# State Ownership and Product Innovation in China: An Integrated View of Efficiency and Legitimacy

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## ABSTRACT

Does state ownership benefit or impede firm innovation? Extant studies offer contradicting perspectives and inconsistent empirical findings regarding this issue. This study develops an integrated view of institutional and efficiency logics by proposing that whereas state ownership enables a firm to obtain R&D resources, it makes the firm less efficient in utilizing the resources to generate innovation. The results of two longitudinal panel datasets of Chinese manufacturing firms show that state ownership positively affects R&D input; however, it also weakens the effect of R&D input on innovation output, making a minority state ownership optimal for innovation development. Moreover, the efficiency problem of state ownership of transforming R&D input into innovation output decreases when industrial competition is high, as well as for start-ups. We discuss the implications of these findings for research of state ownership and firm innovation in emerging economies.

**Keywords**: state ownership, innovation, agency theory, institutional theory, industrial competition, state start-up, emerging economies

## INTRODUCTION

Innovation is a key driver of sustainable competitive advantage and economic growth. With the rise of emerging economies, there is a growing interest in how factors that are unique to emerging markets affect innovation development (Chen et al., 2014; Lee, Özsomer, and Zhou, 2015). Because governments in emerging economies such as Brazil, China, and Russia play critical roles in affecting firm behavior, the strong state power together with the rapid economic growth has stimulated a rising research stream that revisits state capitalism, focusing on how government control may stimulate innovation and competitive advantage (Lazzarini, 2015; Mazzucato, 2015) and various forms of state ownership foster firm performance (Inoue, Lazzarini, and Musacchio, 2013; Musacchio, Lazzarini, and Aguilera, 2015). Despite this rising interest on state capitalism, under-researched is how different levels of state ownership affect firm innovation (Musacchio, Lazzarini, and Aguilera, 2015).

A conventional, efficiency-based economic view, mostly rooted in agency theory, presents a rather pale role for state ownership in innovation and performance. Because state-owned enterprises (SOEs) are governed by administrative rather than economic imperatives, government intervention is unavoidable, and various political tasks hinder firm development (Ramaswamy, 2001; Shleifer, 1998; Shleifer and Vishny, 1994). Managers in SOEs often lack incentives to pursue market-driven, efficiency-based innovative activities and instead just fulfill administrative tasks (Freund, 2001; Ramamurti, 2000). According to this efficiency view, SOEs would gradually lose their innovativeness and competitiveness.

The reality however contrasts sharply with this prediction. Many SOEs in emerging economies have evolved into dynamic dynamos, rather than dying dinosaurs (Musacchio and Lazzarini, 2014; Ralston et al., 2006; Stan, Peng, and Bruton, 2014). China now has 106

companies in 2015 Fortune Global 500 (four times more than in 2006), only behind the United States, among which about two-thirds are SOEs. According to the institutional view (North, 2005; Peng, Wang, and Jiang, 2008), governments are among the most salient institutions in emerging economies, with critical influences on regulatory policies and control over scarce resources, so they profoundly shape firms' competitive environment (Gao et al., 2010; Nee and Opper, 2012). Because SOEs have better access to policy information, government support, and valuable resources (Chen et al., 2014; Musacchio and Lazzarini, 2014), these advantages presumably could foster innovation activities.

Received empirical evidence is also mixed. Consistent with the efficiency-based view, some studies report that state ownership has negative effects on new product sales, patent applications, firms' adoption of product innovation, and revenue from innovation projects in China (Guan et al., 2009; Jefferson et al., 2003; Xu and Zhang, 2008). Ayyagari, Demirguc-Kunt, and Maksimovic (2011) similarly show that SOEs are less innovative than private firms across 47 emerging markets. In contrast, though in accordance with the institutional view, other studies document that SOEs produce more patent registrations or new products than non-SOEs in China (Choi, Lee, and Williams, 2011; Li and Xia, 2008). Meanwhile, Choi, Park and Hong (2012) find that state ownership has no significant bearing on Korean firms' technological innovation performance.

Clarifying the theoretical and empirical inconsistencies of state ownership is the major intended contribution of this paper. We argue that the institutional and efficiency logics pertain to different facets of state ownership: the institutional logic focuses on resource *allocation*, yet the efficiency logic refers to resource *utilization*; so they are intertwined in affecting the impact of state ownership on innovation. Whereas state ownership could enable a firm to obtain more

resource input for innovation (i.e., more *R&D input*), it also decreases the firm's ability to convert its R&D input into innovation output (i.e., lower *efficiency*). As a result, state ownership has an inverted U-shaped relationship with a firm's innovation output such that a minority state ownership enables the firm to achieve the highest innovation output. Moreover, we uncover important contingencies related to the role of state ownership, which may have differential effects on innovation across various institutional and industrial environments. We propose that better institutional environment reduces the positive impact of state ownership on R&D resources, whereas a more competitive market or start-up status could push firms with state ownership to use their resources more efficiently. Figure 1 depicts our conceptual model.

***Insert Figure 1 about Here***

Our empirical setting, the Chinese market, is suitable for testing these conjectures. As a leading emerging market, China has been undergoing a fundamental institutional transformation. After three decades of reform, the Chinese economy has become increasingly competitive and market-oriented, yet government influence remains prevalent; the government retains resource allocation power and still guides business activities (Sheng, Zhou, and Li, 2011; Xu, Lu, and Gu, 2014). Moreover, despite the continuous reform in China, institutional development and market competition vary dramatically across different regions (Li and Qian, 2013). Thus, China serves as a rich context for examining the role of state ownership in emerging markets.

## THEORY AND HYPOTHESES

*State ownership* refers to the percentage of ownership stake that the government holds in a firm; SOEs are firms with majority government ownership (Boisot and Child, 1996; Jefferson et al., 2003). Owned by "the whole people" but "operated and managed by the state," SOEs act as agencies of the government that carry out the state policies and regulations (Shleifer, 1998).

Whereas empirical evidence in general shows that SOEs perform worse than their private counterparts (see Megginson and Netter, 2001 for a review), state ownership exists in both developed and emerging markets and various forms of state control (e.g., majority ownership and minority investor) have emerged in many countries (Musacchio, Lazzarini, and Aguilera, 2015). Firms with different types of state control take up to 20 percent of the total stock market value worldwide (Musacchio and Lazzarini, 2014).

Starting from the mid 1990s, the Chinese government took two major criteria as the general guiding policy to restructure and privatize its SOEs: (1) whether the SOE was in strategically important industries that the government wished to keep, such as natural resources, national defense, transportation, and communication network, etc. (Lin, Fang, and Zhou, 1998); (2) whether the SOE was a large company, based on the annual production capacity or fixed assets. Larger SOEs were kept whereas smaller ones were gradually transformed into or acquired by private companies (Xu, Lu, and Gu, 2014). The remaining SOEs continue to be critical in the country's economy, such that they generate 23.72% of national revenues from principle businesses in 2014 (National Bureau of Statistics of China, 2015).

**Resource Allocation: An Institutional Logic**

Institutional theory focuses on the interaction between institutions and organizations and emphasizes how firm behavior is shaped by the surrounding institutions (Scott, 1995). Institutions include both formal organizations, such as social, economic, and political bodies, and informal social norms and rules (North, 1990; Peng, 2003). Because institutions reflect a nation's history, culture, and ideology, they create the rules of the game and regulate business activities through formal and informal constraints (North, 1990; Oliver, 1997). Firms come under strong pressures to react and adapt to various institutional constraints; those that conform to the rules are more likely

to survive and prosper (Dacin, Oliver, and Roy, 2007).

According to the institutional view, the efficiency logic represents only one perspective from which to evaluate state ownership; as institutional factors define the rules of the game and regulate business operations, they also must be considered to determine the role of ownership governance (Dacin, Oliver, and Roy, 2007; North, 2005; Peng, Wang, and Jiang, 2008). In emerging economies, *institutional voids*, such as shallow capital markets, shortages of skilled labor, weak legal enforcement, and lack of independent financial intermediaries, seriously hinder firm operation and development (Hoskisson et al., 2000; Khanna and Palepu, 1997; Ramamurti, 2000). In terms of innovation, voids of capital markets severely constrain a firm's motivation and ability to invest in innovative yet risky projects (Chen et al., 2014; Yang, Sun, and Yang, 2015).

One way to address such institutional voids is to get connected with the government[1], which exerts a strong influence on business operations through policy making and resource allocation (Xu, Lu, and Gu, 2014; Musacchio and Lazzarini, 2014). First, governments often intervene with economic activities and grant protection to certain business actors through national strategic planning, antitrust policies, financing, and banking regulations (Hoskisson et al*.,* 2000; Sun and Liu, 2014). For instance, many emerging market governments only allow SOEs to operate in strategically important sectors such as petroleum processing (Musacchio and Lazzarini, 2014). Second, emerging market governments still play a major role in allocating key factor resources such as fund, land, or technical infrastructure (Chen et al., 2014; Sheng, Zhou, and Li, 2011). As government owned entities, SOEs enjoy privileges granted by the government and related agencies to overcome institutional voids. As Musacchio and Lazzarini (2014) document,

[1] Another important way is to form business groups, which use formal and informal ties to take coordinated actions (Guillén, 2000; Khanna and Palepu, 2000). Such business groups serve as internal capital markets to provide financial support and act as intermediaries to offer quality market information to member firms, and they also use their market power to facilitate transactions and reduce risks (He et al., 2013a; Khanna and Palepu, 2000).

SOEs, especially those in emerging markets, often receive subsidized credit from the government.

We propose that state ownership enables firms to gain more resources to invest in R&D activities. Innovation often requires substantial resources, but access to financial capital in many emerging economies is heavily controlled by the governments (Musacchio and Lazzarini, 2014). In China, for example, state-owned banks, which prioritize SOEs as their top clients, control most of the lending capital (Chen et al., 2014). State ownership helps a firm to access such capital (Xu and Zhang, 2008), borrow more at a lower cost (Khwaja and Mian, 2005) and obtain government subsidies (Ramaswamy, 2001), which then enable the firm to spend more in pursuing its innovation activities. State ownership also offers access to government policy support. As governments devise policies to encourage or discourage certain types of development, SOEs can access important infrastructure resources and enjoy the privileged incentives that facilitate government-initiated innovation (Chang, Chung, and Mahmood, 2006; Siegel, 2007). Government R&D funding also is primarily funneled to SOEs in the name of constructing indigenous national, technological, and defense innovation systems (Sun and Liu, 2014).

Moreover, SOEs are under strong regulatory pressures to fulfill the requirements from the government. In China, for instance, the government views innovation as one of the national top priorities and encourages firms to invest more in innovation development (Chen et al., 2014). After recognizing the power of technological innovation in stimulating productivity growth, the Chinese government places great emphasis on building an innovation-oriented economy. In 2006, China officially stated its ambition to become the world's leading innovative powerhouse by 2020 and the leader in science and technology by 2050 (Sun and Liu, 2014). The government specially indicated its goal of increasing the R&D investment relative to GDP to 2.5% by 2020, which was close to that of the United States in 1998 (Du, Zeng, and Du, 2012). As the main body of

implementing the country's ambitious innovation plan, SOEs must respond to the government's call and invest the obtained resources into R&D activities. Thus, we predict that

*Hypothesis 1a: State ownership of a firm has a positive effect on its R&D input.*

**Resource Utilization: An Efficiency Logic**

The conventional economic view posits that state ownership is incompatible with *efficiency*, defined as the degree of transformation of resource input into product output (Megginson and Netter, 2001; Shleifer, 1998). According to agency theory, as long as ownership and management are separated, agency problems arise, such that professional managers take advantage of their positions as agents and exploit inside information for personal gain, at the expense of investors' (principals') interests (Jensen and Meckling, 1976). Because principals and agents have different goals, and agents often have more inside information, principals cannot ensure that agents always act in their best interests (Eisenhardt, 1989).

To reduce the agency problem, principals in private firms often devise detailed employment contracts with managers to specify high-powered incentive structures based on performance evaluations (Jensen and Meckling, 1976). Principals could also impose a monitoring system that collects timely information about what agents are doing (Betty and Zajac, 1994; Fama, 1980). The key is to align the agent's interests with the principal's, such that the agent acts on behalf of the principal and operates the company efficiently (Eisenhardt, 1989).

Whereas shareholders of private firms may fail to control their management teams, SOEs likely suffer more from the *dual agency* problem. First, the principal is not clearly defined in SOEs, and there is an absence of a visible owner (Shleifer, 1998). Because SOEs in principle are owned by the society as a whole, they end up belonging to nobody and become agents without a principal (Shleifer, 1998; Shleifer and Vishny, 1994). While citizens are the nominal owner of

SOEs, they have neither contractual nor monitoring mechanisms to align the objectives of the politicians (as the nominal agents but *de-facto* principals) with their own objectives (Cuervo-Cazurra, et al., 2014). Without effective monitoring mechanism, government officials as *de-facto* principals look for rent-seeking opportunities, such as maximizing their own interests, securing political support, or increasing their chances of being elected (Khwaja and Mian, 2005). When politicians use SOEs for their personal rent-seeking, they unavoidably interfere with firms' regular operations (Khwaja and Mian, 2005), which reduces SOEs' efficiency of utilizing R&D input to generate innovation output.

Second, in many emerging economies, when politicians as principals appoint managers of SOEs, they consider more about political reasons other than managerial capabilities (Qian, 1996; Ramaswamy, 2001). As a result, SOE managers are often bureaucrats but not businessmen, who lack appropriate capabilities or skills to run companies efficiently (Xu and Zhang, 2008). Even if some SOE managers are highly qualified, they lack strong motivations to pursue innovation diligently: SOE managers themselves cannot benefit much from successful innovation because the lack of aggressive profit sharing incentives normally provided by private firms (Shleifer, 1998). Also, SOE managers do not face close scrutinizing usually conducted by the shareholders of private firms (Megginson and Netter, 2001), so they likely misuse the R&D investment for their personal objectives, reducing the efficiency of generating innovation output.

Taken together, due to diffuse ownership, citizens as owners are less able to write complete contracts to incentivize and monitor how politicians or managers run the firms. As a result of such dual agency problem, SOEs' efficiency in transforming R&D input into innovation output is lower when compared to non-SOEs.

*Hypothesis 1b: State ownership negatively moderates the effect of R&D input on innovation output.*

**Joint Consideration of Institutional and Efficiency Views**

Whereas the institutional view emphasizes the resource advantage brought by state ownership, the efficiency view highlights the dual agency problem caused by state ownership. Because both views offer valid arguments, a joint consideration is necessary to examine the overall effect of state ownership on innovation. As firm ownership varies from majority state-owned (i.e., SOEs), minority state-owned (i.e., mixed firms), to private-owned without state capital (i.e., private firms), the varying degree of state ownership can make the institutional or efficiency logic more or less salient.

When state ownership increases from zero to minority levels, the institutional effect becomes more salient yet the efficiency problem is relatively minor. Due to the voids of capital markets, one major challenge for private firms in emerging economies is the difficulty of obtaining financial resources (Khanna and Palepu, 1997; Zhou et al., 2014). Having partial state ownership provides these firms with access to scarce resources. As Musacchio and Lazzarini (2014) observe, with partial state ownership, firms in various emerging economies can obtain resources more easily from state-owned/development banks, sovereign wealth funds, and other state-controlled funds (e.g., pension funds and life insurance). Meanwhile, because private ownership dominates, governments as minority owners relinquish major decision power to the private owners, who will employ pay-for-performance incentives practices and close monitoring systems to reduce agency problems (Inoue, Lazzarini, and Musacchio, 2013). As a result, the impact of state ownership on innovation would be positive.

However, as state ownership moves from minority to majority levels, the additional resource allocation advantages increase rather incrementally; yet since state ownership dominates, the key decision power lies in the hand of the managers designated by the

government officials. Accordingly, the dual agency problem of SOEs becomes evident, such that politicians likely interfere with business operations for their own benefits and managers may lack capabilities or motivations to run the company efficiently (Megginson and Netter, 2001; Shleifer, 1998). In such situations, an increase in state ownership triggers more inefficiency problems. Taken together, a minority level of state ownership is most beneficial to innovation.

> *Hypothesis 1c: State ownership of a firm has an inverted U-shaped impact (first increasing and then decreasing) on its innovation, such that a minority state ownership generates most innovation output.*

**Contingencies**

According to the institutional view, a country's economic, political, and social institutions jointly determine the costs of production and transaction, which in turn shape firm strategies and operations (North, 2005; Peng, 2003). Because emerging markets are featured with uneven development of institutional settings across regions, *institutional development* has a profound influence on the role of state ownership. As McDermott (2007) reveals, institutional reform in East Central Europe creates alternative routes, which facilitates or hinders the ability of relevant public and private banks to experiment with new initiatives. Schipani and Liu (2002) argue that China's enactment of better laws, rules, and regulations for its growing market economy compels firms to bring their business practices more in line with Western norms of management. Musacchio and Lazzarini (2014) also suggest that institutional development in Brazil significantly affects the role of state ownership in various types of enterprises. Related, Khanna and Palepu (2000) find that the institutional development in Chile reduces the benefits of business group membership.

*Institutional development* refers to the degree to which market fundamentals support economic activities, including the proportion of resources allocated through the market, the

percentage of products with market-based prices, and the development of market intermediaries and legal systems (Meyer and Nguyen, 2005). In China, institutional development varies in pace across provinces: in less developed regions, local governments remain as "visible hands" that intervene in economic activities and business practices; in more developed regions, the governments tend to coordinate economic activities in their territory but let the market govern business transactions (Li and Qian, 2013; Zhou et al., 2014).

We posit that institutional development weakens the effect of state ownership on R&D input. First, the resource advantage of state ownership decreases with institutional development. When the market becomes more cultivated, and the "the invisible hand" of the market permeates economic life, market forces bear more influence on determining the supply and demand of resources (Peng, 2003). Accordingly, firms turn to the market for critical resources. For example, as China's capital market develops, firms are able to find alternative sources to attain credit funds, rather than relying only on state-owned banks (Nee and Opper, 2012). The growth of the private sector and the intermediate institutions such as foreign financial institutions and venture capital also expand the source of external funding (Cuervo-Cazurra and Dau, 2009). Sarkar, Sarkar, and Bhaumik (1998) show that as India's institutional environments improve, new private investors emerge and provide alternative sources of capital. Musacchio and Lazzarini (2014) indicate that government loans are less important for Brazilian firms after the local capital market develops. These financial and institutional developments break state monopolies and create competitive capital environments, so firms' reliance on the government as a source of funding for innovation declines.

Second, the regulatory pressure is alleviated with institutional development, which is accompanied by a reduction of government intervention in economic activities (Li, Peng, and

Macaulay, 2013). With less interference, the government relaxes the control of SOEs and grants them higher degree of managerial autonomy (Cuervo-Cazurra and Dau, 2009). SOE managers thus have more discretionary power in resource allocation and face less regulatory pressures from the government to invest resources in R&D. As Sun and Liu (2014) note, the contribution rate of major governmental agencies of innovation policy making declines as the Chinese market develops. In the long-term, China aims to move from a state-run innovation system toward an enterprise-centered system so that it would provide policy support, such as subsidies, tax reduction, and funds to enterprises, no matter SOEs or non-SOEs, that conduct its preferred innovation activities. Therefore,

*Hypothesis 2: The effect of state ownership on R&D input is less positive when institutional development is high rather than low.*

Agency theory posits that the alignment of the interests between the agents and principals is the most critical means to reduce the agency problem (Eisenhardt, 1989). Various internal and external controls could be adopted to achieve this objective. Internal corporate governance controls can take the forms of setting up the board of directors to monitor the managers, drafting outcome-based contracts, imposing internal control procedures and auditing systems, and etc. (Betty and Zajac, 1994; Fama, 1980; Jensen and Meckling, 1976). External corporate governance controls include inducing competition, disclosing performance information, imposing accounting regulations, and etc., which enable external stakeholders to monitor the actions, strategies, and performance of corporations (Eisenhardt, 1989).

Among various external governance controls, *competition* is perhaps the most salient because it forces inefficient firms to exit the market (Geroski, Mata, and Portugal, 2010; Porter, 1985). *Industrial competition* refers to the extent of competition a firm confronts in its industry (Porter, 1985). In highly competitive markets, competitive rivalry is intensive and product choices

are abundant. In response to increased competition, innovative product development becomes an essential process for the survival, success, and renewal of organizations (Brown and Eisenhardt, 1995). Companies must act quickly in response to competitive actions and strategies; otherwise, they will be driven out of the market.

We posit that a higher level of industrial competition reduces the dual agency problem of SOEs and pushes them to be more efficient in generating innovation output. In emerging markets, whereas governments used to be very protective of their domestic markets and local firms, they have gradually liberalized the economies and opened the markets to boost economic growth (Hoskisson et al., 2000). As a result, competition has been intensified with the explosive growth of private sectors and foreign firms (Peng, 2003). Facing competitive pressures from private-sector entrants and foreign multinationals, SOEs must become more sensitive to market needs and open to new product ideas in order to survive (Ramaswamy, 2001). Politicians have to constrain their intentions to use SOEs for their personal benefits, otherwise the SOEs would face higher chance of bankruptcy under the strong market competition. Accordingly, the government officials reduce their interference with firm operation; rather, they tend to appoint managers based on merits and capabilities, draft performance-based incentive contracts with them, and delegate more control and decision-making power to those managers (Stan, Peng, and Bruton, 2014).

Whereas SOE managers now receive more discretion and decision power, they also are held accountable for SOE performance. In competitive markets, information is abundant about the environments in which firms operate, which provides clear benchmark for performance comparison and evaluation (Porter, 1985). Because of the transparent evaluation, managers' tenure could be terminated if SOEs underperform seriously (Stan, Peng, and Bruton, 2014). Meanwhile, even if SOE managers depend on the state for certain resources, industry competition forces them

to respond quickly to market demand and develop innovative products to meet customer preferences, otherwise firms may not be able to survive the competition (Cuervo-Cazurra and Dau, 2009). As Ralston et al. (2006) observe, increasingly competitive markets force SOEs to adopt alternative strategies and pursue new initiatives to survive and succeed. Thus, in a highly competitive environment, the reduced political interference and increased managerial motivation lead SOEs to employ their resources more efficiently in innovation development.

*Hypothesis 3: The moderating effect of state ownership on the R&D input–innovation output relationship is less negative when industrial competition is high rather than low.*

The increasingly intensified competition is also induced by the proliferation of *start-ups*, including newly founded SOEs (Li, Poppo, and Zhou, 2008; Ralston et al*.,* 2006). The rise of China's emerging economy has been coupled with explosive new firm growth, changing the competitive landscape and the behavior of existing firms (Peng, 2003). Start-ups in general are more innovative, because once the routines are formed, the likelihood of adopting new alternatives is largely reduced for established firms (Hannan and Freeman, 1984). Since innovation requires risk-taking and deviation from current practices, start-ups are in a better position in identifying new opportunities, responding promptly to environmental changes, managing the innovation processes. Managers in start-ups are also more inclined to engage in R&D because it increases the chances of the firms' early survival. As Stam and Wennberg (2009) document, R&D relates strongly to new product development, interfirm alliances, and employment growth during the early stages of firms' lives.

When governments set up state start-ups, they aim to develop breakthrough technologies with great potential that are yet to be understood by the business community; governments also use public venture capital to fund many innovative yet highly risky start-ups (Mazzucato, 2015). As such, state start-ups have relatively straightforward economic objectives rather than social goals;

and the governments scrutinize them closely to ensure the behaviors are consistent with their objectives. Facing higher scrutiny, individual politicians are less likely to take advantage of state start-ups for their own benefits (Musacchio, Lazzarini, and Aguilera, 2015). Rather, they would grant greater discretion to the managers with regard to the strategic decisions, so state start-ups suffer less from rent-seeking behaviors of individual politicians.

Compared with long-existing SOEs, state start-ups also are less influenced by the legacy of a socialist imprint and bear fewer historical burdens, such as redundant workers (Lin, Fang, and Zhou, 1998). Without such historical burdens, state start-ups can build a more flexible organizational structure and employ incentive mechanisms that reward managers based on performance and profitability. These new incentive mechanisms enable SOEs to provide market compensation to better attract and retain qualified managers (Khanna, 2009). With clear objectives and performance-based incentives, managers can focus their attention to make and implement strategic decisions that lead to firm innovativeness and competitiveness. Also, unlike established SOEs, state start-ups face liabilities of newness, including limited resources and no established relationships with key actors (e.g., suppliers, buyers, distributors) (Chen et al., 2014; Peng, 2003). Managers must work diligently to overcome these liabilities and enhance the competitiveness of the firm in order to survive in the market. As a result, state start-ups suffer less from the dual agency problem and can use their resource input more efficiently to generate innovation.

*Hypothesis 4: The moderating effect of state ownership on the R&D intensity–innovation output relationship is less negative for start-up firms.*

## METHOD

### Study 1 – Main Study

### Data

We used data from the *Annual Census of Chinese Industrial Enterprises* (2001-2007), conducted

by the National Bureau of Statistics of China. This database contains detailed information about manufacturing firms operating in China, such as their ownership type, industry, assets, liabilities, capital structure, and financial performance. The annual census covers all SOEs and non-SOEs whose annual sales are at least 5 million RMB (about US$685,000 in 2007); it thus provides a comprehensive coverage of SOEs in China. Research in strategy and international business often uses it as a reliable information source of firms operating in China (e.g., Gao et al., 2010; Xu, Lu, and Gu, 2014).

Because our focus is to examine SOEs' innovation activities relative to other types of domestic firms, we excluded firms with majority foreign (≥50%) ownership and firms that were registered as SOEs initially (i.e., with majority state capital) but then were transformed into mixed or private firms, and employed a one-year lag for the independent variables in the models. The final sample consisted of a balanced panel of 12,288 manufacturing firms and the number of observations in our analyses was 73,728 (12,288 × 6 years, 2002–2007). The 12,288 firms consist of 2,235 SOEs, 647 mixed firms, and 9,406 firms without state capital[2]. The sample covers manufacturing firms in 31 provinces and 182 industries, classified by three-digit Chinese Industry Code, which exhibit significant variance in cross-region institutional environments and cross-industry competition levels.

**Measures**

*Innovation output*. The new product value that a firm can generate in the market is an important measure of its innovation capability, because it indicates the commercial significance of the firm's product innovation (Laursen and Salter, 2006). Innovations cannot enhance firm performance until they have gone through testing, production, and commercialization processes

[2] Notable examples include Weichai Heavy Machinery as a SOE, Gree as a mixed firm, and Sichuan New Hope Agribusiness as a private firm without state capital.

(Katila, 2002). Therefore, we measured innovation output as the ratio of new product output to its total industrial output. In the census, new products are defined by National Bureau of Statistics as those new to the market that (1) are based on substantially new technologies and designs or (2) have substantial improvement on functionality and performance. For *R&D input*, we measured it as R&D expenses divided by a firm's total sales.

*State ownership.* We measured state ownership in two ways. First, we treated it as a continuous variable and measured the percentage of stakes owned by the government. Because ownership structure does not change often, this measure is an enduring, objective indicator. Second, we created a dummy variable to indicate if a firm was a SOE (i.e., firms with majority state ownership). The two measures produced consistent results.

*Institutional development*. In China, the National Economic Research Institute (NERI) compiles a composite "marketization" index yearly to indicate the institutional development at provincial level (Fan, Wang and Zhu, 2011). This index consists of five sub-indices: (1) the relationship between the government and the market, (2) the development of the non-state sectors, (3) the development of the product market, (4) the development of the factor market, and (5) the development of market intermediaries and the legal environment. Previous studies in economics, finance, and international business have used it extensively to measure institutional development in different regions in China (e.g., Gao et al., 2010; Li, Meng, and Zhang, 2006).

*Industrial competition*. We used the Herfindahl index to measure industrial competition (one minus industry concentration). On the basis of information from the census data, we calculated the Herfindahl index at the three-digit industry level for each year, using the sales revenue and market share of each firm (Gao et al., 2010).

*Start-ups*. We used a dummy variable to indicate whether an enterprise was established as

a new venture within the previous five years (1 = yes; 0 = no). Start-ups that have failed to build strong market positions in five years likely go extinct (Bantel, 1998) and the average gap between a firm's founding and its first foreign entry is 5.4 years (Autio, Sapienza, and Almeida, 2000) . So the five-year cutoff offers a reasonable indicator of start-up status[3].

*Controls*. We controlled for several variables that may influence firms' product innovation. First, we controlled for *firm size* with a logarithm transformation of the number of employees. Second, we controlled for a firm's *export market orientation* (i.e., whether the percentage of exporting to total sales is greater than 50%) to capture possible differences between firms that focus on the domestic market and those that generate the majority of their sales from overseas. Third, we used *industry growth rate* (based on industry-aggregated annual sales) and *industrial performance* (average return on assets) variables, at three-digit industry levels, to control for industry heterogeneity.

**ANALYSIS AND RESULTS**

We employed a Tobit analysis to deal with the non-negative nature of our dependent variables, namely, R&D intensity and new product output (Feinberg and Gupta, 2004; Salomon and Shaver, 2005). We used firm random effects and industry/year fixed effects in the model estimation. In Table 1, we report the descriptive statistics and correlations for the variables. A review of correlations among independent variables suggests that multicollinearity is not a major concern, as confirmed by the variance of inflation (VIF) ranging from 1.01 to 1.50 (Hair et al., 1998).

***Insert Table 1 about Here***

Table 2 contains the estimation results regarding the impact of state ownership on firms' R&D intensity, with both state ownership as a continuous variable (Models 2 and 3) and the SOE dummy (Models 4 and 5). Hypothesis 1a predicts that state ownership exert a positive effect on

[3] We used six- and eight-year to classify start-up status, and obtained consistent results.

R&D intensity. Consistent with this assertion, the coefficient of state ownership is positive and significant (Model 2, $p < 0.001$), and so is that of the SOE dummy (Model 4, $p < 0.001$), so Hypothesis 1a receives support.

***Insert Table 2 about Here***

We report the results of the moderating effect of state ownership in Table 3, again including the results of state ownership as a continuous variable (Models 2, 3, and 4) and as a SOE dummy (Models 5, 6, and 7). Hypothesis 1b suggests a weaker positive effect of R&D input on innovation output when state ownership is high; our findings confirm that the interaction between R&D intensity and state ownership exerts a negative effect on new product output (Model 2, $p < 0.001$)[4]. The SOE dummy also negatively moderates the R&D intensity–innovation output relationship (Model 5, $p < 0.001$), in support for Hypothesis 1b.

***Insert Table 3 about Here***

Hypothesis 1c deals with the direct effect of state ownership on a firm's innovation output (see Table 4). The results show that state ownership positively affected innovation output (Model 3, $p < .001$), yet the squared term has a negative effect on new product output (Model 3, $p < .001$). Therefore, state ownership has an inverted U-shaped relationship with innovation, with a turning point at 29.18%. That is, a minority state ownership of 29.18% is most beneficial for product innovation, in support of Hypothesis 1c.

***Insert Table 4 about Here***

Hypothesis 2 predicts that institutional development weakens the effect of state ownership on R&D intensity. Because the index of institutional development is endogenous to

[4] The moderating effect consists of one with an interaction variable and one with the inherent nonlinearity of limited dependent variable models, such as Tobit models. We decomposed this interaction effect into secondary moderating effect and structural moderating effect (Bowen, 2014). The results show that the secondary effect is significant and consistent with the total interaction effects. Thus, it provides support for the validity of our hypothesis testing.

regional economic development and coterminous with regional market development, we need to treat it as endogenous and find an instrument that affects the R&D intensity indirectly through institutional development. Regions' geographic location can be considered exogenous and predetermined by nature (Frankel and Romer, 1999). We therefore used the distance of each province to major seaports as the instrument for the index of institutional development (Wei and Wu, 2001). Specifically, we calculated the shortest physical distance of the capital city of each province to one of the two major seaports (Hong Kong and Shanghai) using the Great Circle formula with the latitudes and longitudes of cities[5]. The instrumental variable estimate of institutional development was substituted into the models. In contrast with our prediction though, the interactions of state ownership or the SOE dummy with institutional development are not significant (Table 2, Models 3 and 5), so Hypothesis 2 is not supported.

To deal with the inefficiency of SOEs in transforming R&D input into innovation output, we propose two potential remedies, industrial competition and start-up status. As Table 3 shows, the three-way interaction of R&D with state ownership and industrial competition has a significantly positive effect ($p < 0.001$, Model 3), as does the parallel three-way interaction of R&D, state ownership, and start-up status ($p < 0.01$, Model 4). The results using the SOE dummy offer consistent findings (Models 6 and 7). Thus, both Hypotheses 3 and 4 are supported.

We further plotted the moderating effects of industrial completion and start-ups. We displayed the effect of R&D intensity on new product output at different levels of industrial competition for non-SOEs and SOEs in Figure 2a. It shows that the effect of R&D intensity is stronger for non-SOEs than SOEs at lower levels of industrial competition; however, the two lines converge at higher levels of industrial competition. Figure 2b exhibits effect of R&D

[5] We also used the shortest physical distance of the capital city of each province to one of the four major seaports (Hong Kong, Shanghai, Dalian, and Qinhuangdao) in China as an alternative instrumental variable and obtained consistent results.

intensity on new product output for non-SOEs and SOEs depending on whether they are established firms or start-ups. Consistent with our prediction, the marginal impact of R&D intensity is stronger for non-SOEs when they are established firms, whereas R&D intensity contributes more to innovation outputs for state start-ups.

***Insert Figures 2 about Here***

With respect to the effects of the control variables, firm size and industry growth have positive, significant effects on R&D intensity and new product output. Export market-oriented firms devote less to R&D. Institutional development exhibits a positive effect on innovation output, and industries with higher performance produce more product innovation.

**Robustness Test**

We tested the sensitivity of the results in several ways. First, we used the propensity score matching techniques to generate a sample of comparable SOEs and private owned enterprises. We firstly estimated a probit model using 2,235 SOEs and 3,153 private firms in our sample, with variables of firm size, age, capital intensity, debt ratio, export market orientation, industry growth, industrial performance, and institutional development. We then used the propensity score to perform a one-to-one matching, resulting in 788 pairs of matched SOEs and private firms. Such matched sample removes differences between SOEs and private firms other than firm ownership type and ensures comparability between these two types of firms. We then re-ran the analysis and the results were highly consistent with findings of the whole sample.

Second, we excluded SOEs that were restructured into mixed or private firms during 2001–2007. We examined whether our results remained the same if we included those firms that experienced dramatic changes in their state ownership, and the findings were consistent.

Third, we used the logarithm of new product output as an alternative dependent variable.

We obtained consistent results, with all significant effects still unchanged. Fourth, we estimated the models with various subsamples of local firms, excluding local-controlled firms with limited foreign ownership at various levels (e.g., >25%, >5%, >0%). We again obtained highly consistent results, across these different subsamples.

**Post-Hoc Analysis**

We tested whether industrial competition moderates the effect of state ownership on R&D intensity in Hypothesis 1a and if institutional development affects the moderation of state ownership in Hypothesis 1b, but we found no significant effect. These findings were consistent with our reasoning that competition affects the efficiency of generating new product output.

We also performed additional analysis to rule out the endogeneity concern of state ownership that R&D activities and previous innovation performance may affect whether a SOE was privatized or not. In the original sample, 755 SOEs were privatized in various years. We compared R&D intensity and new product output ratio of all pairs of privatized vs. non-privatized SOEs one year before the ownership change, none of the results were significant. We further ran an event history analysis with R&D intensity and new product output ratio as predictors of the privatization of SOEs. These two variables again were not significant (R&D intensity: $\beta$ = -2.925, $p$ = 0.174; new product output: $\beta$ = -0.036, $p$ = 0.769), suggesting that the ownership change of SOEs are not related to their R&D efforts and innovation outcomes. This is consistent with Xu, Tihanyi and Hitt's (2014) finding that in China whether a SOE will be privatized is not related to its innovation capability.

**STUDY 2**

In Study 1, we measured innovation outcome as a firm's new product output ratio, which captures the commercial value of product innovation in the market. To examine the impact of

state ownership on more fundamental and revolutionary innovation, we conducted Study 2 to employ *patent* as the innovation output indicator, using a sample of Chinese publicly listed manufacturing firms.

We retrieved archival data of Chinese publicly listed manufacturing firms on the Shanghai or Shenzhen stock markets (2006–2010) from the CSMAR (China Stock Market Accounting Research) database and WIND database. We restricted our samples to manufacturing firms and merged with firm-level patent information from the Chinese Patent Data Project (He et al., 2013b). After deleting firms with incomplete information, we obtained a balanced panel of 827 firms. We employed a one-year lag for the independent variables in the models; therefore, the final sample consisted of 3,308 firm-year observations (827 × 4 years, 2007–2010).

Patent information was obtained from the State Intellectual Property Office of China (SIPO)[6]. The Chinese patent law defines an *invention patent* as a new technical solution relating to a product, a process, or an improvement, and it can only be approved after substantive examination by patent examiners. To measure innovation output, we used the total number of *invention patents* that had been applied by a listed firm in a given year of 2007–2010 and eventually granted by the end of 2012. We used firms' cumulative R&D investment as the innovation input to capture the effect of past R&D expenditure in the long-term process of fundamental innovation. A declining weight of 0.4 was adopted for R&D investment from previous years (Dutta, Narasimhan, and Rajiv 2005) and our findings were robust with different declining weights. We measured state ownership, institutional development, and industrial competition in the same way as in Study 1. Firm age and firm size of the number of employees were included as controls with logarithm transformation.

[6] According to the information of *Derwent Innovations Index*, Chinese firms have overwhelmingly focused on patent application in China, mainly due to the high costs of international patent filing and lack of foreign market orientation.

In Table 5, we report the descriptive statistics and correlations for the variables. We firstly tested the effect of state ownership on firms' R&D investment. However, state ownership has no significant effect on R&D investment for publicly listed manufacturing firms. The interaction term between state ownership and institutional development is also not significant. So Hypothesis 1a and Hypothesis 2 are not supported.

***Insert Table 5 about Here***

To test the R&D investment–patent relationship and the moderating effects of state ownership and industrial competition, we employed Poisson models to deal with the count nature of the dependent variable (Ahuja and Katila, 2001) and reported the results in Table 6. The findings are similar to those in Study 1: the interaction term between R&D investment and state ownership has a negative effect on patent output (Model 2, $p < .001$), supporting Hypothesis 1b. As for the direct effect of state ownership on patent output, state ownership positively affects patent output (Model 4, $p < .001$) and the squared term has a negative effect (Model 4, $p < .01$). Therefore, state ownership exhibits an inverted U-shaped relationship with patent, with a turning point at 28.89%, in support of Hypothesis 1c.

***Insert Table 6 about Here***

Hypothesis 3 proposes industrial competition as a remedy for the inefficiency of state ownership. As Model 3 in Table 6 shows, the three-way interaction of R&D investment with state ownership and industrial competition has a significant, positive effect ($p < 0.001$), thus supporting Hypothesis 3. Because the latest founding year of listed firms in this sample was 1995, we could not test the three way interactions with the variable of start-up proposed in Hypothesis 4. Overall, the findings of Study 2 with the number of patents as the innovation output are largely consistent with the results of Study 1, which uses new product output ratio as the

innovation measure.

**Additional Analysis**

First, because SIPO does not provide information on patent citation, we could not employ a measure of weighted patent count. SIPO specifies three types of patents: invention, utility, and design: *utility patents* are new technical solutions of the shape, structure, or their combination, and *design paten*ts are new designs relating to the shape, pattern or their combinations, or the combination of color, shape and/or pattern for aesthetic purposes (He et al., 2013b). In previous analysis, we focused on *invention patents* as they possess higher levels of technological advancement. We also tested our model with utility and design patents as innovation output respectively. Consistently, the findings show that state ownership reduces the impact of R&D input on innovation output. Interestingly, state ownership has a negative main effect of design patents, suggesting that state capital favors more fundamental innovations (i.e., invention patents).

Second, because the state may use pyramidal structures to ensure control, we considered *state ultimate control*, measured as a dummy variable whether the largest shareholder is the state or governmental authorities based on the information from the CSMAR and WIND databases (Liang, Ren, and Sun, 2015). Because state ultimate control captures the effect of state capital and is highly correlated with state ownership ($r = 0.623$), we used it to replace SOE dummy and re-estimated our model, which generated highly consistent results. Third, we also tested our model that included a firm's *stock of patents* up to 2006 as an additional control, and again got highly consistent results.

**DISCUSSION**

This study examines how state ownership affects a firm's innovation, as well as the contingent

roles of institutional development, industrial competition, and start-up status. Based on two longitudinal panel datasets of Chinese firms, we find that state ownership positively affects the R&D input of non-listed firms. However, state ownership weakens the effect of R&D input on innovation output; this negative effect decreases when competition is high and for state start-ups. Overall, state ownership has an inverted U-shaped effect on a firm's innovation such that firms with minority state ownership are most innovative. These findings provide novel insights into the role of state ownership and contribute to extant literature in four ways.

First, we contribute with a new framework of state ownership to explain its implications on innovation. The conventional economic theory (agency theory) views state ownership as incompatible with innovation (Ramaswamy, 2001; Shleifer, 1998), yet it overlooks the resource advantage that state ownership brings to overcome the institutional voids in emerging economies (Inoue, Lazzarini, and Musacchio, 2013; Musacchio, Lazzarini, and Aguilera, 2015). As our findings show, state ownership enables firms to obtain more resources to invest in R&D. However, due to the dual agency problem, state ownership also leads to the inefficiency curse, such that SOEs are less capable of transforming their R&D input into innovation output. Our framework sheds new light on previous inconsistent findings: prior studies consider the direct linear effect of state ownership (or SOEs vs. other types of firms) on innovation outcomes, thus only partially capture the impact of state ownership (e.g., Ayyagari, Demirguc-Hunt, and Maksimovic, 2011; Choi, Lee, and Williams, 2011; Choi, Park and Hong, 2012; Guan et al., 2009). By considering both the resource allocation advantage and resource utilization disadvantage associated with state ownership, our framework provides a more complete understanding of the role of state ownership in innovation and helps reconcile existing controversial perspectives (Ralston et al*.,* 2006; Ramaswamy, 2001; Shleifer and Vishny, 1994).

Second, our study also contributes to the recent development of state capitalism and expands it to the innovation context. The rapid growth of emerging economies is featured with the prevalence of government capital (e.g., development banks and sovereign wealth funds) and the globalization of SOEs (Cuervo-Cazurra et al., 2014). Many regard the rise of state capitalism as antithetical to market capitalism and reflecting the state's ambition to use the market for political goals (e.g., Bremmer, 2010). However, they overlook the new varieties of state ownership that governments now use to influence business activities, such as the state as a majority or minority shareholder (Musacchio and Lazzarini, 2014; Musacchio, Lazzarini, and Aguilera, 2015). For example, Inoue, Lazzarini, and Musacchio (2013) find that minority state ownership positively affects firm performance in Brazil. Lazzarini (2015) proposes a conceptual framework to discuss how governments can actively devise industrial policies to enhance firms' competitive advantage. Extending this line of enquiry, our findings show that state ownership has an inverted U-shaped effect on innovation, such that minority state-owned firms could generate more innovation output than either SOEs or private firms. Our findings also reveal the intermediating mechanisms of R&D input and resource utilization efficiency that explain why a minority state ownership is optimal for innovation. As such, this study enriches the development of state capitalism by showing how governments can strategize to boost innovation output (Lazzarini, 2015; Mazzucato, 2015) and echoing the call for more research on how state capital affects innovation development (Inoue, Lazzarini, and Musacchio, 2013: 1796; Musacchio, Lazzarini, and Aguilera, 2015: 127). However, we must caution that our findings do not suggest that state capitalism is better than market capitalism, because state ownership still reduces the efficiency of resource utilization; rather, they offer important evidence on the power of state capital and explain the rise of mixed firms in emerging markets with institutional voids.

Third, we add to the agency theory of state ownership by showing how to address the inefficiency problem of SOEs from the competition side. In particular, we find that firms with state ownership can convert their R&D input into innovation output more efficiently in a more competitive market. State start-ups also suffer less from inefficiency, because they must work hard to survive. These aligned objectives reduce the dual agency problem for state start-ups. However, listing SOEs on the stock market does not solve their inefficiency problem (see Study 2). Because listed SOEs are under heavy control of the government, they still suffer from the dual agency problem. By examining the moderating roles of industrial competition and start-up status, our research complements traditional agency studies, which tend to focus on internal mechanisms such as incentives and board of directors to solve the agency problems (Becht, Bolton, and Roell, 2003; Cuervo-Cazurra and Dau, 2009).

Fourth, this study adds to the institutional void literature. Previous studies have emphasized the important role of business group membership in overcoming institutional voids in emerging markets (Guillén, 2000; He et al., 2013a; Khanna and Palepu, 2000). Extending this line of enquiry, our study suggests that state ownership represents another critical means to obtain scarce resources and address institutional voids. However, our findings in both Studies 1 and 2 indicate that institutional development does not reduce the resource advantage of a firm's state ownership. Possibly, institutional development creates market-based norms, such that firms must rely on their own market- and technology-based capabilities (Briscoe and Safford, 2008; Zhou et al., 2014). Due to these normative pressures, SOEs may invest more in R&D. Overall, when institutions develop, whereas SOEs may receive less resources from the government, they invest more due to rising normative pressures from the market, resulting in a non-significant moderating effect of institutional development. Interestingly, we also find that state ownership has no

significant bearing on R&D investment for listed firms (see Study 2). When SOEs are listed publicly, they rely primarily on the market to obtain capital resources, making state ownership less important for resource allocation. Taken together, the findings of Studies 1 and 2 suggest the resource advantage of either state ownership or getting listed, resource utilization inefficiency of state ownership, and a minority state ownership being optimal for innovation output, as well as the importance role of competition in reducing the inefficiency problems associated with SOEs. These findings show the complicated interplay of institutions, competition, and state ownership in China and provide new insights into the ongoing development of the institutional view (Xu, Lu, and Gu, 2014).

**Managerial Implications**

Our findings offer some important implications for managers and policymakers. Managers must understand both the benefits and the costs of state ownership. Conventional academic literature and the popular press tend to view state ownership as an impediment to innovation and firm growth, but our findings suggest state ownership offers important resource advantages, making a minority state ownership most beneficial for innovation development. Therefore, SOEs should attempt to negotiate with the government and persuade it to diversify their ownership structures. By diluting their governmental ownership, firms can reduce interferences from the politicians but retain access to resources and innovation opportunities. For example, Gree negotiated with related governmental authorities and restructured into a mixed company with minority state ownership (around 20%) during 2000s, which greatly weakened the control rights of bureaucrats and reduced government interference; at the same time, its remaining state ownership provided Gree opportunities to access important resources, such as financial capital from state-owned banks and governmental subsidies, making it a highly innovative and successful enterprise.

Managers should also understand the conditions in which state ownership can be beneficial or detrimental to their new product development. As our findings suggest, competition and start-up status reduce the inefficiency problems associated with state ownership. Therefore, start-ups and firms in more competitive industries should try to exploit the resource advantages of state ownership fully to build their innovation capabilities.

Chinese policymakers have long attempted to convert SOEs into dynamos and global competitors. Our findings suggest that whereas R&D investment is critical to innovation development, more important is how to improve the efficiency of transforming R&D input into innovation output. Getting SOEs listed cannot solve the low efficiency problem; instead, governments could partially privatize SOEs and hold minority state shares in order to boost their efficiency and innovation. Policymakers also need to recognize that established SOEs tend to have inefficiency problems, so policymakers should encourage SOEs to form start-ups with other types of companies, to sustain their innovation ability. Also, SOEs suffer less inefficiency in competitive markets. Whereas SOEs may need protection to survive, policymakers should balance between protection and efficiency and gradually decrease entry barriers to encourage competition. Beiqi Foton Motor represents an example of a truly competitive and innovative state start-up: since its founding in 1996, the company has invested substantial resources in R&D and been granted over 4000 patents, including many international patents. It has grown into the leading automaker for commercial vehicle in China.

**Limitations and Further Research**

We posit that state ownership can provide policy and resource benefits, as well as political intervention and motivational concerns, but we do not explicitly test this argument. Further research should delineate this mechanism and assess possible mediating effects. Also, we only

focus on the role of state ownership, yet ownership structures are quite complex in China, including SOEs, collective, cooperative, shareholding, and private firms. As Xu et al. (2014) show, collective firms possess mix features of SOEs and private firms. Further research could examine the differences and similarity among different types of firms. In addition, Musacchio, Lazzarini, and Aguilera (2015) suggest that alternative forms of state ownership may function differently across various institutional conditions; it is thus necessary to examine those contingency variables, including voids in production factor and local capital markets as well as key government capabilities such as legal enforceability and independent regulation.

Another important means to overcome institutional voids in emerging markets is to form business groups (Guillén, 2000; He et al., 2013a; Khanna and Palepu, 2000). Primate firms could also build informal personal connections with government officials to obtain scarce resources (Li et al., 2008; Sheng et al., 2011). To develop innovative products, firms could use technologies acquired from external research institutes, universities, alliance partners, or foreign companies (Sun and Liu, 2014). Future research could consider how different types of relationships (e.g., state ownership, business group membership, and political ties) and various sources of technologies affect innovation outcomes.

We have used the propensity score matching techniques to generate a sample of comparable SOEs and private owned enterprises. It will be worthwhile to examine innovation activities of SOEs and private firms before and after major political and policy changes with a difference-in-difference estimation (Moita and Paiva, 2013). Because provincial governments in China can also formulate and implement local policies in the context of institutional polycentricism, the privatization process of SOEs varies across regions (Batjargal et al., 2013). A plausible approach is to limit the scope to particular industries and locations to capture the

impact of exogenous policy changes.

Moreover, our research context may limit the generalizability of our findings. Whereas China is one of the leading emerging markets, its government is particularly strong in directing economic activities. Also, institutional environments in emerging economies, including legal environment, R&D infrastructure, and capital market, are constantly changing. Additional research should refine our framework with a longer time period in other emerging and developed economies, to understand the evolving role of state ownership. Facing the financial tsunami, many governments, including those in developed countries, are adopting more proactive stances toward corporations, such as providing financial bailouts and taking over business operations (Musacchio and Lazzarini, 2014). The value of state ownership, especially minority state ownership, is thus becoming a more critical issue in developed markets.

In conclusion, this study represents an initial effort to examine the complicated effect of state ownership on firm innovation. Our findings reveal the benefits and downsides of state ownership in relation to innovation development, as well as the important contingency conditions. We hope that further research continues to explore the intriguing interplay of institutional and competitive conditions with various forms of state ownership in emerging economies.

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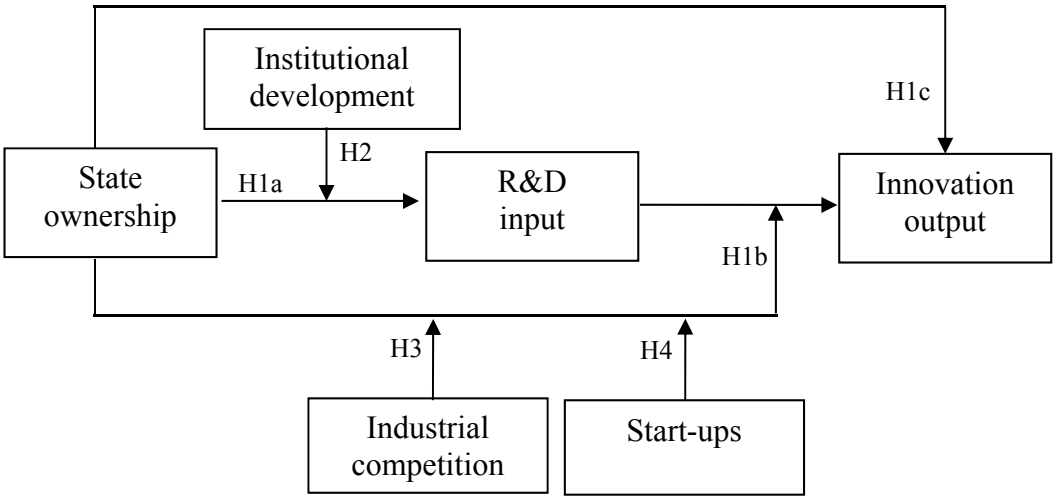
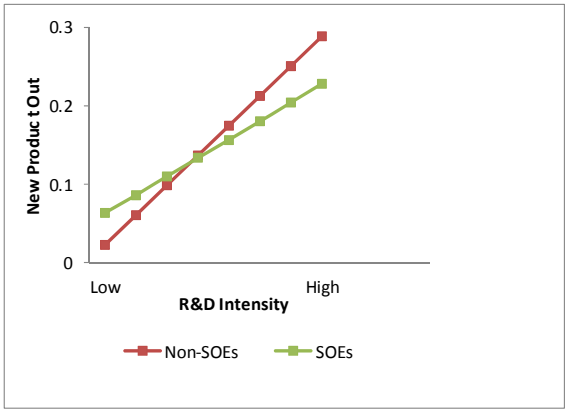
**Figure 1. An Integrated Model of Institutional and Efficiency Logics**



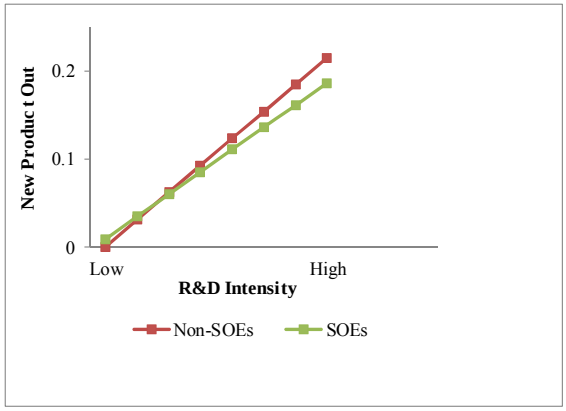
## Figure 2 Three-way Interaction Effects (H3 and H4)

a) Impact of competition on R&D intensity and new product output linkage for SOEs and non-SOEs

Low Industrial Competition

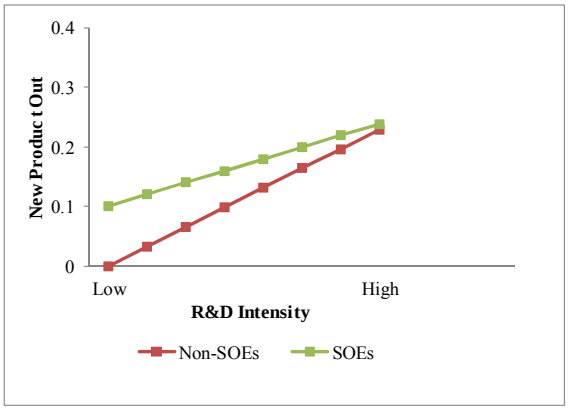



High Industrial Competition




b) Impact of start-ups on R&D intensity and new product output linkage for SOEs and non-SOEs

Established Firms




Start-ups

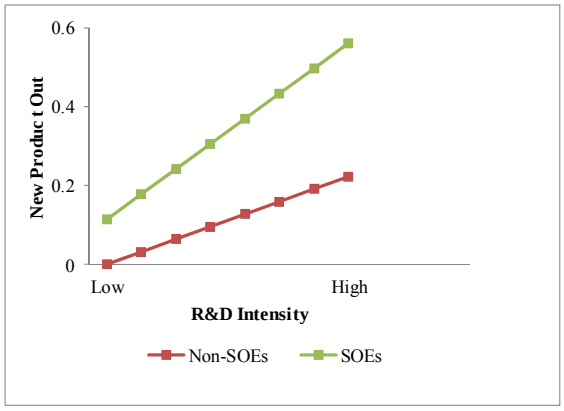


**TABLE 1. Study 1: Descriptive Statistics and Correlations**

| | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. State ownership (SO) | 0.18 | 0.35 | 1.00 | | | | | | | |
| 2. SOE dummy | 0.18 | 0.39 | 0.96*** | 1.00 | | | | | | |
| 3. Institutional development (ID) | 8.13 | 1.91 | -0.24*** | -0.22*** | 1.00 | | | | | |
| 4. Industrial competition (IC) | 0.97 | 0.05 | -0.07*** | -0.07*** | 0.08*** | 1.00 | | | | |
| 5. Start-ups | 0.11 | 0.31 | -0.08*** | -0.07*** | -0.13*** | -0.03*** | 1.00 | | | |
| 6. Firm size | 5.06 | 1.24 | 0.32*** | 0.31*** | -0.15*** | -0.05*** | -0.10*** | 1.00 | | |
| 7. Export market orientation | 0.12 | 0.33 | -0.12*** | -0.11*** | 0.18*** | 0.02*** | 0.00 | 0.03*** | 1.00 | |
| 8. Industry growth | 0.29 | 0.22 | -0.01* | -0.01* | 0.05*** | 0.02*** | -0.06*** | -0.04*** | -0.00 | 1.00 |
| 9. Industrial performance | 0.08 | 0.04 | -0.00 | -0.00 | 0.07*** | 0.04*** | -0.09*** | -0.02*** | -0.01*** | 0.03*** |
| 10. R&D intensity (RDI) | 0.01 | 0.02 | 0.01** | 0.01* | 0.03*** | -0.02*** | -0.02*** | -0.01 | 0.03*** | 0.02*** |
| 11. SO × ID | -0.16 | 0.70 | -0.37*** | -0.35*** | 0.08*** | 0.02*** | 0.06*** | -0.16*** | -0.01*** | -0.02*** |
| 12. RDI × SO | 0.00 | 0.01 | 0.01** | 0.01** | 0.02*** | 0.01 | 0.00 | -0.02*** | 0.01 | 0.00 |
| 13. RDI × IC | -0.00 | 0.00 | 0.01** | 0.01* | -0.01*** | -0.11*** | 0.00 | 0.02*** | 0.00 | -0.00 |
| 14. SO × IC | -0.00 | 0.01 | -0.09*** | -0.08*** | 0.01*** | 0.36*** | 0.01*** | -0.06*** | -0.00 | 0.02*** |
| 15. RDI × SO × IC | 0.00 | 0.02 | -0.01 | -0.01 | -0.01 | -0.08*** | -0.00 | 0.01** | 0.00 | -0.00 |
| 16. RDI × Start-ups | -0.00 | 0.01 | 0.00 | 0.00 | -0.01 | 0.00 | -0.05*** | 0.00 | -0.00 | 0.02*** |
| 17. SO × Start-ups | -0.01 | 0.09 | -0.15*** | -0.14*** | 0.08*** | 0.02*** | -0.23*** | -0.02*** | 0.02*** | 0.02*** |
| 18. RDI × SO × Start-ups | 0.00 | 0.00 | -0.02*** | -0.02*** | 0.00 | -0.00 | 0.02*** | 0.00 | 0.00 | -0.00 |
| 19. New product output | 0.10 | 0.23 | 0.03*** | 0.03*** | 0.08*** | -0.04*** | -0.03*** | 0.12*** | 0.00 | 0.02*** |

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Industrial performance | 1.00 | | | | | | | | | | |
| 10. R&D intensity (RDI) | -0.03*** | 1.00 | | | | | | | | | |
| 11. SO × ID | 0.01** | 0.02*** | 1.00 | | | | | | | | |
| 12. RDI × SO | -0.00 | 0.16*** | 0.05*** | 1.00 | | | | | | | |
| 13. RDI × IC | 0.02*** | -0.23*** | -0.02*** | -0.34*** | 1.00 | | | | | | |
| 14. SO × IC | -0.01* | 0.01 | 0.07*** | -0.01 | -0.10*** | 1.00 | | | | | |
| 15: RDI × SO × IC | 0.01 | -0.25*** | -0.02*** | -0.53*** | 0.48*** | -0.16*** | 1.00 | | | | |
| 16. RDI × Start-ups | 0.02*** | -0.10*** | 0.00 | -0.14*** | 0.06*** | -0.00 | 0.07*** | 1.00 | | | |
| 17. SO × Start-ups | 0.03*** | 0.00 | -0.05*** | -0.01*** | -0.01 | -0.00 | -0.00 | 0.02*** | 1.00 | | |
| 18. RDI × SO × Start-ups | -0.00 | -0.21*** | -0.01 | -0.41*** | 0.14*** | -0.00 | 0.22*** | -0.30*** | -0.03*** | 1.00 | |
| 19. New product output | -0.06*** | 0.16*** | -0.01 | -0.00 | -0.03*** | -0.01*** | 0.00 | -0.03*** | 0.01* | 0.01** | 1.00 |

Notes: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

**TABLE 2. Study 1: Impact of State Ownership on R&D Intensity (H1a & H2)**

| **Dependent variable** R&D intensity | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** |
|---|---|---|---|---|---|
| **Independent variables** | | **State share** | | **SOE dummy** | |
| Intercept | -0.038*** (0.007) | -0.039*** (0.007) | -0.039*** (0.007) | -0.039*** (0.007) | -0.039*** (0.007) |
| **H1a**: State ownership (SO) | --- | 0.002*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) |
| Institutional development (ID) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) |
| **H2**: SO × ID | --- | --- | 0.001 (0.000) | --- | 0.001 (0.000) |
| Industrial competition | -0.002 (0.006) | -0.001 (0.006) | -0.000 (0.006) | -0.001 (0.006) | -0.001 (0.007) |
| Start-ups | -0.001 (0.000) | -0.001 (0.000) | -0.001 (0.004) | -0.001 (0.000) | -0.001 (0.000) |
| Firm size | 0.003*** (0.000) | 0.003*** (0.000) | 0.003*** (0.000) | 0.003*** (0.000) | 0.003*** (0.000) |
| Export market orientation | -0.003*** (0.000) | -0.003*** (0.000) | -0.003*** (0.000) | -0.003*** (0.000) | -0.003*** (0.000) |
| Industry growth | 0.003*** (0.001) | 0.003*** (0.001) | 0.002*** (0.001) | 0.003*** (0.001) | 0.003*** (0.001) |
| Industrial performance | -0.001 (0.004) | -0.001 (0.003) | -0.001 (0.004) | -0.001 (0.004) | -0.001 (0.004) |
| Log likelihood | 68180.4 | 68191.7 | 68193.5 | 68190.1 | 68191.5 |
| AIC | -136267 | -136287 | -136387 | -136284 | -136285 |
| Number of observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |

Notes: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$; Standard errors in parentheses; industry and year fixed effects are included and not shown; the instrumental variable for institutional development is distance to major seaports, with first-stage F value of $144.12^{***}$.

**TABLE 3. Study 1: State Ownership, R&D Intensity, and New Product Output (H1b, H3, & H4)**

| **Dependent variable** New product output | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** | **Model 7** |
|---|---|---|---|---|---|---|---|
| **Independent variables** | | **State share** | | | **SOE dummy** | | |
| Intercept | -2.191*** (0.234) | -2.235*** (0.235) | -2.382*** (0.245) | -2.233*** (0.234) | -2.228*** (0.234) | -2.377*** (0.244) | -2.225*** (0.234) |
| R&D intensity (RDI) | 3.220*** (0.106) | 3.354*** (0.108) | 3.472*** (0.111) | 3.406*** (0.110) | 3.334*** (0.107) | 3.464*** (0.111) | 3.378*** (0.110) |
| State ownership (SO) | --- | 0.048*** (0.008) | 0.046*** (0.008) | 0.051*** (0.008) | 0.042*** (0.007) | 0.041*** (0.007) | 0.045*** (0.007) |
| **H1b**: RDI × SO | --- | -1.764*** (0.247) | -0.955** (0.295) | -1.407*** (0.283) | -1.634*** (0.239) | -0.853** (0.281) | -1.289*** (0.274) |
| Industrial competition (IC) | -0.130 (0.133) | -0.097 (0.133) | -0.058 (0.152) | -0.096 (0.133) | -0.102 (0.133) | -0.055 (0.150) | -0.101 (0.133) |
| RDI × IC | --- | --- | -2.903 (7.978) | --- | --- | -2.018 (7.936) | --- |
| SO × IC | --- | --- | -0.325 (0.271) | --- | --- | -0.343 (0.260) | --- |
| **H3**: RDI × SO × IC | --- | --- | 0.757*** (0.155) | --- | --- | 0.765*** (0.151) | --- |
| Start-ups | -0.019 (0.009) | -0.016 (0.009) | -0.016 (0.009) | -0.013 (0.009) | -0.015 (0.009) | -0.015 (0.009) | -0.012 (0.009) |
| RDI × Start-ups | --- | --- | --- | -0.212 (0.440) | --- | --- | -0.230 (0.439) |
| SO × Start-ups | --- | --- | --- | 0.060 (0.031) | --- | --- | 0.058 (0.027) |
| **H4**: RDI × SO × Start-ups | --- | --- | --- | 5.349** (1.642) | --- | --- | 4.597** (1.571) |
| Firm size | 0.142*** (0.002) | 0.138*** (0.003) | 0.138*** (0.003) | 0.138*** (0.003) | 0.138*** (0.003) | 0.139*** (0.003) | 0.138*** (0.003) |
| Export market orientation | 0.002* (0.009) | 0.003** (0.009) | 0.003** (0.009) | 0.003** (0.009) | 0.003** (0.009) | 0.003** (0.009) | 0.003** (0.009) |
| Institutional development | 0.021*** (0.003) | 0.024*** (0.003) | 0.024*** (0.003) | 0.024*** (0.003) | 0.024*** (0.003) | 0.024*** (0.003) | 0.023*** (0.003) |
| Industry growth | 0.051*** (0.012) | 0.052*** (0.012) | 0.052** (0.012) | 0.051** (0.012) | 0.052*** (0.012) | 0.052** (0.012) | 0.051** (0.012) |
| Industrial performance | 0.849*** (0.083) | 0.867*** (0.084) | 0.863*** (0.084) | 0.866*** (0.084) | 0.867*** (0.084) | 0.862*** (0.084) | 0.866*** (0.084) |
| Log likelihood | -38247.5 | -38207.2 | -38192.3 | -38197.8 | -38209.8 | -38193.4 | -38201.1 |
| AIC | 76591.0 | 76514.5 | 76490.7 | 76501.6 | 76519.5 | 76492.9 | 76508.1 |
| Number of observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |

Notes: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$; Standard errors in parentheses; industry and year fixed effects are included and not shown; the instrumental variable for institutional development is distance to major seaports, with first-stage F value of $144.12^{***}$.

**TABLE 4. Study 1: Direct Effect of State Ownership on New Product Output (H1c)**

| **Dependent variable** New Product Output | **Model 1** | **Model 2** | **Model 3** |
|---|---|---|---|
| **Independent variables** | | | |
| Intercept | -1.993*** (0.240) | -2.031*** (0.241) | -1.881*** (0.240) |
| **H1c**: State ownership (SO) | --- | 0.048*** (0.008) | 0.344*** (0.026) |
| **H1c**: SO squared | --- | --- | -0.503*** (0.042) |
| Institutional development | 0.021*** (0.003) | 0.024*** (0.003) | 0.023*** (0.002) |
| Industrial competition | -0.297* (0.135) | -0.265 (0.136) | -0.299* (0.135) |
| Start-ups | -0.022 (0.010) | -0.019 (0.010) | -0.019 (0.010) |
| Firm size | 0.142*** (0.002) | 0.139*** (0.003) | 0.135*** (0.003) |
| Export market orientation | 0.015 (0.009) | 0.018* (0.009) | 0.021* (0.009) |
| Industry growth | 0.040** (0.013) | 0.040** (0.013) | 0.042** (0.013) |
| Industrial performance | 0.383*** (0.092) | 0.395*** (0.092) | 0.403*** (0.092) |
| Log likelihood | -38557.4 | -38539.6 | -38468.9 |
| AIC | 77218.8 | 77185.2 | 77045.9 |
| Number of observations | 73,728 | 73,728 | 73,728 |

Notes: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$; Standard errors in parentheses; industry and year fixed effects are included and not shown; the instrumental variable for institutional development is distance to major seaports, with first-stage F value of $144.12^{***}$.

**TABLE 5. Study 2: Descriptive Statistics and Correlations**

| | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. State ownership (SO) | 0.21 | 0.23 | 1.00 | | | | | | | | | | | |
| 2. R&D | 7.07 | 9.85 | -0.01 | 1.00 | | | | | | | | | | |
| 3. Industrial competition (IC) | 0.90 | 0.09 | 0.06*** | 0.10*** | 1.00 | | | | | | | | | |
| 4. Institutional development (ID) | 8.18 | 1.99 | -0.20*** | 0.15*** | 0.02 | 1.00 | | | | | | | | |
| 5. Firm age | 2.79 | 0.16 | 0.14*** | 0.14*** | 0.04* | 0.07*** | 1.00 | | | | | | | |
| 6. Firm size | 7.47 | 0.94 | 0.22*** | -0.01 | -0.01 | -0.05*** | 0.02 | 1.00 | | | | | | |
| 7. SO × ID | -0.09 | 0.42 | -0.05** | -0.03 | -0.01 | -0.14*** | -0.03 | 0.01 | 1.00 | | | | | |
| 8. RD × SO | -0.02 | 2.21 | 0.01 | -0.04* | 0.03 | -0.03 | -0.04* | 0.05** | 0.20*** | 1.00 | | | | |
| 9. RD × IC | 0.10 | 0.84 | 0.03* | 0.09*** | -0.26*** | -0.02 | -0.01 | -0.01 | 0.03 | 0.09*** | 1.00 | | | |
| 10. SO × IC | 0.00 | 0.02 | 0.03 | 0.03 | -0.09*** | -0.01 | 0.03* | 0.05** | 0.03 | 0.13*** | -0.12*** | 1.00 | | |
| 11. RD × SO × IC | 0.01 | 0.18 | 0.14*** | 0.09*** | -0.11*** | 0.01 | -0.03 | 0.03 | 0.01 | 0.13*** | -0.22*** | -0.29*** | 1.00 | |
| 12. Patent | 3.30 | 14.37 | 0.04* | 0.04* | -0.04* | 0.07** | 0.00 | 0.08*** | 0.00 | -0.04* | -0.04* | 0.02 | 0.02 | 1.00 |

Notes: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

**TABLE 6. Study 2: State Ownership, R&D, and Patent Output**

| **Dependent variable**<br>Number of patents | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
|---|---|---|---|---|
| **Independent variables** | | | | |
| Intercept | 0.841<br>(0.536) | 0.748<br>(0.538) | 0.725<br>(0.542) | 1.046<br>(0.492) |
| R&D (RD) | 0.009$^{***}$<br>(0.001) | 0.010$^{***}$<br>(0.001) | 0.008$^{***}$<br>(0.001) | --- |
| **H1c**: State ownership (SO) | 0.295$^{***}$<br>(0.048) | 0.393$^{***}$<br>(0.048) | 0.396$^{***}$<br>(0.049) | 0.461$^{***}$<br>(0.057) |
| **H1c**: SO squared | --- | --- | --- | -0.666$^{**}$<br>(0.205) |
| **H1b**: RD × SO | --- | -0.056$^{***}$<br>(0.004) | -0.050$^{***}$<br>(0.004) | --- |
| Industrial competition (IC) | -4.842$^{***}$<br>(0.617) | -5.213$^{**}$<br>(0.620) | -5.386$^{***}$<br>(0.626) | -4.914$^{***}$<br>(0.600) |
| RD × IC | --- | --- | -0.104$^{***}$<br>(0.011) | --- |
| SO × IC | --- | --- | 1.014$^{*}$<br>(0.498) | --- |
| **H3**: RD × SO × IC | --- | --- | 0.132$^{*}$<br>(0.052) | --- |
| Firm age | 0.257$^{***}$<br>(0.068) | 0.315$^{***}$<br>(0.068) | 0.355$^{***}$<br>(0.068) | 0.233$^{***}$<br>(0.062) |
| Firm size | 0.087$^{***}$<br>(0.010) | 0.098$^{***}$<br>(0.010) | 0.099$^{***}$<br>(0.011) | 0.086$^{***}$<br>(0.010) |
| Institutional development | 0.180$^{***}$<br>(0.006) | 0.184$^{***}$<br>(0.006) | 0.183$^{***}$<br>(0.006) | 0.185$^{***}$<br>(0.008) |
| Log likelihood | 8804.9 | 8911.1 | 8971.1 | 8766.0 |
| AIC | 38361.4 | 38151.3 | 38035.0 | 38433.4 |
| Number of observations | 3,308 | 3,308 | 3,308 | 3,308 |

Notes: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$; Standard errors in parentheses; industry and year fixed effects are included and not shown; the instrumental variable for institutional development is distance to major seaports, with first-stage F value of 137.52$^{***}$.