0.3200)
TREND	0.2370***	0.2333***	0.2170***	0.2070***	0.3204***	0.2160***	0.2213***	0.2112***	0.2213***	0.3425***
	(0.0032)	(0.0037)	(0.0043)	(0.0064)	(0.0059)	(0.0054)	(0.0063)	(0.0077)	(0.0116)	(0.0112)
Constant	−0.6614***	−1.2375***	−0.7605***	0.4861**	0.6865***	−1.1909***	−0.5554	−0.2315	0.9873**	1.3891***
	(0.2085)	(0.2132)	(0.2065)	(0.2063)	(0.1944)	(0.3712)	(0.3894)	(0.3891)	(0.4073)	(0.3988)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	8605.83***	6257.09***	4075.70***	2230.73***	5886.73***	3211.45***	2455.30***	1596.06***	941.63***	2178.84***
Obs.	11,516	9502	7827	6271	6072	3920	3236	2675	2150	2061
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×LNEPU vs. *DLCOAL×LNEPU*	62.22***	48.07***	35.79***	36.85***	19.17***	29.24***	33.75***	39.77***	22.24***	16.70***

Notes: This table shows the moderating effect of economic policy uncertainty on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) and (6)–(10) for high and low economic development regions, respectively. Following Phan et al. (2021), economic policy uncertainty (*EPU*) is measured by the Economic Policy Uncertainty Index constructed by Baker et al. (2016). A higher *EPU* score indicates a higher level of policy-related economic uncertainty. *LNEPU* is the logarithm of *EPU*. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to *t* + *3*. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to *t* + *3*. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 15
Varieties in state capitalism, innovation, and corruption: manufacturing vs. nonmanufacturing industry.

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_{t}$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNPATENT_{t}$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$
Panel A: Patent quantity										
Panel A1: Main results										
CPI	0.4276***	0.6481***	−1.7383***	−2.0293***	−0.9709***	0.1580*	0.3769***	−1.1052***	−1.4123***	−0.6249***
	(0.0721)	(0.0752)	(0.1280)	(0.1464)	(0.1020)	(0.0953)	(0.0974)	(0.1437)	(0.1769)	(0.1533)
DCENTRAL	−1.3664**	−1.9300***	−0.3474	0.8008	−1.7876***	−2.7506***	−3.0294***	−2.9642***	−1.4830	−3.8120***
	(0.6007)	(0.6218)	(0.6656)	(0.9376)	(0.6666)	(0.6361)	(0.6418)	(0.6817)	(0.9733)	(0.8426)
DLOCAL	−0.9999**	−1.9193***	−1.1864**	−0.6990	−1.4152***	0.1388	−0.0191	−1.0114*	−1.8285**	−0.1202
	(0.5010)	(0.5099)	(0.5429)	(0.7653)	(0.5267)	(0.4800)	(0.4822)	(0.5220)	(0.7419)	(0.6424)
DCENTRAL×CPI	0.0509**	0.0874***	0.0660***	0.0884***	0.0563**	0.0367	0.0708***	0.0844***	0.1254***	0.0839**
	(0.0209)	(0.0238)	(0.0254)	(0.0275)	(0.0277)	(0.0234)	(0.0263)	(0.0278)	(0.0302)	(0.0370)
DLOCAL×CPI	−0.0303*	−0.0083	−0.0227	0.0071	−0.0464**	−0.0482***	−0.0563***	−0.0587***	−0.0459**	−0.0694**
	(0.0174)	(0.0196)	(0.0207)	(0.0225)	(0.0218)	(0.0182)	(0.0204)	(0.0217)	(0.0233)	(0.0292)
RDTA	0.1034***	0.0892***	0.0948***	0.0713***	0.0355***	0.0624***	0.0399***	0.0421***	0.0185	0.0440***
	(0.0089)	(0.0099)	(0.0112)	(0.0124)	(0.0087)	(0.0088)	(0.0094)	(0.0103)	(0.0122)	(0.0106)
SIZE	0.0218**	−0.0398***	0.0640***	0.0479***	0.0430***	0.0367***	0.0083	0.0530***	0.0449***	0.0351***
	(0.0091)	(0.0096)	(0.0116)	(0.0120)	(0.0084)	(0.0098)	(0.0103)	(0.0120)	(0.0127)	(0.0112)
LEVERAGE	0.2336**	0.1742	0.0522	−0.0934	0.0785	0.2287**	0.2069*	0.0129	−0.2092	0.1719
	(0.0932)	(0.1097)	(0.1238)	(0.1398)	(0.1184)	(0.1026)	(0.1178)	(0.1325)	(0.1507)	(0.1542)
ROA	0.0397	0.6681***	0.6575***	0.4248	0.2961	−0.1559	0.1234	0.0508	−0.1000	0.1566
	(0.1822)	(0.2148)	(0.2449)	(0.3015)	(0.2595)	(0.2126)	(0.2477)	(0.2824)	(0.3373)	(0.3876)
TREND	0.0994***	0.0636***	0.2014***	0.1675***	0.2581***	0.0535***	0.0445***	0.1247***	0.1155***	0.1578***
	(0.0048)	(0.0061)	(0.0125)	(0.0130)	(0.0091)	(0.0048)	(0.0061)	(0.0120)	(0.0126)	(0.0110)
Constant	−0.7600***	−0.0151	6.2589***	7.9252***	4.9980***	−0.9788**	−0.9709**	3.2980***	4.6140***	2.1894***
	(0.2945)	(0.3027)	(0.3799)	(0.4647)	(0.3232)	(0.3873)	(0.3928)	(0.4674)	(0.6041)	(0.5264)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	1493.01***	888.37***	477.81***	318.54***	1539.39***	625.97***	513.19***	399.08***	391.84***	578.21***
Obs.	9989	8227	6756	5400	5207	5447	4511	3746	3021	2926
Panel A2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×CPI vs. *DLCOAL×CPI*	14.84***	16.36***	12.35***	8.60***	17.01***	14.01***	25.19***	29.15***	35.85***	19.77***

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_{t}$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_{t}$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel B: Patent quality										
Panel B1: Main results										
CPI	0.1672***	0.1511***	−1.0214***	−0.8503***	−0.8259***	−0.0817	0.0607	−0.3330***	−0.3829***	−0.2328*
	(0.0525)	(0.0532)	(0.0847)	(0.0890)	(0.0760)	(0.0824)	(0.0813)	(0.1125)	(0.1275)	(0.1351)
DCENTRAL	−0.4493	0.2607	0.9270**	0.7218	1.3304***	−2.6154***	−1.7520***	−1.0658**	−0.8730	−1.2005
	(0.4384)	(0.4411)	(0.4407)	(0.5690)	(0.4971)	(0.5503)	(0.5365)	(0.5333)	(0.7000)	(0.7429)
DLOCAL	−0.0806	0.0332	0.2565	−0.3101	0.0891	0.8916**	0.8659**	1.0488**	1.0476*	1.3369**
	(0.3655)	(0.3614)	(0.3587)	(0.4637)	(0.3921)	(0.4153)	(0.4033)	(0.4097)	(0.5358)	(0.5670)
DCENTRAL×CPI	0.1763***	0.1720***	0.1715***	0.1495***	0.1416***	0.1485***	0.1419***	0.1277***	0.1474***	0.1400***

(*continued on next page*)

Table 15 (*continued*)

	Manufacturing industry					Nonmanufacturing industry				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
	(0.0176)	(0.0197)	(0.0213)	(0.0228)	(0.0233)	(0.0228)	(0.0255)	(0.0277)	(0.0304)	(0.0356)
DLOCAL×CPI	0.0698***	0.0652***	0.0657***	0.0560***	0.0718***	0.0192	0.0118	0.0073	−0.0218	0.0074
	(0.0145)	(0.0161)	(0.0171)	(0.0183)	(0.0182)	(0.0179)	(0.0198)	(0.0218)	(0.0235)	(0.0280)
RDTA	0.0835***	0.0793***	0.0609***	0.0436***	0.0356***	0.0771***	0.0796***	0.0695***	0.0484***	0.0628***
	(0.0066)	(0.0071)	(0.0075)	(0.0077)	(0.0065)	(0.0078)	(0.0079)	(0.0081)	(0.0089)	(0.0093)
SIZE	0.0255***	0.0033	0.0449***	0.0415***	0.0347***	0.0467***	0.0352***	0.0368***	0.0365***	0.0342***
	(0.0067)	(0.0069)	(0.0078)	(0.0074)	(0.0063)	(0.0086)	(0.0087)	(0.0096)	(0.0094)	(0.0099)
LEVERAGE	0.3682***	0.2821***	0.2176**	0.1346	0.1146	0.4636***	0.4612***	0.0995	0.0766	0.0797
	(0.0712)	(0.0826)	(0.0910)	(0.1003)	(0.0924)	(0.0918)	(0.1031)	(0.1125)	(0.1236)	(0.1390)
ROA	0.2138	0.4963***	0.3610**	0.3190	0.1001	0.1990	0.2010	−0.1635	−0.1514	0.2058
	(0.1344)	(0.1538)	(0.1678)	(0.2076)	(0.2003)	(0.1852)	(0.2097)	(0.2271)	(0.2772)	(0.3534)
TREND	0.2748***	0.2781***	0.3595***	0.2883***	0.4297***	0.1413***	0.1424***	0.1747***	0.1696***	0.2403***
	(0.0035)	(0.0044)	(0.0082)	(0.0079)	(0.0068)	(0.0042)	(0.0051)	(0.0094)	(0.0090)	(0.0096)
Constant	−1.5122***	−0.6144***	2.9068***	3.0142***	3.2583***	−0.9161***	−1.1372***	0.4638	0.7789*	0.4186
	(0.2162)	(0.2159)	(0.2509)	(0.2836)	(0.2423)	(0.3374)	(0.3307)	(0.3668)	(0.4384)	(0.4657)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	10,772.37***	7615.12***	5022.78***	2532.57***	8315.38***	2176.25***	1741.48***	1194.70***	806.26***	1445.14***
Obs.	9989	8227	6756	5400	5207	5447	4511	3746	3021	2926
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×CPI vs. *DLCOAL×CPI*	39.36***	32.75***	28.93***	20.20***	12.42***	34.67***	28.40***	21.24***	35.91***	16.34***

Notes: This table shows the moderating impact of corruption on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) for manufacturing industry and Columns (6)–(10) for nonmanufacturing industry. Following Chen et al. (2015), we use the Transparency International's Corruption Perceptions Index (CPI) developed by Lambsdorff (2008) to measure corruption. *CPI* indicates the perceived level of prevailing corruption on a scale of 0–10, with a higher score suggesting a higher economic and political integrity. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted to a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted to a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table 16
Varieties in state capitalism, innovation, and corruption: high vs. low economic development region.

	High economic development region					*Low economic development region*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$	$LNPATENT_t$	$LNPATENT_{t+1}$	$LNPATENT_{t+2}$	$LNPATENT_{t+3}$	$LNPATENT_{t\sim t+3}$
Panel A: Patent quantity										
Panel A: Main results										
CPI	0.3880***	0.6486***	−1.4660***	−1.7828***	−0.7530***	0.3392**	0.3122**	−1.8241***	−2.1445***	−1.0829***
	(0.0642)	(0.0666)	(0.1115)	(0.1281)	(0.0954)	(0.1319)	(0.1379)	(0.2093)	(0.2540)	(0.1908)
DCENTRAL	−1.5822***	−1.9529***	−0.9399*	0.1793	−2.4062***	−1.4467	−2.4619***	−1.9044*	−0.8086	−2.1629**
	(0.5177)	(0.5304)	(0.5612)	(0.7900)	(0.5971)	(0.9081)	(0.9458)	(1.0266)	(1.4408)	(1.0936)
DLOCAL	0.1233	−0.2334	−0.8371*	−1.0751*	−0.3149	−0.4051	−2.0184***	−2.6232***	−2.6419**	−1.8321**
	(0.4181)	(0.4229)	(0.4496)	(0.6300)	(0.4672)	(0.6741)	(0.6944)	(0.7591)	(1.0780)	(0.8060)
DCENTRAL×CPI	0.0237	0.0614***	0.0595**	0.0984***	0.0190	0.0768***	0.1192***	0.0810**	0.1089***	0.0675*
	(0.0194)	(0.0220)	(0.0233)	(0.0253)	(0.0279)	(0.0286)	(0.0323)	(0.0344)	(0.0379)	(0.0406)
DLOCAL×CPI	−0.0558***	−0.0522***	−0.0570***	−0.0264	−0.0927***	−0.0305	−0.0259	−0.0428	0.0100	−0.0862***
	(0.0160)	(0.0181)	(0.0190)	(0.0204)	(0.0220)	(0.0226)	(0.0255)	(0.0274)	(0.0302)	(0.0315)
RDTA	0.0826***	0.0631***	0.0665***	0.0402***	0.0404***	0.1735***	0.1714***	0.1478***	0.1410***	0.1106***
	(0.0069)	(0.0076)	(0.0085)	(0.0096)	(0.0072)	(0.0177)	(0.0198)	(0.0222)	(0.0275)	(0.0211)
SIZE	0.0221***	−0.0279***	0.0576***	0.0457***	0.0354***	0.0315**	−0.0152	0.0678***	0.0499***	0.0429***
	(0.0080)	(0.0085)	(0.0101)	(0.0105)	(0.0079)	(0.0132)	(0.0146)	(0.0170)	(0.0179)	(0.0135)
LEVERAGE	0.0408	−0.0017	−0.1194	−0.2192*	0.0070	0.3162**	0.2698*	0.0794	−0.1137	−0.0855
	(0.0835)	(0.0976)	(0.1102)	(0.1238)	(0.1115)	(0.1341)	(0.1582)	(0.1759)	(0.2020)	(0.1833)
ROA	0.0266	0.6493***	0.7722***	0.4433	0.5432**	−0.0653	0.3203	0.1402	0.1310	−0.1238
	(0.1834)	(0.2244)	(0.2604)	(0.3000)	(0.2699)	(0.2206)	(0.2505)	(0.2818)	(0.3623)	(0.3769)
TREND	0.0815***	0.0567***	0.1798***	0.1524***	0.2182***	0.0904***	0.0644***	0.1887***	0.1671***	0.2481***
	(0.0041)	(0.0052)	(0.0107)	(0.0111)	(0.0083)	(0.0070)	(0.0091)	(0.0183)	(0.0191)	(0.0146)
Constant	−1.1074***	−0.7071**	4.8030***	6.0974***	3.6044***	−1.2528**	−0.0176	5.5824***	7.3919***	4.3473***
	(0.2796)	(0.2872)	(0.3487)	(0.4252)	(0.3189)	(0.5476)	(0.5745)	(0.6980)	(0.8743)	(0.6625)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	1625.22***	1105.09***	794.19***	709.31***	1520.64***	809.70***	576.73***	418.08***	315.18***	779.12***
Obs.	11,516	9502	7827	6271	6072	3920	3236	2675	2150	2061
Panel B: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×CPI vs. *DLCOAL×CPI*	15.69***	25.47***	24.09***	23.33***	17.51***	16.78***	24.24***	15.99***	8.53***	21.54***

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
Panel B: Patent quality										
Panel B1: Main results										
CPI	0.1482***	0.1984***	−0.5714***	−0.5191***	−0.3980***	0.1100	0.0112	−1.0831***	−0.9973***	−0.8671***
	(0.0505)	(0.0503)	(0.0786)	(0.0809)	(0.0755)	(0.1001)	(0.1008)	(0.1448)	(0.1651)	(0.1599)
DCENTRAL	−0.3198	0.2124	0.7237*	0.3286	0.9164*	−2.2256***	−1.2050*	−0.2568	0.0058	0.0559
	(0.4083)	(0.4023)	(0.3967)	(0.4983)	(0.4734)	(0.6896)	(0.6929)	(0.7123)	(0.9368)	(0.9167)
DLOCAL	1.3671***	1.3724***	1.6338***	1.1830***	2.0071***	0.2337	−0.1564	−0.2887	−0.7526	−0.5602
	(0.3296)	(0.3204)	(0.3174)	(0.3980)	(0.3702)	(0.5118)	(0.5085)	(0.5264)	(0.7006)	(0.6759)
DCENTRAL×CPI	0.1730***	0.1618***	0.1590***	0.1513***	0.1211***	0.1189***	0.1398***	0.1477***	0.1364***	0.1408***

(*continued on next page*)

Table 16 (*continued*)

	High economic development region					Low economic development region				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$	$LNCITATION_t$	$LNCITATION_{t+1}$	$LNCITATION_{t+2}$	$LNCITATION_{t+3}$	$LNCITATION_{t\sim t+3}$
	(0.0175)	(0.0196)	(0.0210)	(0.0225)	(0.0248)	(0.0227)	(0.0255)	(0.0278)	(0.0308)	(0.0345)
DLOCAL×CPI	0.0326**	0.0252	0.0375**	0.0167	0.0192	0.0044	0.0079	0.0013	0.0188	0.0292
	(0.0144)	(0.0159)	(0.0170)	(0.0179)	(0.0193)	(0.0179)	(0.0200)	(0.0219)	(0.0243)	(0.0267)
RDTA	0.0841***	0.0794***	0.0663***	0.0460***	0.0505***	0.1677***	0.1777***	0.1480***	0.1117***	0.1292***
	(0.0055)	(0.0058)	(0.0061)	(0.0062)	(0.0057)	(0.0135)	(0.0146)	(0.0156)	(0.0183)	(0.0177)
SIZE	0.0327***	0.0219***	0.0366***	0.0351***	0.0291***	0.0353***	−0.0014	0.0477***	0.0392***	0.0284**
	(0.0064)	(0.0065)	(0.0072)	(0.0067)	(0.0062)	(0.0101)	(0.0107)	(0.0119)	(0.0117)	(0.0113)
LEVERAGE	0.3033***	0.2363***	0.0317	0.0333	−0.0676	0.4546***	0.3975***	0.2041	0.0345	0.0948
	(0.0685)	(0.0779)	(0.0855)	(0.0913)	(0.0913)	(0.1035)	(0.1198)	(0.1312)	(0.1484)	(0.1544)
ROA	0.2941**	0.4310**	0.2876	0.4750**	0.3375	−0.0140	0.1333	−0.0822	−0.4220	−0.2524
	(0.1455)	(0.1718)	(0.1907)	(0.2048)	(0.2165)	(0.1682)	(0.1845)	(0.1995)	(0.2778)	(0.3199)
TREND	0.2327***	0.2316***	0.2842***	0.2369***	0.3487***	0.2108***	0.2192***	0.2978***	0.2574***	0.3708***
	(0.0033)	(0.0040)	(0.0075)	(0.0070)	(0.0066)	(0.0054)	(0.0067)	(0.0127)	(0.0125)	(0.0122)
Constant	−1.4420***	−1.2639***	1.2837***	1.4297***	1.4655***	−1.4257***	−0.1898	2.8342***	2.7991***	2.8473***
	(0.2222)	(0.2193)	(0.2468)	(0.2710)	(0.2538)	(0.4164)	(0.4217)	(0.4857)	(0.5721)	(0.5560)
Industry F.E	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Wald chi^2	8630.84***	6284.85***	4128.18***	2302.10***	5995.40***	3256.90***	2458.31***	1688.67***	987.44***	2220.85***
Obs.	11,516	9502	7827	6271	6072	3920	3236	2675	2150	2061
Panel B2: Test of equality in coefficients (Chi^2 statistics)										
DCENTRAL×CPI vs. *DLCOAL×CPI*	62.95***	48.99***	34.55***	37.87***	19.71***	30.95***	33.32***	36.98***	20.62***	15.86***

Notes: This table shows the moderating impact of corruption on the relationship between central government ownership and innovation performance estimated using Tobit regression for panel data. Columns (1)–(5) and (6)–(10) for high and low economic development regions, respectively. Following Chen et al. (2015), we use the Transparency International's Corruption Perceptions Index (CPI) developed by Lambsdorff (2008) to measure corruption. *CPI* indicates the perceived level of prevailing corruption on a scale of 0–10, with a higher score suggesting a higher economic and political integrity. $LNPATENT_t$ is measured by the logarithm of one plus the number of patents granted by a company in year *t*. $LNPATENT_{t\sim t+3}$ is measured by the logarithm of one plus the total number of patents granted by a company for 4 years from *t* to $t+3$. $LNCITATION_t$ is the logarithm of one plus the number of future citations received by the patents granted to a company in year *t*. $LNCITATION_{t\sim t+3}$ is the logarithm of one plus the number of future citations received by the patents granted to a company for 4 years from t to $t+3$. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *RDTA* is the ratio of R&D expenditures to total assets. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

findings suggest that *Hypotheses 2b*, *3b*, *4b*, *3c*, and *4c* are valid only in the in high-economic-development region.

5. Conclusions

SOEs controlled by different levels of government become an inherent part of China's state capitalism system. Such varieties in state capitalism are characterized by institutionally derived organization differences in terms of resources, logic, behavior, and hence innovation strategies between central and local SOEs. This study investigates the impact of different forms of state ownership on innovation performance and the underlying mechanisms through which the varieties in state capitalism affect corporate innovation. The data used are listed firms in China during the 2007–2015 period. We find that central SOEs outperform their local and private peers in innovation creation in all scenarios. Private firms outperform local SOEs in terms of patent quantity, mainly in the nonmanufacturing industry and high-economic-development regions. Local SOEs outperform their private peers with respect to patent quality in the manufacturing sector and high-economic-development regions. However, in low-economic-development regions, no significant difference in innovation performance exists between local SOEs and private firms. Such an ownership–innovation nexus is then found to be more pronounced for firms with more ESG practices, during periods of higher EPU, and when less corruption is present. We use both the treatment effect model and the PSM method to address the endogeneity concerns, and our main findings are robust.

Broadly, our findings make important contributions to the corporate finance and political economy bodies of literature by showing how the institutional diversity of SOEs in emerging economies can substantially influence their innovation strategies. Specifically, our findings underscore the importance of institutional heterogeneity as a driving component of corporate innovation strategy in emerging economies. The ongoing mixed ownership reform of SOEs characterized by increasingly differentiated organizational modalities under the framework of a regionally decentralized authoritarian system (Xu, 2011) is proven to significantly affect their innovation strategies. Based on the institutional theory concerning diversity in state capitalism, we are able to identify the crucial factors that may shape national innovation policies. Our findings are in line with Atkinson and Stiglitz (1980), who suggest that SOEs are established to provide remediation for market failures because innovation deals with basic knowledge that has the nature of a public good (Arrow, 1962). We also reveal the criticality of the ability to deal with risks in the production of exploratory innovation (Holmstrom, 1989).

Furthermore, we unpack the black box of the successful "national champions" policy, showing that SOEs can be automatic stabilizers and ESG promoters. In particular, our findings echo the argument of Belloc (2014), who proposes a reconsideration of the conventional wisdom concerning SOEs and indicates that SOE inefficiency is not the result of state ownership per se but, rather, is caused by conditions to which SOEs often relate. For example, reducing corruption through enhanced legislation or organizational culture could significantly improve SOEs' innovation performance. One obvious piece of evidence is that many SOEs in Finland, such as Kemira, Metso, Outokumpu, Rautaruukkiare, and Enso, are national leaders in terms of productivity and innovativeness. As a result, the "national champions" could team up with their local peers and the vigorous private sector to become key enablers of China's plan to encourage indigenous innovation and combat global crises, such as the ongoing COVID-19 pandemic.

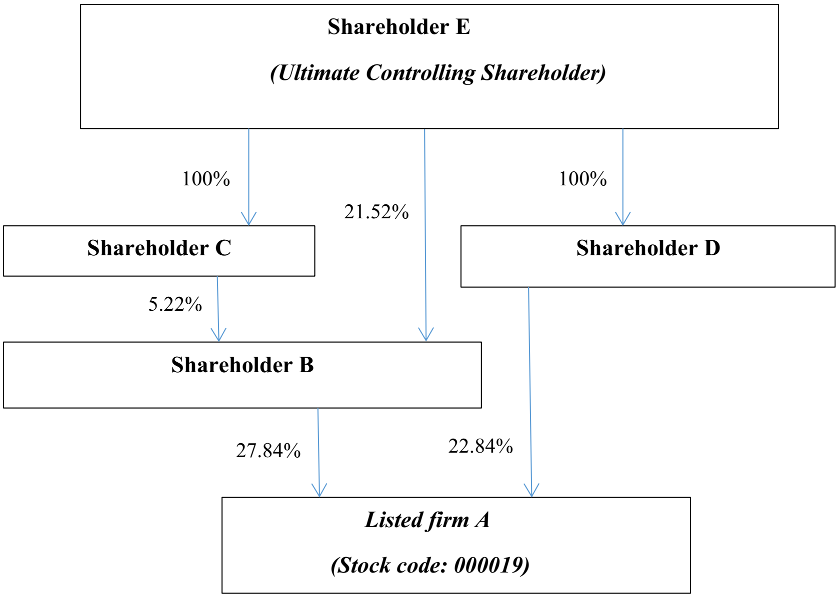
Although this paper is a pioneer study that uses a large dataset to investigate the impacts of diversity in state capitalism on corporate innovation in China, the empirical analysis remains subject to empirical limitations and drawbacks that could be considered new research opportunities. For example, because this study focuses on listed firms in China, its findings might not be valid for nonlisted firms. Thus, future research could expand the sample set by including both listed and nonlisted firms to better understand the mechanism between ownership structure and innovation in China.

Acknowledgements

We would like to thank the editor and the two anonymous reviewers for their very insightful comments and constructive suggestions on the previous version of the paper. We appreciate the comments from participants of the 2016 Research Workshop co-organized by the Technology and Management Centre for Development and the Said Business School in the University of Oxford and the 2019 New Zealand Finance Meeting. We acknowledge financial support from the Specialized Subsidy Scheme for Macao Higher Education Institutions in the Area of Research in Humanities and Social Sciences of Higher Education Bureau (Grant reference no.: HSS-UMAC-2020-14).

Appendix A. Ultimate controlling ownership

To calculate a listed firm's ultimate controlling ownership, we follow La Porta et al. (1999) and Faccio and Lang (2002) by combining the shareholder's direct and indirect voting rights in the firm and summing the weakest layer in each chain of control. Please see the chart below for an example.



This example has three shareholding relation chains: (1) *E*-C-B-A, (2) E-B-A, and (3) E-D-A. The weakest layers of these shareholding relation chains are 5.22%, 21.52%, and 22.84%, respectively. Therefore, Shareholder E's ultimate controlling ownership (i.e., the percentage of voting rights held by ultimate controlling shareholder E) of the listed firm A is equal to 49.58% (5.22% + 21.52% + 22.84%).

Appendix B. Correlation matrix

	LNCITATION	*LNPATENT*	*RDTA*	*DCENTER*	*DLOCAL*	*DPRIVATE*	*SIZE*	*LEVERAGE*	*ROA*
LNPATENT	0.6316***								
RDTA	0.3819***	0.3793***							
DCENTER	0.1689***	0.0788***	−0.0228***						
DLOCAL	−0.1427***	−0.1786***	−0.2371***	−0.2767***					
DPRIVATE	0.0106	0.1083***	0.2352***	−0.4621***	−0.7243***				
SIZE	0.2776***	0.1779***	−0.0761***	0.2107***	0.1772***	−0.3147***			
LEVERAGE	−0.0052	−0.0958***	−0.2726***	0.1569***	0.2455***	−0.3392***	0.4053***		
ROA	0.0294***	0.0658***	0.1373***	−0.0608***	−0.0849***	0.1219***	0.0211***	−0.3582***	
TREND	0.3506***	0.1887***	0.2467***	−0.0688***	−0.1324***	0.1716***	0.0663***	−0.0366***	−0.0809***

Notes: *LNCITATION* is the logarithm of one plus the number of future citations received by the patents granted to a company. *LNPATENT* is the logarithm of one plus the number of patents granted by a company. *RDTA* is measured by the ratio of R&D expenditures to total assets. *DCENTRAL* is a dummy variable that takes a value of one if a company is ultimately controlled by the central government and zero otherwise. *DLOCAL* is a dummy variable that takes a value of one if a company is ultimately controlled by a local government and zero otherwise. *DPRIVATE* is a dummy variable that takes a value of one if a company is ultimately controlled by a private entity and zero otherwise. Firm profitability (*ROA*) is measured by return on assets. Firm leverage (*LEVERAGE*) is measured as the ratio of the book value of total liabilities to the book value of total assets. Firm size (*SIZE*) is measured by the logarithm of operating income. Trend (*TREND*) denotes time trend.

References

Abadie, A., Imbens, G., 2011. Bias-corrected matching estimators for average treatment effects. J. Bus. Econ. Stat. 29 (1), 1–11. https://doi.org/10.1198/jbes.2009.07333.

Allen, F., Qian, J., Qian, M., 2005. Law, finance, and economic growth in China. J. Financ. Econ. 77 (1), 57–116. https://doi.org/10.1016/j.jfineco.2004.06.010.

Arrow, K., 1962. Economic welfare and the allocation of resources for invention. In: Nelson, R.R. (Ed.), The Rate and Direction of Inventive Activities. Princeton University Press, Princeton, US, pp. 609–625.

Atkinson, A.B., Stiglitz, J.E., 1980. Lectures on Public Economics. McGraw-Hill, London.

Ayyagari, M., Demirgüç-Kunt, A., Maksimovic, V., 2012. Firm innovation in emerging markets: the role of finance, governance, and competition. J. Financ. Quant. Anal. 46 (6), 1545–1580. https://doi.org/10.1017/S0022109011000378.

Backman, M., 1999. Asian Eclipse: Exposing the Dark Side of Business in Asia. Wiley, Singapore.

Baker, S.R., Bloom, N., Davis, S.J., 2016. Measuring economic policy uncertainty. Q. J. Econ. 131 (4), 1593–1636. https://doi.org/10.1093/qje/qjw024.
Bao, S., Chang, G.H., Sachs, J.D., Woo, W.T., 2002. Geographic factors and China's regional development under market reforms, 1978–1998. China Econ. Rev. 13 (1), 89–111. https://doi.org/10.1016/s1043-951x(02)00055-x.
Baumol, W.J., 1996. Entrepreneurship: productive, unproductive, and destructive. J. Bus. Ventur. 11 (1), 3–22. https://doi.org/10.1016/0883-9026(94)00014-X.
Bellettini, G., Berti Ceroni, C., Prarolo, G., 2013. Persistence of politicians and firms' innovation. Econ. Inq. 51 (4), 2056–2070. https://doi.org/10.1111/ecin.12015.
Belloc, F., 2014. Innovation in state-owned enterprises: reconsidering the conventional wisdom. J. Econ. Issues 48, 821–848. https://doi.org/10.2753/jei0021-3624480311.
Belloc, F., Laurenza, E., Rossi, M.A., 2016. Corporate governance effects on innovation when both agency costs and asset specificity matter. Ind. Corp. Chang. 25, 977–999. https://doi.org/10.1093/icc/dtw009.
Bernanke, B.S., 1983. Irreversibility, uncertainty and cyclical investment. Q. J. Econ. 98 (1), 85–106. https://doi.org/10.2307/1885568.
Bhattacharya, U., Hsu, P.H., Tian, X., Xu, Y., 2017. What affects innovation more: policy or policy uncertainty? J. Financ. Quant. Anal. 52 (5), 1869–1901. https://doi.org/10.1017/S0022109017000540.
Bloom, N., 2014. Fluctuations in uncertainty. J. Econ. Perspect. 28 (2), 153–176. https://doi.org/10.1257/jep.28.2.153.
Bocquet, R., Le Bas, C., Mothe, C., Poussing, N., 2013. Are firms with differenct CSR profiles equally innovative? Empirical analysis with survey data. Eur. Manag. J. 31 (6), 642–654. https://doi.org/10.1016/j.emj.2012.07.001.
Boeing, P., Mueller, E., Sandner, P., 2016. China's R&D explosion—analyzing productivity effects across ownership types and over time. Res. Policy 45 (1), 159–176. https://doi.org/10.1016/j.respol.2015.07.008.
Broadstock, D.C., Matousek, R., Meyer, M., Tzeremes, N.G., 2019. Does corporate social responsibility impact firms' innovation capacity? The indirect link between environmental & social governance implementation and innovation performance. J. Bus. Res. 119, 99–110. https://doi.org/10.1016/j.jbusres.2019.07.014.
Brødsgaard, K.E., 2012. Politics and business group formation in China: the party in control? China Q. 211, 624–648. https://doi.org/10.1017/S0305741012000811.
Bruton, G.D., Peng, M.W., Ahlstrom, D., Stan, C., Xu, K., 2015. State-owned enterprises around the world as hybrid organizations. Acad. Manag. Perspect. 29 (1), 92–114. https://doi.org/10.5465/amp.2013.0069.
Cao, X., Cumming, D., Zhou, S., 2020. State ownership and corporate innovative efficiency. Emerg. Mark. Rev. 44, 100699. https://doi.org/10.1016/j.ememar.2020.100699.
Carney, M., 2005. Corporate governance and competitive advantage in family-controlled firms. Entrep. Theory Pract. 29 (3), 249–265. https://doi.org/10.1111/j.1540-6520.2005.00081.x.
Chang, S.J., Hong, J., 2000. Economic performance of group-affiliated companies in Korea: intragroup-resource sharing and internal business transactions. Acad. Manag. J. 43, 429–448. https://doi.org/10.2307/1556403.
Chen, L., 2015. China's Centralized Industrial Order: Industrial Reform and the Rise of Centrally Controlled Big Business. Routledge, New York.
Chen, G., Firth, M., Xu, L., 2009. Does the type of ownership control matter? Evidence from China's listed companies. J. Bank. Financ. 33 (1), 171–181. https://doi.org/10.1016/j.jbankfin.2007.12.023.
Chen, V.Z., Li, J., Shapiro, D.M., Zhang, X., 2014. Ownership structure and innovation: an emerging market perspective. Asia Pac. J. Manag. 31 (1), 1–24. https://doi.org/10.1007/s10490-013-9357-5.
Chen, M., Jeon, B.M., Wang, R., Wu, J., 2015. Corruption and bank risk-taking: evidence from emerging economies. Emerg. Mark. Rev. 24, 122–148. https://doi.org/10.1016/j.ememar.2015.05.009.
Child, J., Tse, D.K., 2001. China's transition and its implications for international business. J. Int. Bus. Stud. 32 (1), 5–21. https://doi.org/10.1057/palgrave.jibs.849093.
Choi, J., Wang, H., 2009. Stakeholder relations and the persistence of corporate financial performance. Strateg. Manag. J. 30 (8), 895–907. https://doi.org/10.1002/smj.759.
Choi, S.B., Lee, S.H., Williams, C., 2011. Ownership and firm innovation in a transition economy: evidence from China. Res. Policy 40, 441–452. https://doi.org/10.1016/j.respol.2011.01.004.
Claessens, S., Yurtoglu, B.B., 2013. Corporate governance in emerging markets: a survey. Emerg. Mark. Rev. 15, 1–33. https://doi.org/10.1016/j.ememar.2012.03.002.
Clarke, G., 2001. How institutional quality and economic factors impact technological deepening in developing countries. J. Int. Dev. 13 (8), 1097–1118. https://doi.org/10.1002/jid.841.
Costa, C., Lage, L.F., Hortinha, P., 2015. The bright and dard side of CSR in export markets: its impact on innovation and performance. Int. Bus. Rev. 24 (5), 749–757. https://doi.org/10.1016/j.ibusrev.2015.01.008.
Cuervo-Cazurra, A., Inkpen, A., Musacchio, A., Ramaswamy, K., 2014. Governments as owners: state-owned multinational companies. J. Int. Bus. Stud. 45 (8), 919–942. https://doi.org/10.1057/jibs.2014.43.
Cumming, D., Rui, O., Wu, Y., 2016. Political instability, access to private debt, and innovation investment in China. Emerg. Mark. Rev. 29, 68–81. https://doi.org/10.1016/j.ememar.2016.08.013.
Custódio, C., Metzger, D., 2014. Financial expert CEOs: CEO's work experience and firm's financial policies. J. Financ. Econ. 114 (1), 125–154. https://doi.org/10.1016/j.jfineco.2014.06.002.
Démurger, S., 2001. Infrastructure development and economic growth: an explanation for regional disparities in China? J. Comp. Econ. 29 (1), 95–117. https://doi.org/10.1006/jcec.2000.1693.
Deng, X., Kang, J.K., Low, B.S., 2013. Corporate social responsibility and stakeholder value maximization: evidence from mergers. J. Financ. Econ. 110 (1), 87–109. https://doi.org/10.1016/j.jfineco.2013.04.014.
Dharwadkar, R., George, G., Brandes, P., 2000. Privatization in emerging economies: an agency theory perspective. Acad. Manag. Rev. 25, 650–669. https://doi.org/10.5465/amr.2000.3363533.
Dixit, A.K., Pindyck, R.S., 1994. Investment under Uncertainty. Princeton University Press, Princeton.
Dong, J., Gou, Y.N., 2010. Corporate governance structure, managerial discretion, and the R&D investment in China. Int. Rev. Econ. Financ. 19 (2), 180–188. https://doi.org/10.1016/j.iref.2009.10.001.
EBRD, 2020. Transition Report 2020–21: The State Strikes Back. European Bank for Reconstraucction and Development, London.
Ericson, R., Pakes, A., 1995. Markov-perfect industry dynamics: a framework for empirical work. Rev. Econ. Stud. 62 (1), 53–82. https://doi.org/10.2307/2297841.
Faccio, M., Lang, L.H.P., Young, L., 2001. Dividends and expropriation. Am. Econ. Rev. 91 (1), 54–78. https://doi.org/10.1257/aer.91.1.54.
Faccio, M., Lang, L.H.P., 2002. The ultimate ownership of Western European corporations. Journal of Financial Economics 65 (3), 365–395. https://doi.org/10.1016/S0304-405X(02)00146-0.
Fan, J.P.J., Wei, K.C.J., Xu, X., 2011. Corporate finance and governance in emerging markets: a selective review and an agenda for future research. J. Corp. Finan. 17, 207–214. https://doi.org/10.1016/j.jcorpfin.2010.12.001.
Fang, L.H., Lerner, J., Wu, C., 2017. Intellectual property rights protection, ownership, and innovation: evidence from China. Rev. Financ. Stud. 30 (7), 2446–2447. https://doi.org/10.1093/rfs/hhx023.
Feng, X., Johansson, A., 2017. Political uncertainty and innovation in China. In: Stockholm School of Economics Asia Working Paper, (No. 44).
Fernandes, A.M., Paunov, C., 2015. The risks of innovation: are innovating firms less likely to die? Rev. Econ. Stat. 97 (3), 638–653. https://doi.org/10.1162/REST_a_00446.
Filatotchev, I., Zhang, X., Piesse, J., 2011. Multiple agency perspective, family control, and private information abuse in an emerging economy. Asia Pac. J. Manag. 28 (1), 69–93. https://doi.org/10.1007/s10490-010-9220-x.
Firth, M., Rui, O.M., Wu, W., 2011. The effects of political connections and state ownership on corporate litigation in China. J. Law Econ. 54, 573–607. https://doi.org/10.1086/659261.
Freeman, R.E., 1984. Strategic Management: A Stakeholder Approach. Cambridge University Press.

Friede, G., Busch, T., Bassen, A., 2015. ESG and financila performance: agregated evidence from more than 2000 empirical studies. J. Sustain. Finan. Invest. 5 (4), 210–233. https://doi.org/10.1080/20430795.2015.1118917.
Friedman, M., 1970. The social responsibility of business is to increase its profits. In: The New York Times. Septermber 13.
Fu, X., 2008. Foreign direct investment, absorptive capacity and regional innovation capabilities: evidence from China. Oxf. Dev. Stud. 36 (1), 89–110. https://doi.org/10.1080/13600810701848193.
Fu, X., 2015. China's Path to Innovation. Cambridge University Press, Cambridge, UK.
Gan, W., Xu, X., 2019. Does anti-corruption campaign promote corporate R&D investment? Evidence from China. Financ. Res. Lett. 30, 292–296. https://doi.org/10.1016/j.frl.2018.10.012.
Genin, A.L., Tan, J., Song, J., 2020. State governance and technological innovation in emerging economies: state-owned enterprises restructuration and institutional logic dissonance in China's high-speed train sector. J. Int. Bus. Stud. 1–25. https://doi.org/10.1057/s41267-020-00342-w.
Gentry, W.M., Hubbard, R.G., 2000. Tax policy and entrepreneurial entry. Am. Econ. Rev. 90 (2), 283–287. https://doi.org/10.1257/aer.90.2.283.
Griliches, Z., 1990. Patent statistics as economic indicators: a survey. In: NBER Working Paper no. 3301. National Bureau of Economic Research, Cambridge, MA.
Guan, J., Yam, R., Tang, E., Lau, A., 2009. Innovation strategy and performance during economic transition: evidences in Beijing, China. Res. Policy 38 (5), 802–812. https://doi.org/10.1016/j.respol.2008.12.009.
Gugler, K., Mueller, D.C., Yurtoglu, B.B., 2008. Insider ownership, ownership concentration and investment performance: an international comparison. J. Corp. Finan. 14, 688–705. https://doi.org/10.1016/j.jcorpfin.2014.03.001.
Guo, G., 2007. Retrospective economic accountability under authoritarianism evidence from China. Polit. Res. Q. 60, 378–390. https://doi.org/10.1177/1065912907304501.
Habiyaremye, A., Raymond, W., 2013. Transnational corruption and innovation in transition economies. In: UNU-MERIT Working Paper Series #2013-050.
Hall, B.H., 2002. The financing of research and development. Oxf. Rev. Econ. Policy 18 (1), 35–51. https://doi.org/10.1093/oxrep/18.1.35.
Haveman, H., Rao, H., 2006. Hybrid forms and the evolution of thrifts. Am. Behav. Sci. 49 (7), 974–986. https://doi.org/10.1177/0002764205285179.
He, F., Ma, Y., Zhang, X., 2020. How does economic policy uncertainty affect corporate innovation? Evidence from China listed companies. Int. Rev. Econ. Financ. 67, 225–239. https://doi.org/10.1016/j.iref.2020.01.006.
Heckman, J.J., 1979. Sample selection bias as a specification error. Econometrica 47 (1), 153–162. https://doi.org/10.2307/1912352.
Heilig, G.K., 2004. RAPS-China: A Regional Analysis and Planning System. International Institute for Applied Systems Analysis, IIASA, Luxemburg, Austria.
Holmstrom, B., 1989. Agency costs and innovation. J. Econ. Behav. Organ. 12 (3), 305–327. https://doi.org/10.1016/0167-2681(89)90025-5.
Holmstrom, B., Milgrom, P., 1991. Multitask principal-agent analyses: incentive contracts, asset ownership, and job design. J. Law Econ. Org. 7 (special), 24–52. https://doi.org/10.1093/jleo/7.special_issue.24.
Hu, H.W., Cui, L., Aulakh, P.S., 2019. State capitalism and performance persistence of business group-affiliated firms: a comparative study of China and India. J. Int. Bus. Stud. 50 (2), 193–222. https://doi.org/10.1057/s41267-018-0165-5.
Jefferson, G., Albert, G.Z., Guan, X., Yu, X., 2003. Ownership, performance, and innovation in China's large-and medium-size industrial enterprise sector. China Econ. Rev. 14 (1), 89–113. https://doi.org/10.1016/S1043-951X(03)00003-8.
Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. J. Financ. Econ. 3, 305–360. https://doi.org/10.1016/0304-405x(76)90026-x.
Jia, N., Huang, K.G., Zhang, C.M., 2019. Public governance, corporate governance, and firm innovation: an examination of state-owned enterprises. Acad. Manag. J. 62 (1), 220–247. https://doi.org/10.5465/amj.2016.0543.
Jiang, G., Lee, C.M.C., Yue, H., 2010. Tunneling through intercorporate loans: the China experience. J. Financ. Econ. 98 (1), 1–20. https://doi.org/10.1016/j.jfineco.2010.05.002.
Jiang, L., Waller, D.S., Cai, S., 2013. Does ownership type matter for innovation? Evidence from China. J. Bus. Res. 66 (12), 2473–2478. https://doi.org/10.1016/j.jbusres.2013.05.037.
Jiang, X., Kong, D., Xiao, C., 2020. Policy certainty and heterogeneous firm innovation: evidence from China. China Econ. Rev. 63, 101500. https://doi.org/10.1016/j.chieco.2020.101500.
Johnson, S., La Porta, R., Lopez-de-Silanes, F., Shleifer, A., 2000. Tunneling. Am. Econ. Rev. 90 (2), 22–27. https://doi.org/10.1257/aer.90.2.22.
Judge, W.Q., 2010. Thomas Kuhn and corporate governance research. Corp. Gov. Int. Rev. 18 (2), 85–86. https://doi.org/10.1111/j.1467-8683.2010.00787.x.
Kao, E.H., Yeh, C.C., Wang, L.H., Fung, H.G., 2018. The relationship between CSR and performance: evidenc in China. Pac. Basin Financ. J. 51, 155–170. https://doi.org/10.1016/j.pacfin.2018.04.006.
Khanna, T., Rivkin, J.W., 2001. Estimating the performance effects of business groups in emerging markets. Strateg. Manag. J. 22 (1), 45–74. https://doi.org/10.1002/1097-0266(200101)22:1<45::aid-smj147>3.0.co;2-f.
Khanna, T., Palepu, K.G., Sinha, J., 2005. Strategies that fit emerging markets. Harv. Bus. Rev. 83, 63–76.
Kim, T., 2018. Does a Firm's Political Capital Affect Its Investment and Innovation? Available at SSRN https://doi.org/10.2139/ssrn.2971752.
Kong, D., Wang, Y., Zhang, J., 2020. Efficiency wages as gift exchange: evidence from corporate innovation in China. J. Corp. Finan. 65, 101725. https://doi.org/10.1016/j.jcorpfin.2020.101725.
Kroll, H., Frietsch, R., 2014. Regional structures and trends in China's innovation system: an indicator-based account of the last decade's developments. In: Liefner, I., Wei, Y.D. (Eds.), Innovation and Regional Development in China. Routledge, New York, NY and London, UK, pp. 41–72.
Kroll, H., Kou, K., 2019. Innovation output and state ownership: empirical evidence from China's listed firms. Ind. Innov. 26 (2), 176–198. https://doi.org/10.1080/13662716.2018.1456323.
La Porta, R., Lopez-De-Silanes, F., Shleifer, A., 1999. Corporate ownership around the world. J. Financ. 54, 471–517. https://doi.org/10.1111/0022-1082.00115.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 2000. Investor protection and corporate governance. J. Financ. Econ. 58 (1–2), 3–27. https://doi.org/10.1016/s0304-405x(00)00065-9.
Lambsdorff, J., 2008. The Methodology of the Corruption Perceptions Index 2008. Transparency International. https://images.transparencycdn.org/images/2008_CPI_LongMethodology_EN.pdf.
Lazzarini, S.G., Musacchio, A., 2018. State ownership reinvented? Explaining performance differences between state-owned and private firms. Corp. Gov. Int. Rev. 26 (4), 255–272. https://doi.org/10.1111/corg.12239.
Lerner, J., Wulf, J., 2007. Innovation and incentives: evidence from corporate R&D. Rev. Econ. Stat. 89, 634–644. https://doi.org/10.1162/rest.89.4.634.
Leutert, W., 2018. Firm control: governing the state-owned economy under Xi Jinping. China Perspect. 2018 (2018/1-2), 27–36. https://doi.org/10.4000/chinaperspectives.7605.
Li, S., Xia, J., 2008. The role and performance of state firms and non-state firms in China's economic transition. World Dev. 36 (1), 39–54. https://doi.org/10.1016/j.worlddev.2007.01.008.
Li, W., Zhang, R., 2010. Corporate social responsibility, ownership structure, and political interference: evidence from China. J. Bus. Ethics 96, 631–645. https://doi.org/10.1007/s10551-010-0488-z.
Li, H., Zhou, L.A., 2005. Political turnover and economic performance: the incentive role of personnel control in China. J. Public Econ. 89 (9–10), 1743–1762. https://doi.org/10.1016/j.jpubeco.2004.06.009.
Li, Q., Luo, W., Wang, Y., Wu, L., 2013. Firm performance, corporate ownership, and corporate social responsibility disclosure in China. Bus. Ethics. Eur. Rev. 22 (2), 159–173. https://doi.org/10.1111/beer.12013.
Li, M.H., Cui, L., Lu, J., 2014. Varieties in state capitalism: outward FDI strategies of central and local state-owned enterprises from emerging economy countries. J. Int. Bus. Stud. 45, 980–1004. https://doi.org/10.1007/978-3-319-51715-5_8.
Li, J., Xia, J., Zajac, E.J., 2018. On the duality of political and economic stakeholder influence on firm innovation performance: theory and evidence from Chinese firms. Strateg. Manag. J. 39 (1), 193–216. https://doi.org/10.1002/smj.2697.

Liang, H., Ren, B., Sun, S.L., 2015. An anatomy of state control in the globalization of state-owned enterprises. J. Int. Bus. Stud. 46 (2), 223–240. https://doi.org/10.1057/jibs.2014.35.
Liu, G.S., Sun, P., 2005. The class of shareholdings and its impacts on corporate performance: a case of state shareholding composition in Chinese public corporations. Corp. Gov. 13 (1), 46–59. https://doi.org/10.1111/j.1467-8683.2005.00402.x.
Luo, Y., 2005. An organizational perspective of corruption. Manag. Organ. Rev. 1 (1), 119–154. https://doi.org/10.1111/j.1740-8784.2004.00006.x.
Manso, G., 2011. Motivating innovation. J. Financ. 66 (5), 1823–1860. https://doi.org/10.1111/j.1540-6261.2011.01688.x.
Mariotti, S., Marzano, R., 2019. Varieties of capitalism and the internationalization of state-owned enterprises. J. Int. Bus. Stud. 50 (5), 669–691. https://doi.org/10.1057/s41267-018-00208-2.
McWilliams, A., Siegel, D., 2000. Corporate social responsibility and financial performance: correlation or misspecification? Strategic Management Journal 21 (5), 603–609. https://doi.org/10.1002/(SICI)1097-0266(200005)21:5603::AID-SMJ1013.0.CO2-3.
Minzner, C.F., 2009. Riots and cover-ups: counterproductive control of local agents in China. Univ. Pennsylvania J. Int. Law 31, 53–123.
Murphy, K.M., Shleifer, A., Vishny, R.W., 1991. The allocation of talent: implications for growth. Q. J. Econ. 106 (2), 503–530. https://doi.org/10.2307/2937945.
Murphy, K.M., Shleifer, A., Vishny, R.W., 1993. Why is rent-seeking so costly to growth? Am. Econ. Rev. 83 (2), 409–417.
Musacchio, A., Lazzarini, S.G., Aguilera, R.V., 2015. New varieties of state capitalism: strategic and governance implications. Acad. Manag. Perspect. 29 (1), 115–131. https://doi.org/10.5465/amp.2013.0094.
O'Brien, K.J., Li, L., 1999. Selective policy implementation in rural China. Comp. Polit. 31 (2), 167–186. https://doi.org/10.2307/422143.
OECD, 2020. Gross Domestic Spending on R&D. The Organisation for Economic Co-operation and Development, Paris, France.
Oh, W.Y., Chang, Y.K., Martynov, A., 2011. The effect of ownership structure on corporate social responsibility: empirical evidence from Korea. J. Bus. Ethics 104, 283–297. https://doi.org/10.1007/s10551-011-0912-z.
Paligorova, T., Xu, Z., 2012. Complex ownership and capital structure. J. Corp. Finan. 18 (4), 701–716. https://doi.org/10.1016/j.jcorpfin.2012.05.001.
Paunov, C., 2016. Corruption's asymmetric impacts on firm innovation. J. Dev. Econ. 118, 216–231. https://doi.org/10.1016/j.jdeveco.2015.07.006.
Phan, D.H.B., Iyke, B.N., Sharma, S.S., Affandi, Y., 2021. Economic policy uncertainty and financial stability – is there a relation? Econ. Model. 94, 1018–1029. https://doi.org/10.1016/j.econmod.2020.02.042.
Pindyck, R.S., 1991. Irreversibility, uncertainty, and investment. Journal of Economic Literature 29 (3), 1110–1148.
Poon, D., 2009. China's evolving industrial policy strategies & instruments: lessons for development. In: Trade & Industrial Policy Strategies: Working Paper Series.
Ramasamy, B., Yeung, M., Laforet, S., 2012. China's outward foreign direct investment: location choice and firm ownership. J. World Bus. 47 (1), 17–25. https://doi.org/10.1016/j.jwb.2010.10.016.
Salter, A.J., Martin, B.R., 2001. The economic benefits of publicly funded basic research: a critical review. Res. Policy 30 (3), 509–532. https://doi.org/10.1016/S0048-7333(00)00091-3.
Scott, W.R., 2004. Institutional theory: contributing to a theoretical research program. In: Smith, K.G., Hitt, M.A. (Eds.), Great Minds in Management: The Process of Theory Development. Oxford University Press, Oxford, UK, pp. 460–484.
Stiglitz, J.E., 1999. Knowledge as a global public good. In: Kaul, I., Grunberg, I., Stern, M.A. (Eds.), Global Public Goods. Oxford University Press, Oxford, UK, pp. 308–325.
Stiglitz, J., Lin, J., 2013. The Industrial Policy Revolution I: The Role of Government beyond Ideology. Palgrave Macmillan, New York.
Tajaddini, R., Gholipour, H.F., 2020. Economic policy uncertainty, R&D expenditures and innovation outputs. J. Econ. Stud. 48 (2), 413–427. https://doi.org/10.1108/JES-12-2019-0573.
Tan, J., 2006. Growth of industry clusters and innovation: lessons from Beijing Zhongguancun Science Park. J. Bus. Ventur. 21, 827–850. https://doi.org/10.1016/j.jbusvent.2005.06.006.
Tan, Y., Tian, X., Zhang, X., Zhao, H., 2020. The real effects of privatization: evidence from China's split share structure reform. J. Corp. Finan. 64, 101661. https://doi.org/10.1016/j.jcorpfin.2020.101661.
The Economist, 2011. Entrepreneurship in China. Let a million flowers bloom. The Economist 398, 71–74.
Tian, X., Wang, T.Y., 2014. Tolerance for failure and corporate innovation. Rev. Financ. Stud. 27 (1), 211–255. https://doi.org/10.1093/rfs/hhr130.
Tobin, J., 1958. Estimation of relationships for limited dependent variables. Econometrica 26 (1), 24–36. https://doi.org/10.2307/1907382.
Unirule Institute of Economics, 2011. The Nature, Performance, and Reform of the State-Owned Enterprises. Unirule Institute of Economics, Beijing, China.
Van Vo, L., Le, H.T.T., 2017. Strategic growth option, uncertainty, and R&D investment. Int. Rev. Financ. Anal. 51, 16–24. https://doi.org/10.1016/j.irfa.2017.03.002.
Waldemar, F.S., 2012. New products and corruption: evidence from Indian firms. Dev. Econ. 50 (3), 268–284. https://doi.org/10.1111/j.1746-1049.2012.00171.x.
World Intellectual Property Organization, 2019. World Intellectual Property Indicators – 2019. World Intellectual Property Organization, Geneva, Switzerland.
Xu, C., 2011. The fundamental institutions of China's reforms and development. J. Econ. Lit. 49 (4), 1076–1151. https://doi.org/10.1257/jel.49.4.1076.
Xu, Z., 2020. Economic policy uncertainty, cost of capital, and corporate innovation. J. Bank. Financ. 111, 105698. https://doi.org/10.1016/j.jbankfin.2019.105698\.
Xu, G., Yano, G., 2017. How does anti-corruption affect corporate innovation? Evidence from recent anti-corrutpion effefts in China. J. Comp. Econ. 45 (3), 498–519. https://doi.org/10.1016/j.jce.2016.10.001.
Xu, E., Zhang, H., 2008. The impact of state shares on corporate innovation strategy and performance in China. Asia Pac. J. Manag. 25, 473–487. https://doi.org/10.1007/s10490-008-9093-4.
Yao, Y., Xu, L., Liu, Z., 2010. Taking away the voting powers from controlling shareholders: evidence from the Chinese securities market. J. Int. Financ. Manag. Acc. 21 (3), 187–219. https://doi.org/10.1111/j.1467-646x.2010.01040.x.
Yi, J., Hong, J., Hsu, W., Wang, C., 2017. The role of state ownerhsip and institutions in the innovation performance of emeging market enterprises: evidence from China. Technovation 62-63, 4–13. https://doi.org/10.1016/j.technovation.2017.04.002.
Yiu, D.W., 2011. Multinational advantages of Chinese business groups: a theoretical exploration. Manag. Organ. Rev. 7 (2), 249–277. https://doi.org/10.1111/j.1740-8784.2010.00210.x.
Young, M.N., Peng, M.W., Ahlstrom, D., Bruton, G.D., Jiang, Y., 2008. Corporate governance in emerging economies: a review of the principal-principal perspective. J. Manag. Stud. 45 (1), 196–220. https://doi.org/10.1111/j.1467-6486.2007.00752.x.
Zhang, X., Yu, M., Chen, G., 2020. Does mixed-ownership reform improve SOEs' innovation? Evidence from state ownerhsip. China Econ. Rev. 61, 101450. https://doi.org/10.1016/j.chieco.2020.101450.
Zhou, K.Z., Gao, G.Y., Zhao, H., 2017. State ownership and firm innovation in China: an integrated view of institutional and efficiency logics. Adm. Sci. Q. 62, 375–404. https://doi.org/10.1177/0001839216674457.
Zu, L., Song, L., 2009. Determinants of managerial values on corporate social responsibility: evidence from China. J. Bus. Ethics 88, 105–117. https://doi.org/10.1007/s10551-008-9828-7.