# Varieties in state capitalism and corporate innovation:

# Evidence from an emerging economy

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**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. Drawing on data from 2,629 listed firms in China between 2007 and 2015, our results suggest that the 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 non-manufacturing sectors as well as in high economic development region, whereas local SOEs outperform their private peers with respect to patent quality mainly in manufacturing sector and in high economic development region. Such 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 presented. The findings demonstrate the value of diversity in state capitalism in guiding SOEs' heterogeneous innovation activities in emerging economies.

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*Keywords*: Innovation; state capitalism; ESG; economic policy uncertainty; corruption; ultimate controlling ownership

## 1. Introduction

State governments in the emerging economies have undertaken a series of reforms to restructure their state-owned enterprises (SOEs) in the attempts 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 mainly led to state capitalism, a regime that is characterized by the co-existence of hierarchy-based and market-based institutions, with the state imposing great influence on the firms (Bruton et al., 2015; Musacchio et al., 2015; Hu et al., 2019; Mariotti and Marzano, 2019; Genin et al., 2020). While an increasing number of research has investigated how these reforms affect firm innovation performance in emerging economies (Ayyagari et al., 2011; Fan 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 focused on how the underlying modes of control over SOEs imposed by different levels of state government have shaped SOEs' motivations, resources, and capabilities for innovation through reforms, which ultimately affect their innovation performance.

Varieties in state capitalism have important implications for corporate innovation in emerging economies because SOEs may follow different development pathways due to heterogeneous reform treatments. Specifically, different reform measures can be implemented at different levels of government, generating organizational heterogeneity in terms of resources, logics, 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 motive central and local SOEs to adopt varying innovation strategies, and hence resulting in different innovation performance. This provides the basis for our main research questions. What implications does 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 in the world, China provides a valuable platform to investigate 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% over 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 become the largest originator of patent applications in the world (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 structure, while 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 the "central SOEs") have become national policy instruments for sustainable macro-level growth and social welfare maximization, whereas SOEs controlled by the local governments (hereafter referred to as the "local SOEs") are relatively more market-driven, equipped with a strong commercial logic to pursue development goals set by local governments (Li et al., 2014). Given indigenous innovation is a national strategy put forward by the Chinese central government, central SOEs may innovate in order to fulfill this national policy objective. For local SOEs, however, they may innovate to satisfy local fiscal needs mainly. Their diverging motives, together with heterogeneous resources and institutional logics 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 in the world, and the majority of these companies 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 a subject of widespread interest among various stakeholders in economics and politics.

An increasing number of studies have considered the impact of state ownership on corporate innovation performance in China but yielded mix 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; Fan et al., 2017; Xu and Yano, 2017; Yi et al., 2017; Zhou et al., 2017; Cao et al., 2018; Li et al., 2018; Jia et al., 2019; Kroll and Kou, 2019; 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 attempts to fill the void by examining the impact of

[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 output of patents per dollar spending of R&D.

different forms of state ownership on corporate innovation and the underlying mechanisms through which the varieties in state capitalism affect corporate innovation using a large sample of listed firms in China for the 2007-2015 period.

Inspired by the advocacy of Judge (2010) about developing a theory of corporate governance that is accurate to 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, in order 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 non-manufacturing firms and firms in high versus low economic development regions with an attempt to explore whether there are any industry and/or regional heterogeneous effects in this ownership-innovation nexus.

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 non-manufacturing industry and in high economic development region. However, local SOEs outperform their private peers with respect to patent quality in manufacturing sector and in high economic development region. Furthermore, there is no significant difference in innovation performance between local SOEs and private firms in low economic development

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

region. Finally, such 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 presented. Our findings are robust to concerns of endogeneity.

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 logics and pattern 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 the 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 in these firms, which enables 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 the roles of SOEs may have evolved along different trajectories of economic reforms, 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 regarding whether central government 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 are facing tough choices to determine whether an increase in state role will have positive or negative long-term consequences because the COVID-19 sparks call 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 over the past four decades have transformed the world's largest developing country from a centrally planned economy into a mixed market economy that is characterized by political centralization and economic regional decentralization. On the one hand, the central government focuses on macro-level growth and social welfare maximization, having substantial control over political and personnel governance structure. On the other hand, local governments are granted considerable control rights and resources to run the bulk of the economy within their jurisdiction. By linking regional performance to local officials' promotion, the central government introduces a tournament-like regional competition mechanism that provides high-powered incentives to local officials to undertake market-oriented measures to develop 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 this performance. This mechanism enables the SASAC-SC to impose stringent and effective monitoring over the central SOEs.[4]

Local SOEs, on the other hand, 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 according to the Law of the People's Republic of China on the State-owned Assets of Enterprises, issued in October 2008, 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 the local governments' policies and instructions.

According to institutional theory (Scott, 2004), different levels of government exert differential impacts on their associated SOEs' institutional logics, priorities, and access to

[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.

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 keeps 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 has a great motivation for innovation creation, in particular 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, in order 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 together by cross shareholding, intragroup trade, and cross subsidization (Child and Tse, 2001). This resilient structure facilitates the creation of internal markets enabling intra-group transactions such as technology sharing, rotation of management personnel, and risk pooling (Yiu, 2011). Furthermore, central SOEs enjoy more preferential policies such as cheaper access to credit and easier access to talent pool than their local and private peers (Li et al., 2014).

The local governments, on the other hand, gain significant autonomy to run their local SOEs via the SASAC-LG and the ULGs with an aim to promote local economic development and policy objectives. Consequently, local SOEs are increasingly profit-driven, innovating mainly for commercial purposes to serve local economic development objectives (Li, et al., 2014). Moreover, political economists argue that local governments may engage in 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 to be the

most influential priorities in their career paths, such as a higher GDP growth rate and a lower unemployment rate (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 lower incentives for innovation enhancement compared with central SOEs. In addition, the reform of economic decentralization not only motivates local governments to enhance financial performance of local SOEs to maximize profits, it also restricts the resources that can be provided by local governments to local SOEs because extra budget beyond their budgetary capability requires the central government's further approval. Furthermore, local SOEs scatter across non-strategic 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.

Turning to private firms, they 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 informed rapidly about local trends and, in turn, to 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.

As indicated in Holmstrom (1989), however, 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 (2012) further point out that innovation may expose firms to survival risk because there are uncertainties inherent to innovation itself and its commercialization. Innovation usually involves sunk R&D costs that may be higher than the payoff due to 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), in particular 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 tolerant failure than private firms (Ramasamy et al., 2012; Belloc, 2014; Cuervo-Cazurra et al., 2014; Belloc et al., 2016, among others). Benefited from favorable fiscal and lending policies, SOEs can fund research activities regardless of the necessary revenues from research output and/or the uncertainty involved in risky innovative projects. In addition, governments have control over laws and regulations, which enable them to enforce contracts and reduce risks for their SOEs' innovation activities. Thus, compared to private firm, SOEs are both more likely and more willing to take the risk to finance basic and less-applied research that have a greater probability to generate exploratory innovation because "visionary thinking can open up promising avenues towards powerful new technologies".[5]

Furthermore, as highlighted in Belloc (2014), compared to private owners, governments have a higher capacity to lead knowledge networks that are vital to innovation, especially

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

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 the purpose of innovation production because control rights are wholly and partly concentrated in the hands of one owner—the state. Second, given their superior access to information about economic performance and trends, SOEs can 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 SOEs mentioned above, Chinese governments can provide other key resources, such as resident status and related public benefits that are critical to attract talents 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, in particular its risk tolerance level if exploratory innovation is involved. Comparing with both local SOEs and private firms, central SOEs not only have a strong motivation for innovation, but also have more resources and capability for innovation, especially a higher risk tolerance level. Comparing with local SOEs, private firms typically have stronger motivations for innovation but their failure tolerance level may not surpass that of local SOEs when exploratory innovation projects are involved. Given exploratory innovation is closely related to patent quality rather than patent quantity (Manso, 2011), we therefore propose the following two hypotheses.

***Hypothesis 1a:*** *Central SOEs are associated with the best innovation performance that is 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.*

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

### *2.2 ESG, economic policy uncertainty, and corruption*

We then look into the underlying mechanisms through which the varieties in state capitalism affect corporate innovation. The first movement in this symphony is firms' ESG activities. There is a growing number of extant studies showing 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, namely, the shareholder expense view and the stakeholder value maximization view in the literature (Deng et al., 2013). Based on the agency theory developed by Friedman (1970), the shareholder expense view argues that firms' ESG activities may have a negative impact on 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 and hence fewer resources could be allocated to innovation projects, reducing firms' competitive advantages.

In contrast, the stakeholder value maximization view developed by Freeman (1994) suggests that ESG has a positive effect on innovation performance because increasing ESG activities can improve firms' relationship with their various stakeholders such as the government, local communities, clients, and even competitors. This in turn can reduce the firms' social and financial costs, enable the firms 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, while none of them distinguishes central SOEs from local SOEs. For example, using a sample of companies from manufacturing industry in 2007, Li and Zhang (2010) find a positive

relationship between government ownership and ESG intensity in the Chinese SOEs, arguing that Chinese SOEs' response to ESG is political and economic 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 a more ESG activities in China.

In China, the government strongly encourages the Chinese firms to undertake ESG activities over the past decade. For example, the China Securities and Regulatory Commission coordinates with the State Environmental Protection Administration to initiate the "green securities" scheme, under which the firms in high-energy consumption and high-pollution industries are subject to environmental performance reviews when applying for initial public offering or refinancing. Besides, the Chinese government launched the Green Credit Policy in 2007, requiring banks to lend more to environmental-friendly projects and less to polluting projects. For example, Industrial and Commercial Bank of China and China Development Bank, two major banks in China, recorded a combined green credit loan portfolio of around $200 billion as of 2011.[7] Therefore, it is assumed that undertaking more ESG activities may 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 have obligation 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 the opinion on social responsibility implementation for the central SOEs in 2008 (Li et al., 2013; Kao et al., 2018). Therefore, it is expected that central SOEs are both more willingly and more able to undertake more ESG activities than their local and private peers. For local SOEs, since they are more market-oriented than their central peers, it is expected that the impact of ESG on their

[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

ownership-innovation nexus would be similar to that for private firms. That being said, their differences in terms of motivation for innovation and risk tolerance level 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 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*). There is a growing literature arguing that corporate innovation performance is affected by *EPU* (Cumming et al., 2016; Bhattacharya et al., 2017; Feng & 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 the willingness of firms to spend on innovation. Investment in innovation is 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 period to recover spending. As a result, firms prefer to wait and see instead of making a costly and irreversible decision on innovation that may have unexpected consequences during periods of high uncertainty (Gentry and Hubbard, 2000; Clarke, 2001; Hall, 2002).

According to the game theory view, however, 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 for undertaking innovation activities is influenced by competitors' behavior. If delay in innovation investment due to uncertainty generates competitive advantages for competitors, firms will undertake innovation activities immediately to secure the market shares because the option to delay becomes not valuable if delay is extremely costly (Bloom, 2014; Van Vo and Le, 2017; He et al., 2020; Tajaddini and Gholipour, 2020).

Focusing on the role of policy uncertainty in the ownership-innovation nexus in China, He et al. (2020) 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 mainly 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 less political connections. They also find that political connections increase the probability that a firm has access to direct governmental support for innovation investment.

As analyzed in Section 2.1, both central and local SOEs have the responsibility to operate to accomplish social and political goals under government intervention. One key aspect of these goals is to stabilize the economy when there are more uncertainty in the economy. For example, as indicated in EBRD (2020), SOEs act as automatic stabilizers, providing more stable employment during the ongoing pandemic. That being said, as national policy instruments, central SOEs are expected to play a more important role in this regard comparing to local SOEs, which are supposed to be more market-driven like private firms. For private firms, facing fierce competition from the SOEs, they are more likely to support the game theory view by engaging in more innovation activities that are less risky during the period of higher economic policy

uncertainty so that they could keep their market share to a certain extent. their differences in terms of motivation for innovation and risk tolerance level remain valid. Considering the differences between local SOEs and private firms in terms of motivation for innovation and risk tolerance level, 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 impact 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 there is a higher probability 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 the transaction costs and the levels of uncertainty 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 la., 1993; Paunov, 2016). In addition, it is quite difficult for firms to take actions to guard against corruption on their own because corruption is ex post opportunistic. By making corruption payments, the bribing firms put themselves in the hold of the corrupting officials, who may not perform the agreed service, without fears of counter measures from the bribing firms. Such ex post risk related with corruption is therefore formidable, which will greatly aggravate 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 incentive 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 cost of corruption, resulting in less rent seeking and more innovation (Baumol, 1990; Murphy et al., 1991). This is exactly the case for the Chinese SOEs that are not fear of government expropriation, in particularly prior to the massive anti-corruption campaign launched in late 2012, when corruption could generate higher revenue at lower cost (Bellettini et al., 2013; Kim, 2015; Xu and Yano, 2017).

As discussed in Section 2.1, the central SOEs in China are concentrated on strategically important industries with very limited competition, whereas local SOEs face more competition from private firms. Such 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 SOE usually enjoy a higher administrative rank than their local peers. Some of them have the equivalent of vice-ministerial ranking, which implies that central SOEs impose greater capability to engage in corruption activities (Brødsgaard 2012; Chen 2015; Leutert 2018). For private firms, expropriation is a more serious concern. Private firms do benefit from the strong anti-corruption efforts in China (Xu and Yano, 2017; Gan and Xu, 2019). Again, taking into account the differences between local SOEs and private firms in terms of motivation for innovation and risk tolerance level, we 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 presented.*

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

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

## 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:

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

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:

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

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 proxy by the number of future citations received by the 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 to capture innovation capacity in the innovation literature (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, time periods, and types of technology, they constitute the most detailed and systematically compiled and managed data about innovation in China. Moreover, following Choi et al. (2011), we apply 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 over the four years of interest is also generated to conduct a robust interpretation of the results. 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 shareholders 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 due to 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, which causes the agent to

latch onto the controlling shareholders and to 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 capture the real controlling shareholder.[9] Therefore, it is crucial to adopt the concept of ultimate controlling ownership rather than direct ownership in 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

[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.

ownership for each listed firm and keep those who hold no less than 20 percent 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 percent. The rationale of using 20 percent 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 a value of one if the firm's ultimate controlling owner is the central government (i.e., ultimately controlled by the SASAC-SC & the MF) and zero otherwise. A company controlled by the local government dummy (*DLOCAL*) takes a value of one if the firm's ultimate controlling owner is a local government (i.e., ultimately controlled by the SASAC-LG & the ULGs) and zero otherwise. A company controlled by the private investor dummy (*DPRIVATE*) takes a 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

[10] Ultimate controlling shareholders are also labeled as 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 concerning their ultimate controlling shareholders.

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), we use the 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 a 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 there is a significant trend in the movement of the dependent variable over 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.

### *3.2 Data*

The sample data initially focus on all companies (A shares) listed on the Shanghai Stock Exchange (SHSE) and on 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,

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

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 percent 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 is collected from the State Intellectual Property Office of China (SIPO).[12] Patent citation data is obtained from the Chinese Research Data Services Platform. ESG data is collected from the Sino-Securities Index Information Service (Shanghai) Co. Ltd. *EPU* data is obtained from Baker et al. (2016). *CPI* data is obtained from the official website of Transparency International (TI).

The final sample consists of 2,629 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 period 2001-2006 and 32 for the period 2007-2011. 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 period 1993-2007 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 to that in OECD countries, although it has experienced a remarkable increase. Among the sample firms, approximately

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

15% are ultimately controlled by the central government, 30% are controlled by local governments, and the remaining 55% are controlled by non-state firms. The average *ESG*, *EPU*, and *CPI* indices are around 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 panel data is employed to estimate Equation (1) (Tobin, 1958), and the results are reported in Table 3. This table contains 10 specifications: (1)–(5) for models in which *LNPATENT* is the measurement of patent quantity and (6)–(10) for models with *LNCITATION* as the indicator of patent quality. 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

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

*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 comparing to private peers. The result supports *Hypotheses 1b* and *1c*, which conjecture that local SOE underperform private firms in terms of patent quantity, but they outperform private firms with respect to patent quality. The finding is consistent with that of the extant studies, which shows that SOEs invest more in basic areas of research, where innovative outcomes emerge in the long-term only, whereas private firms invest more in applied research, looking for short-term financial return (Stiglitz, 1999; Salter and Martin, 2001). The finding confirms that a high risk tolerance level is a key factor fostering exploratory innovation. Local SOEs, even assigned with multiple competing tasks, can still play a significant albeit moderate role in stimulating indigenous innovation, favoring the tournament–like regional competition mechanism introduced by the central government in China. On the other hand, the finding witnesses that private firms do make significant efforts in enhancing 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 the above finding is robust after controlling for the lead-lag effect of explanatory variables.

### *4.2 Endogeneity*

A potential concern about the above 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 central or local government may be self-selected. To address the problem of self-section bias, we use the treatment effects model with Heckman (1979) two-stage approach. The first step of this model is a binary outcome equation which is estimated from Probit regression (see Equations 3, 4, and 5 listed below) on the probability of a firm being central SOEs in Specifications (1), (2), (4), and (5) and local SOEs 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 at the local province (Provincial SOE Environment) as instrument variables, which appears to be important to 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 for the second step and two instrument variables to distinguish whether a firm is central/local SOEs or not.

*Central vs. local*

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

Central vs. Private

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

*Local vs. Private*

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

where $Z$ is a set of instrument variables that could affect a firm's central state ownership in Equations (3) and (4) and local state ownership in Equation (5). We choose two variables as

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

instrument variables: product market competition (Herfindahl Index), and the proportion of local SOEs at the local province (Provincial SOE Environment). Controls is 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 to *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 mostly likely central SOEs and local SOEs with similar observed characteristics by selecting all the control variables on the right-hand side from the main regression. Then we select the matched central and local SOEs that have the nearest propensity score (Abadie and Imbens, 2011). Common requirements in distribution are also considered. We not only remove any central/local SOEs with a propensity score higher than the maximum level of private firms but also drop any private firms with a propensity score lower than the minimum level of central/local SOEs. We use all the control variables in the main regression as the 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 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 presented above, supporting *Hypotheses 1b* and *1c*. The estimated coefficients reported in Specifications (2)–(5) and (7)-(10) are significantly negative and insignificant, respectively, suggesting that the above finding shown in Specification (1) is robust after controlling for the lead-lag effect of explanatory variables.

### *4.3 Heterogeneous impacts across industries and regions*

#### *4.3.1 Manufacturing industry vs. non-manufacturing industry*

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 sub-samples representing manufacturing and non-manufacturing industries. 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 non-manufacturing industries, lending strong support to *Hypothesis 1a*.

On the other hand, 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 insignificant, respectively. The results show that private firms outperform local SOEs in terms of patent quantity, in particular in the non-manufacturing 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 non-manufacturing and manufacturing sectors, respectively. The findings are not surprising because in the manufacturing industry, regulations are assumed to be largely absent so that local SOEs are less able to exert monopoly power in increasing patents. However, investment in innovative activities in the manufacturing industry usually involves higher sunk R&D costs than in the non-manufacturing industry. Therefore, local SOEs with a greater failure tolerance capability are able to undertake more high-quality innovation activities than their private peers.

*4.3.2 High economic development region vs. low economic development region*

China's development is characterized by huge provincial disparities in economic development, natural resources, availability of infrastructure, education, etc. (Démurger, 2001; Heilig, 2004). Consequently, firm innovation performance in China may also varies from province to province (Fu, 2008; Kroll and Frietsch 2014). We therefore divide the full sample into two sub-samples representing high and low economic development regions, respectively. Following Bao et al. (2002), regional economic development is measured by GDP per capita of the region. The subsamples are partitioned based on the sample median. The regression results are reported in Tables 7. Again, the estimated coefficients for *DCENTRAL* reported in Specifications (1)-(10) of Panels A1 and B1 are significant and positive, while 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 further confirms that central SOEs, being the national policy instruments, deliver the best innovation performance, in terms of both patent quantity and quality, in both high and low economic development regions, strongly supports *Hypothesis 1a*.

Focusing on local SOEs, the estimated coefficients for *DLOCAL* presented in Specifications (1)-(5) of Panels A1 and B1 are mainly significantly negative and positive, respectively, whereas the estimated coefficients for *DLOCAL* presented in Specifications (6)-(10) of Panels A1 and B1 are mainly insignificant. The result suggests that, in the 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*. In the low economic development region, however, 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. This implies that it would be more difficult for firms in low economic development regions to gain access to these vital innovation resources than in high economic development region, in particular for private firms, reducing the increase in patent quantity. For local SOEs, they may be more likely to put a lower unemployment rate and a higher GDP growth rate in short-term as their top priority than those in high economic development region and hence less 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 of 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. In addition, the results of the mean difference *t* tests are also significantly positive in all specifications. The 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), which find that SOEs are more likely to undertake ESG activities than private firms. Given the ESG activities are usually new to these SOEs, they may enable these firms to tap new markets that are 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 insignificant in Specifications (6)-(10). The result suggests that private firms engaging in more ESG activities outperform local SOEs in terms of patent quantity, lending support to *Hypothesis 2b*. However, no significant moderating effect is observed concerning patent quality, illustrating that local SOEs does not outperform private firms with respect to patent quality when more ESG activities are undertaken. One possible explanation could be that for private firms, the stakeholder value maximization function of ESG engagement sounds more appealing because comparing with local SOEs, private firms often have less support from local governments. Undertaking more ESG activities could greatly improve their relationship with local governments and local communities, which enables them to access more resources and hence enhance their risk tolerance levels for engaging in exploratory innovation. From the perspective of local SOEs, more ESG engagements merely add on to their existing social functions, which may consume their limited resources, slowing their pace for exploratory innovation.

### *4.4.2 Economic policy uncertainty*

Table 9 shows the regression results for the differences of innovation performance among central SOEs, local SOES, and private firms conditional on firms' exposure to economic policy uncertainty (EPU). The estimated coefficients for *DCENTRAL*LNEPU* presented in Panel A are significant and positive in almost all specifications. In addition, the results of the mean

difference *t* tests are also significantly positive in all specifications. The result suggests that central SOEs demonstrate the best innovation performance in terms of both patent quality and quantity during periods of high EPU, supporting *Hypothesis 3a*. This result is in line with Jiang et al. (2020) and He et al. (2020), which find that better innovation performance caused by a higher level of EPU are mainly driven by SOEs. In addition, the estimated coefficients for *DLOCAL*LNEPU* presented in Panel A are significant and negative mainly in Specifications (1)-(5), whereas they become significant and positive mainly in Specifications (6)-(10). The result demonstrates that during the periods of high 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*. The finding not only favors the game theory view but also provides vivid evidence showing that SOEs are economic stabilizers as argued in EBRD (2020).

*4.4.2 Corruption*

Table 10 presents the regression results for the differences of 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. The 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), whereas they become significant and positive in Specification (6) only. 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 expose to less corruption, but such effect becomes insignificant 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), which find that private firms rather than SOEs can benefit from the stronger anti-corruption efforts. That being said, in central SOEs, the risk of corruption could be higher than their local and private peers because their managers enjoy much greater political power than their local and private counterparts. This makes 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 manufacturing versus non-manufacturing industry. 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 non-manufacturing sectors when more ESG activities are engaged, during periods of high economic policy uncertainty, and when less corruption is presented.

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 insignificant, respectively. The results show that under each of the three scenarios (i.e., when more ESG activities are engaged, during periods of high economic policy uncertainty, and when less corruption is presented), private firms outperform local SOEs in terms of patent quantity, in particular in the non-manufacturing 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 to *Hypotheses 2b, 3b*, and *4b* as well as partial support to *Hypotheses 2c, 3c*, and *4c*.

Tables 14-16 present the corresponding results for high versus low economic development region. 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. The 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 high economic policy uncertainty, and when less corruption is presented.

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 mainly insignificant. The only exception is that the estimated coefficients for *DLOCAL*ESG* is insignificant in Specifications (1)-(5) of Panel B1, illustrating that in high economic development region, local SOEs does 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 presented, local SOEs outperform private firms with respect to patent quality. In the low economic development region, however, local SOEs are similar to private firms in both dimensions of innovation creation. In general, the findings suggest that *Hypotheses 2b, 3b, 4b* as well as *3c* and *4c* are valid in high economic development region only.

## 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, logics, 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 using a large sample of listed firms in China during the 2007–2015 period. 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 mainly in non-manufacturing industry and in high economic development region. Local SOEs outperform their private peers with respect to patent quality in manufacturing sector and in high economic development region. In low economic development region, however, there is no significant difference in innovation performance between local SOEs and private firms. Such 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 presented. We use both the treatment effect model and the PSM method to

address the endogeneity concerns, and our main findings are robust.

Broadly speaking, our findings make important contributions to the corporate finance and political economy literatures by showing how 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 proved to have a significant impact on their innovation strategies. Based on the institutional theory concerning diversity in state capitalism, we are able to identify the crucial factors that may shape the 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 public goods nature (Arrow, 1962). We also reveals how critical the ability to deal with risks is 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. Furthermore, our findings echo the argument of Belloc (2014), who proposes to reconsider the conventional wisdom concerning SOEs and indicates that SOE inefficiency is not due to state ownership *per se* but is rather caused by conditions to which SOEs often relate. For example, reducing corruption through enhanced legislation or organizational culture could greatly improve SOEs' innovation performance. One obvious 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 become key enablers of China's plan to encourage indigenous innovation and to combat global crisis such as the ongoing coronavirus COVID-19 pandemic.

Although this paper is a pioneer study to use 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, which could be considered new research opportunities. For example, this study focuses on listed firms in China. Its findings might not be valid for non-listed firms. Thus, future research could expand the sample set by including both listed and non-listed firms to better understand the mechanism between ownership structure and innovation in China.