Ownership, Innovation and Variable Institutional Quality

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ABSTRACT

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Research Question/Issue: Innovation is a consistent feature of studies of transition and transformation. State ownership as the engine of innovation and technological change may be juxtaposed with the "liability of stateness" and the notion that "privatization works". This study seeks to investigate the relationship between legal ownership and innovation inputs and outputs, while accounting for the moderating effect of institutional quality on this relationship.
Research Findings/Insights: We exploit unique data from a very large-scale panel survey of enterprises (65,750 firms between 2007 to 2014) in Vietnam, a fast-growing but understudied transition country, and apply advanced methodologies that control for the selection bias and endogeneity of legal ownership. Our findings point to the continued dominance of State-Owned Enterprises (SOEs) in innovation activities in Vietnam. However, the returns to innovation in SOEs accrue only up to a point and improving institutional quality serves to diminish their advantage over Privately-Owned Enterprises (POEs) and to level the playing field.
Theoretical/Academic Implications: We employ an integrated framework that develops predictions from resource dependence, agency, and institutional theories to explore the direct and contingent influences of ownership and institutional quality on the firm-level innovation production process. Our study contributes to the growing literature on state ownership and innovation in transition and emerging economies and the recent calls for greater attention to local institutional context and revising the existing theories on "state underperformance".
Practitioner/Policy Implications: This study offers insights to policy makers in enhancing the quality of local institutions. Higher quality institutions moderate the advantages that state ownership confers and ameliorate the disadvantages associated with private ownership.

Keywords: Corporate Governance; Agency Theory; Institutional Theory; Resource Dependence Theory; Innovation; Vietnam

INTRODUCTION

Transition economies continue to be characterized by 'high context', in the sense that all aspects of the ideological, political, economic, and social environments exist not merely as a 'context' but, rather, as an extension of state capitalism. Not only does state ownership reflect certain institutional realities, but it also confers advantages in a context in which other ownership types coexist (Lazzarini and Musacchio, 2018). For instance, state-led strategies of technological innovation and development have frequently been associated with national economic growth and technological catch-up (Lee et al., 2015: 16). State ownership, and government connections, more generally, have been shown to associate directly with higher levels of innovation performance (Choi et al., 2011), producing more (diversified) patents (Xu and Zhang, 2008), and building stronger inventive (Lazzarini et al., 2021) and innovative capabilities (Munari et al., 2010). It has also been shown to positively moderate the effect of R&D intensity and technological capabilities on innovation performance (Yi et al. 2017; Wang et al. 2015).

This, however, stands in contrast with Musacchio et al.'s (2015) notion of "liability of stateness", which holds that inefficiencies in SOEs inevitably entail underperformance in innovation and that "privatization works" (Megginson and Netter, 2001). State ownership has been shown to associate with fewer new product introductions, product improvements and new technology adoptions (e.g., Ayyagari et al., 2011; Zhou et al., 2017), and with lower new product sales and revenues from innovation (e.g., Jefferson et al., 2003; Guan et al., 2009). Given this mixed picture of the effect of state ownership (Lan and Galaskiewicz, 2012; Zhou et al., 2017), it is perhaps unsurprising that still further studies have found no relationship between state ownership and innovation (see Wang and Kafouros, 2009 in China; and Choi et al., 2012 in Korea).

Whilst this apparent inconsistency may be a cause for frustration, we use it as our point of departure. Unremarkably, we believe that these inconclusive results are due, in part, (i) to variations in the measures of innovation input, output and the methodologies used to estimate the input-output transformation process; (ii) to essential differences in the manner in which different types of legal ownership provide innovation resources to the firm (Chen et al., 2014) and encourage utilization of these resources with different levels of efficiency (Baysinger et al., 1991); and (iii) to the endogenous nature of 'ownership' within a system that is directed by both political and performance goals (Megginson and Netter, 2001). However, more remarkably, we believe the inconclusiveness is likely to rest in the general neglect of variety in the quality of local and/or national institutional contingencies that endogenously moderate the relationship between ownership structure and innovation inputs/outputs (e.g., Wang et al., 2015; Lazzarini et al., 2021).

In addressing these limitations, we make four contributions. First, we contribute to corporate governance research that aims to understand why different governance mechanisms (such as prevailing ownership types) appear to have different effects on the innovation production process; and how these effects are moderated by the variety and dynamics of local public governance, a core component of institutional quality. In particular, we leverage elements of resource dependence theory (RDT), agency theory (AT) and institutional theory (IT) to elaborate a theoretical framework that outlines the relationships among legal ownership, institutional quality, and innovation. We believe that this approach allows us to resolve some of the tensions that persist in the empirical literature.

Second, most influential studies on the relative merits of state- and private-ownership were written in the 1990s (for a review, see Megginson and Netter, 2001 and Estrin et al., 2009), during which governments divested SOEs in developed economies to enhance economic efficiency, decrease government intervention and introduce competition in monopolized sectors (Estrin and Pelletier, 2018). Only recently has attention turned to the role of innovation in processes of transition and transformation (for a review, see Belloc, 2012). Following this growing literature (e.g., Ahlstrom and Bruton, 2010; Chen et al., 2014; Lee et al., 2015; Santarelli and Tran, 2017), we extend our research to Vietnam. Vietnam, characterized by immature and weak market institutions (Tran, 2019), is an attractive research setting that allows us to explore how transitional institutions[1] and their ongoing restructuring processes impact firm-level innovation (Chen et al., 2014; Xu et al., 2014). We test our theoretical framework using extensive longitudinal census data collected from 65,750 Vietnamese firms from 2007 to 2014 and apply advanced methodologies to control for the potential selection bias and the endogeneity of legal ownership. Of course, the tension between generalizability and specificity is ever present in transition economy research (Meyer and Peng, 2016). However, lack of attention to contextual (and institutional) variety is likely to result in misinterpretations of data and misapplications of findings obtained from different locations. Large scale empirical studies in less studied locations, such as Vietnam (De Jong et al., 2015), contribute to a literature that, inevitably, continues to be dominated by studies of transition in China (e.g., Phan et al., 2010; Lei, 2017).

Third, although an increasing number of studies in the management literature have linked a firm's innovation capacity with its ownership structure (Aghion et al., 2013; Musachio and Lazzarini, 2014) and the institutional context in which it operates (McDermott et al., 2009), the treatment is often static with limited consideration of subnational (regional) institutional

variation. Such regional institutional variation, resulting from uneven economic development and cultural diversity across regions, is evident in every nation (Chan et al., 2010; Teng and Yi, 2017). Indeed, it may be more significant in transition economies (Meyer and Peng, 2016) since "the process of economic transition … is often spatially and structurally uneven" within countries (Chan et al., 2010: 1230; Yi et al. 2017). Our findings suggest that as local institutional quality improves, SOEs' innovation performance tails off as the benefits of privilege are withdrawn. In contrast, higher institutional quality fosters higher innovation performance in private-owned enterprises (POEs) by easing their access to critical innovation resources. In other words, institutional quality moderates the countervailing processes of resource allocation and resource utilization and reduces the innovation performance gap that may arise between state ownership and private ownership.

THEORY AND HYPOTHESES

Corporate ownership structure fundamentally shapes corporate governance by determining how ownership rights, particularly control rights and residual profit rights, are distributed within the corporation (Belloc, 2012). Transition economies frequently follow a state capitalism model wherein the state plays a direct and critical role in promoting and influencing economic development through reform policies (Zhang and Greve, 2018). SOEs, acting as agents of the government, provide an important channel for the State to regulate the economy and society (Xu, 2011). As transition processes (re-)establish market institutions, private entrepreneurship is promoted and POEs, whose productive capabilities are aligned with market requirements, become the dominant organizational form (Tran and Santarelli, 2021). In the following sections we analyze the influence of state and private ownership on firm-level innovation activities by combining the perspectives of resource dependency theory, agency theory and institutional theory.

Legal Ownership and Innovation

Resource dependence theory (RDT) characterizes the firm as an open system of innovation, being both supported and constrained by contingencies in the external environment. The extent to which a firm can control its external environment, particularly critical resources vital to its operations, is positively associated with its competitive power (Pfeffer and Salancik, 2003). To reduce environmental uncertainty and dependence, firms strive to gain control over vital resources (Ulrich and Barney, 1984) or develop exchange-based connections with key external resource holders (Un et al., 2010). An important tenet of RDT is the "power use" hypothesis, or imbalance of organizational interdependencies, which enables dominant actors to exert influence over power-disadvantaged actors and extract a higher share of exchange surpluses (Casciaro and Piskorski, 2005; Wry et al., 2013). This imbalanced interdependence, strongly evident in transition countries, results from the government's role as both the controller and allocator of critical resources. All firms, regardless of their ownership type, rely on the government for access to the resources and capabilities required to consistently innovate (Hansen and Birkinshaw, 2007; Chen et al., 2014).

Institutional theorizing supports a similar conclusion. Institutional theorists propose that firms are pressured to obtain legitimacy, social support, and approval from external constituents to improve the likelihood of survival and growth (Dacin et al., 2007). Here, given their essential association with state patronage and the dominant centrally planned institutions, SOEs are likely to enjoy early legitimacy and support. This, in turn, is likely to facilitate privileged access to public resources and publicly held knowledge (Cull et al., 2015, Inoue et al., 2013) and to secure easier and preferential access to specific and scarce technological and financial resources for technological innovations (Choi et al., 2012), especially to valuable social capital arising from government-supported innovation networks (Santarelli and Tran, 2013). These

network benefits enable SOEs to mobilize greater financial resources, attract skilled employees and embed innovation strategies (Drees and Heugens, 2013; Schott and Jensen, 2016).

In theory, transition processes gradually eliminate, integrate, or transform state-based organizational forms, replacing them with private enterprises through processes of privatization. However, the extent to which the new private organizational form survives and thrives is dependent upon its "ideological fit' with the environment (Tran and Santarelli, 2021), its ability to attract "constitutive legitimation" from the government (Carroll and Khessina, 2019) and whether it is able to win the "diffuse competition" for limited space and resources in the marketplace (Bogaert et al., 2016). POEs, face not only liabilities of newness and smallness but also legitimacy issues. They perceive the government as a complex environmental dependency (Lester et al., 2008) and, in the absence of strong connections with public resource holders, innovation oriented POEs find it difficult to obtain the suitable resources (Li and Putterman, 2008; Yiu et al., 2013. Several studies have observed that financial benefits accrue to those POEs who can manage environmental dependency and obtain "ideological fit" by engaging in politically directed actions aimed at developing long-term cooperative linkages with government (Meznar and Nigh, 1995; Hillman et al., 1999; Peng and Luo, 2000; Hillman, 2005). Extensive interactions with government-affiliated bodies, including SOEs, enable POEs to transfer centrally-planned productive capabilities to their market-oriented product system (Tran and Santarelli, 2021), to lobby government for policy advantages (Schuler et al., 2002; Liu et al., 2018), to overcome their resource barriers and access new markets (Inoue et al., 2013), and to accelerate the absorption and utilization of knowledge embedded in external innovations (Feldman and Kelley, 2006; Gonzalez and Pazo, 2008).

The notion that connections to political and institutional stakeholders enhance innovation in transition economies is well established in research on state capitalism (Li et al., 2017; Rong et al., 2017; Zhou et al., 2017). In particular, the state's long-term orientation and active involvement ought to promote innovation (Choi et al., 2011). In this sense, the peculiarities of the transitional economic environment (e.g., underdeveloped legal and financial institutions and inefficient factor markets) require firms to develop strategic alliances with other firms, government, and administrative officials to alleviate resource and knowledge constraints and pursue innovation (Li and Atuahene-Gima, 2001). In line with these arguments, we hypothesize that:

Hypothesis 1a. SOEs possess more innovation resources (inputs) than POEs.

Hypothesis 1b. POEs can increase their innovation resources by being affiliated with the government.

While most researchers assume that a positive correlation exists between innovation input and innovation output (Acs and Audretsch, 1988), the slope of this relationship – that is, how efficiently firms transform innovation input into innovation output – is sensitive to various organizational and contextual factors (Yayavaram and Chen, 2015). Prior research offers two conflicting views of SOEs' innovation performance. On one hand, SOEs face an array of organizational issues that hinder managerial ambition and create inefficiencies in transforming innovation resources into innovations. Moreover, the dual agency problem (Megginson and Netter, 2001) has been found to exert a greater negative influence in the weaker institutional contexts of transition economies (Musacchio and Lazzarini, 2014). First, while the 'principal' role of SOEs is not clearly defined – they are owned by 'the people' and belong to the society as a whole– the 'agent' role of SOEs is more clearly defined – they are operated and managed by the government, which is represented by multiple politicians. In the absence of useful monitoring mechanisms on behalf of the ultimate owners (i.e., the people), politicians act as

principals, with limited incentive to bear the full cost of monitoring (Cuervo-Cazurra et al., 2014; Lazzarini and Musacchio, 2018). Rather than targeting resources towards enhancing SOEs' innovation as an engine for national economic growth and competitiveness, politicians are provided considerable scope and incentives to self-interestedly manipulate state-granted resources and misdirect innovation investments in pursuit of political dividends, such as securing political support, building political capital, earning bribes, or increasing their chances of being (re)elected (Khwaja and Mian, 2005). Second, the principals (i.e., politicians or public officials) may appoint managers (agents) based on political considerations, rather than managerial capabilities (Qian, 1996; Ramaswamy, 2001). These managers, often bureaucrats, are frequently deficient in the appropriate skills and knowledge required to operate companies efficiently (Xu and Zhang, 2008). Even when managers are sufficiently qualified, without profit-sharing schemes or similar executive rewards systems, they lack clear incentives to pursue innovation diligently (Zhou et al., 2017). Consequently, SOEs' managers tend to be risk-averse and avoid responsibility by sticking to undervalued innovation projects approved and endorsed by the State Planning Committee (Fritsch and Werker 1999), or prioritizing investments in low-risk, short-term, quick-return projects using proven "indigenous" technologies rather than long-term value-adding radical innovation (Breznitz and Murphree, 2011; Gambardella et al., 2015).

On the other hand, economic nationalists suggest that state ownership is not only a solution to market imperfections and social injustice but also an engine for national economic development: the so called "twin logics of the existence of SOEs" (Cuervo-Cazurra et al., 2014: 928). Both anecdotal (Economist, 2014, 2015) and empirical evidence (Zhou et al., 2017; Tran, 2019) provides support for SOEs as organizations through which the state pushes industry development, initiates institutional reforms to solve market failures, and coordinates economic

actors to enable break-through inventions (Cuervo-Cazurra et al., 2014). Shielded by soft budget constraints and loose monitoring from political principals, SOEs' self-interested managers are powerful bureaucratic entrepreneurs[2], capable of transcending the burden of short-termism (Bruton et al., 2015b) and overcoming resource limitations (Poczter, 2017) to engage in bigger and riskier projects (Mazzucato 2013) or produce more breakthrough innovations (Lazzarini et al., 2021). Where successful, these boost personal satisfaction, reputation, and empire building without being exposed to career risks (Aghion et al., 2013). In this way, the rise of champion SOEs as engines of technological catch-up, national economic growth, and global integration for domestic firms has been a common theme in emerging markets (Lazzarini, 2015).

Private ownership, however, has been consistently found to be more efficient than state ownership in most contexts (since at least Shleifer, 1998). Agency conflicts are thought to be less severe in privately held firms because principals and agents are more likely to be either the same individuals or have intimate relationships with each other (as in family firms) (Durand and Vargas, 2003; George, 2005; Lodh et al., 2014). Even where owners and managers are more distant, owners of POEs have access to various governance mechanisms to monitor their management teams and prevent agency problems escalating (Madison et al., 2016). These mechanisms are used to align agents' interests with those of the principals', so that agents are motivated to operate the company diligently towards a shared set of objectives and goals (Eisenhardt, 1989; Megginson and Netter, 2001). Guided by goal alignment, POE managers avoid speculative endeavors that may compromise the firm's future, choosing to be more selective in pursuit of those opportunities that offer the greatest chance of increasing firm value (Aghion et al., 2013: 278). Frequently this involves relying on the state to undertake the initial efforts towards the development of pioneering technologies, and seeking to develop related

technologies with clearer goals, lower risks, and shorter time horizons, but higher probability of success.

In summary, there are competing narratives on the relative innovation efficiencies of SOEs and POEs. However, on the balance of the evidence and our intimate familiarity with the context, we anticipate that a transition context characterised by significant institutional voids, that prioritizes political objectives, will exacerbate the dual agency problem in SOEs[3]. In contrast, emerging POEs, with fewer agency problems, increasingly receive constitutive legitimation. This eases access to government-controlled resources during the transition, enabling them to convert innovation resources more successfully into valuable innovation outcomes[4]. Accordingly, we hypothesize, with some caveats, that:

Hypothesis 2. Given the same level of innovation resources (inputs), SOEs produce fewer innovation outcomes (outputs) than POEs do.

The Moderation of Institutional Quality

The influence of context on innovativeness is well established (Autio et al. 2014). The 'quality' of local institutions shapes the choices, strategies, and actions of innovative actors (Mair et al., 2012). Importantly, as transition progresses, sub-national institutions[5] undergo reforms and improvement at different paces (e.g., Peng et al. 2015, Dheer et al. 2015), resulting in sub-national institutional variation. Improvements in institutional quality are signalled by reduced government intervention in economic activities and the replacement of the weakened state-controlled innovation model by a market-oriented one. However, movement towards a market economy relies on the establishment of market-oriented institutional logics[6]. This is likely to be a lengthy process due to the embeddedness of existing non-market logics (Foo et al., 2020).

In regions where market institutions are developing and private entrepreneurship is extensive, this may serve to weaken the effect of state ownership and state capitalism on innovation input (McDermott, 2007; Zhou et al., 2017). Growing capital markets will provide firms with access to sources of finance, regardless of their ownership, that may, in turn, alleviate dependence on state actors for innovation resources (Ahlstrom and Bruton, 2006; Nee and Opper, 2012; Musacchio and Lazzarini, 2014). However, as transition processes are decentralized, local government officials become more accountable to the public interest, leading to reduced intervention in SOEs (Bruton et al., 2015a). This higher-quality public governance approach stimulates public officials to diligently perform their principal role in SOEs, encouraging the pursuit of innovation investments on market bases. Finally, where successful, institutional restructuring is seen to alleviate regulatory pressures (Li et al., 2013) and accelerate privatization (Grosman et al., 2016). In a recent study of economic transition in Vietnam, Tran and Santarelli (2021) suggest that, as institutional quality improves, the private sector can build legitimacy that enables if to effectively compete with the established state sector. The consequent market selection process reduces reliance on the government and SOEs for "legitimacy spillovers," opportunities and resources, enabling POEs to generate entrepreneurial initiatives and spur innovation. Thus, we hypothesize that:

Hypothesis 3. The effect of state ownership on innovation inputs is less positive when institutional quality is higher.

The introduction of market-oriented institutions weakens SOEs' privileged position, requiring them to engage in resource competition that favours relatively efficient and profitable firms (Tran, 2019). Of course, privatization does not spell the end of state ownership. Instead, it marks the beginning of a new range of organizations that represent hybrids of state and private capital (Bruton et al., 2015a). Despite tensions in combining market and centrally planned institutional logics in mixed ownership, these hybrid firms increasingly shift from

administrative to market-oriented corporate governance practices in the face of new market competition and loosening government control (Peng, 2003). Moreover, as government officials reduce their interference in firms' operations, SOEs' managers are more likely to be appointed based on merit, to have performance-based incentive contracts, and to be delegated greater control and decision-making authority (Stan et al., 2014). With fewer constraints on action, executives are expected to innovate in response to market signals, improving utilization and the efficiency of innovation investments (Lazzarini et al., 2021). Further, improved information disclosure better enables monitoring by external stakeholders (Ralston et al., 2006). Following this line of argument, we hypothesize that improving institutional quality reduces the dual agency problem faced by SOEs and pushes them to be more efficient in transforming innovation inputs into innovation outputs:

Hypothesis 4. The effect of state ownership on innovation outputs is less negative when institutional quality is higher.

Figure 1 illustrates our conceptual framework. We study innovation as an input-output production process (Guan and Chen, 2010), that situates the relationship between innovation inputs and outputs in context (Li, 2009). For innovation resources/inputs, we consider both financial resources (internal R&D expenditure) and human resources (scientists, technologists, and R&D employees) that may be leveraged into technological innovations. For technological innovations, as outputs, the annual stock of intellectual properties (patents, trademarks, industrial designs, registered innovation projects) is captured. Since not all technological innovation outcomes will (or can) be commercialized we do not consider the link between innovation and firm performance.

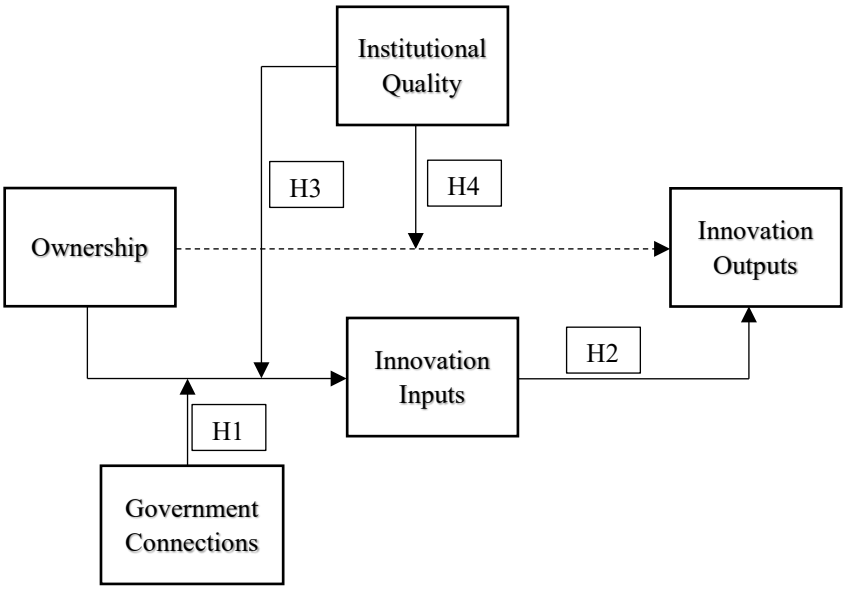

Figure 1. An integrated framework for Ownership-Innovation-Performance linkages

RESEARCH DESIGN

An Overview of The Empirical Context

Our empirical setting is Vietnam: a fast-growing transition country that has experienced "fundamental and comprehensive changes" (Peng, 2003: 275) to its institutional environment since the *doimoi* in 1986. A distinctive characteristic of Vietnam's transition is the 'hold-and-see' approach that gradually transferred productive capabilities from state-owned production systems to market-oriented business units, and progressively permitted SOEs and private start-ups to participate in markets for resources (Tran, 2019). Although this gradualist approach has been broadly successful, it entails some uncertainty and ambiguity in formal institutions that result from variations in institutional environments across provinces over time. After two decades of high growth (World Bank, 2016), Vietnam's economy began to lose its momentum in late 2000s (Fforde, 2016). The Vietnamese economy experienced significant turbulence during 2008-2012, characterised by a large trade deficit, a high level of business closures, corruption, and transparency problems. However, macroeconomic stability was restored by late 2013 thanks to policy-easing and austerity measures introduced in 2011, large inflows of FDI

and the rapid expansion of the export sector. The period 2007-2015 was also marked by extensive institutional restructuring to foster economic liberalization and integration in global markets, including entry into the World Trade Organization (WTO) and other international agreements.

While many pro-market reforms have been undertaken[7], these have always been conditional on the maintenance of the supremacy of the state and state ownership as the backbone of the economy. POEs, governed by market mechanism, have been allowed to coexist and prosper alongside state capitalism. Small and inefficient SOEs have been liquidated or privatized, while efficient and large SOEs are revitalized through conversion into state-controlled limited liability or joint stock companies. However, weaknesses in the prevailing state-run conglomerate model are apparent[8]. Political interest groups and entrenched corruption induce rent-seeking and exacerbate the 'resource curse' problem in Vietnam (Vuong and Napier, 2014). The national innovation system is marked by infrastructure deficiencies, underqualified labour, outdated production technologies and weak linkages with the public research sector (OECD and World Bank, 2014; CIEM et al., 2014). The Science and Technology (S&T) system is underfunded and has limited access to highly skilled personnel and the state-of-the-art facilities required to undertake advanced R&D, while performance metrics emphasize the quantity of patents and pay limited attention to patent novelty (Bezanson et al. 1999: 52).

To some extent, the emergence of a strong private sector in Vietnam (Santarelli and Tran, 2012) has been inevitable. Private ownership was experimentally permitted to operate in 1987-1988 in small-scale industries. With the enactment of the *Law on Foreign Investment* in 1987, the *Company Law* in 1990 and the *Enterprise Law* in 2000, there has been a sharp increase in the number of private enterprises, from about 400 in 2000 to more than 250,000 in 2010 (Tran,

2019)[9]. However, the growth of the private sector has been constrained by: (i) the large number of licenses required before beginning business operations; (ii) the difficulty in accessing financial resources from state-owned banks; and (iii) the slow progress of privatization of SOEs, especially large SOEs.

Data description

We integrate three datasets to test our hypotheses. First, the annual survey of enterprises conducted by the Vietnam General Statistics Office (GSO) covers all existing firms who possess an independent business account with a legal ownership form. This database has proven to be a reliable source of information for firm-level studies in Vietnam (e.g., Vu et al., 2017; Tran, 2019). Since our interest is in contrasting the innovation activities and performance of state- versus privately-owned firms, we exclude firms with foreign ownership from our sample – including both foreign subsidiaries and joint ventures[10]. Second, the Provincial Competitiveness Index (PCI) dataset, constructed through a collaboration between the Vietnam Chamber of Commerce (VCCI) and the U.S. Agency for International Development (USAID), develops a weighted average provincial institutional index that measures different aspect of local formal and informal governance. Third, information on provincial population density is extracted from the GSO's Provincial Annual Report comprising aggregate data on the 63 provinces.

To clean the data, all firms with gaps, missing observations, negative total assets, sales, and employees were dropped. The outliers were controlled by censoring the top and bottom 1% of observations in the distribution of each variable. The final sample consists of a balanced panel of 65,750 firms covering 231 industries (classified by three-digit ISIC code) in 63 provinces across 8 years from 2007 to 2014, which results in a total of 526,000 firm-year observations. Based on respondents' self-reporting to the question on 'the type of ownership', our 65,750

sample consists of 1,075 state-owned firms (1.63%); 59,808 private firms (91%); 2,089 mixed firms (3.2%); and 2,778 collective firms (4.2%). Up to 97% of sampled firms are micro, small, and medium sized firms, of which 60% are less than 10 years old. Because we want to examine innovation activities of state ownership relative to those of private ownership, we adopt Hubbard (2016)'s broader definition of state ownership to include all enterprises that have capital or investment from the State or SOEs. This reclassifies our sampled firms into 4,805 state firms and 60,945 private ones (wholly privately financed). Of all sampled firms, 1282 (1.9%) firms are involved in innovation activities, identified by the presence of R&D employees and/or positive innovation input such as R&D expenditure, machine/equipment investment[11]. Of these, 482 are state firms and 800 are privately owned. Most of innovation activities are concentrated in manufacturing industry: 45% of SOEs and 49% of POEs. Further, innovation is a state-led activity: more than 10% of SOEs engage in innovation activities, of which 30% are medium and large firms accounting for up to 98% of the total innovation investment from the state sector. By contrast, innovation is a rare thing among POEs, with only 1.3% engaged. Most of the innovative private firms are micro- and small-sized (88%).

Variables

Innovation resources (input) are indicated by: (i) financial resources, proxied by the ratio of innovation expenses over a firm's total sales. Innovation expenses consist of R&D and technological change expenses; and (ii) human resources, proxied by the ratio of R&D employees over a firm's total labor force.

Innovation output is measured by the number of intellectual property registrations (IP) acquired by the firm in each year. We believe, following the literature on patents (e.g., Griliches 1990), that this measure is a good indicator of the volume of inventive output, or innovative activity (Acs et al., 2002). However, in the absence of micro data gathered from a variety of

perspectives (individuals, firms, industries, sectors), it may be less well-suited to distinguish variable innovation novelty. Here, IP registrations consist of: (i) number of innovation projects completed and registered at three levels (province-, ministry-, and the government-level); (ii) number of patents newly obtained; (iii) number of industrial designs, trademarks, designations of origin; and (iv) number of patents and technical solutions currently appropriated.

State ownership and *private ownership* are measured in two ways. First, they are measured by dummies indicating whether a firm is a SOE or a POE respectively. Instead of using self-reported answers which may produce many unaccounted firms in hybrid organizational forms (mixed or collective), we adopt Hubbard (2016)'s broader definition of state ownership to include all enterprises that have state capital or investment from the State or SOEs. In this sense, POEs are wholly privately financed firms. Second, addressing the recent call for viewing state ownership as a continuous variable (Bruton et al., 2015a), we also consider the percentage of capital contributed by the government, *state capital,* as a proxy for state ownership. To test H1b, we consider a dummy variable 'state affiliation' to indicate if a POE is connected to or significantly influenced by the government.

Institutional quality is measured by the provincial competitiveness index (PCI), which is designed to assess the quality of local governance and administrative reforms by Vietnam's provincial governments in 63 provinces. Many studies have documented that the provincial government, more than the central government, is the relevant level of government when analysing the institutional climate facing firms in Vietnam (Malesky, 2008; Meyer and Nguyen, 2005). The weighted index has been constructed annually from 2006 comprising ten factors reflecting firms' perception and experience with various aspects of local institutions in each province: (i) entry costs; (ii) land access; (iii) transparency in information access; (iv)

bureaucracy; (v) corruption; (vi) policy bias; (vii) proactivity of provincial leadership; (viii) business support services; (ix) labor training; and (x) legal institutions (for a detailed analysis of the PCI index, see Tran, 2019). Generally, a higher PCI score indicates higher quality market institutions.

Controls: We control for several firm-, industry-, and provincial-level variables that may influence firms' innovation activities. At the firm-level, we control for: (i) *firm size* measured by a logarithmic transformation of total employment; (ii) *firm export*, a dummy that indicates if the firm engages in export activities; (iii) *firm diversification*, a dummy that indicates if the firm engages in diversification activities; (iv) *debt ratio*, measured as the ratio of total debt to total assets, reflecting the firm's financial conditions and leverage situation; (v) *firm age* measured by subtracting the calendar year in which a firm was established from the observing year; and, (vi) *industrial zone*, a dummy that indicates if the firm is located in an industrial zone. Second, [3 digit] industry-level variables include (i) *industry competition*, reflected by the Herfindahl index, a common measure of market concentration; (ii) *industry profitability*, measured by the industry-level return on assets; (iii) *industry growth rate*, measured as the industry-level annual growth of sales; and (iv) *industry life cycle*, which, following Agarwal et al (2002), is measured by taking the ratio of gross entries to total firms in the industry. At the provincial level (i) we control for the capacity of the regional market by including the provincial *population density* (the number of people per square kilometre); and (ii) since our measure of innovation output may capture more pro-forma fillings due to political influence from the central government, we control for the *distance* from the province where the firm resides to the capital city, Hanoi.

Table 1A presents the descriptive statistics and pair-wise correlation matrix of the variables. A simple review of correlations suggests that multicollinearity is not a major concern, as confirmed by variance inflation factors (VIF) ranging from 1.00 to 1.40.

Insert Table 1A about here

Estimation Methods

To test H1a and H1b, we employ an innovation input equation in which innovation expenditure and R&D labor are alternately used to reflect innovation input.

$$Innovation\ input_{it} = private_{it}\beta_1 + state\ connection_{it}\beta_2 + private \times state\ connection_{it}\beta_3 + X_{it}\beta_4 + \varepsilon_{it} \quad (1)$$

where X_{it} is the matrix of other independent and control variables and ε_{it} is the disturbance term. Equation (1) studies the effect of private ownership (relatively to state ownership) and its connection to the government on innovation input. H1a is supported if β_1 is significantly negative, while H1b is supported if β_3 is significantly positive. Due to the non-negative nature of innovation input, a random-effect Tobit model is adopted to deal with zero left censoring of our two innovation input variables: innovation expenditure and R&D labor.

To test H2, an innovation output equation is employed, in which the number of registered intellectual properties is the dependent variable.

$$Innovation\ output_{it} = state_{it}\gamma_1 + innovation\ input_{it}\gamma_2 + state \times innovation\ input_{it}\gamma_3 + X_{it}\gamma_4 + \mu_{it} \quad (2)$$

where X_{it} is the matrix of other independent and control variables, and μ_{it} is the disturbance term. Equation (2) studies the direct effect of state ownership on innovation output and their indirect effect on the relationship between innovation input and innovation output, in relation to private ownership. H2 is supported if γ_3 is negative and statistically significant. Since the number of intellectual properties is a count variable (of 65,750 firms in our sample, 394 firms

reported to have intellectual properties, which accounts for 0.6% of the sample), we apply zero-inflated Poisson model to estimate equation (2) as our innovation output has an excess of zero counts.

To test H3 and H4, we return to equation (1) and (2) to test the interaction effect of state ownership and institutional quality on innovation input and innovation output respectively. Interaction terms will be added into equation (1) and (2) as follows:

$$Innovation\ input_{it} = state_{it}w_1 + Institutional\ quality_{it}w_2 + state \times Institutional\ quality_{it}w_3 + X_{it}w_4 + \sigma_{it} \quad (3)$$

$$Innovation\ output_{it} = state_{it}k_1 + Institutional\ quality_{it}k_2 + state \times Institutional\ quality_{it}k_3 + X_{it}k_4 + \rho_{it} \quad (4)$$

where X_{it} is the matrix of other independent and control variables, and σ_{it} and ρ_{it} are disturbance terms. H3 is supported if $w_1 > 0$ and $w_3 < 0$, while H4 is supported when $k_1 < 0$ and $k_3 > 0$.

We also follow the approach of Montresor and Vezzani (2015) in estimating the innovation production process in an augmented Cobb-Douglass formulation for firm *i* at time *t* to include innovation expenditure and innovation labor:

$$Y_{it} = C_{it}^{\alpha} I_{it}^{\beta} L_{it}^{\gamma} K_{it}^{\theta} e^{u_{it}} \quad (5)$$

where Ydenotes the firms' innovation output, L stands for labor resources (total labor), C for physical resources (total assets), I for innovation input (innovation investment), K for knowledge capital (R&D staff) and u_{it} represents the error terms. The parameters of interest are $\alpha, \beta, \gamma, \theta$. Taking the logarithms of (5), we get the following estimation equation, where small letters stand for logarithms:

$$y_{it} = a + \alpha c_{it} + \beta i_{it} + \gamma l_{it} + \theta k_{it} + u_{it} \quad (6)$$

To test H2 and H4, we add the interactions $state \times innovation\ input_{it}$ and $state \times Institutional\ quality_{it}$ into equation (6), respectively:

$$y_{it} = a + \alpha c_{it} + \beta i_{it} + \beta_1 state_{it} \times i_{it} + \gamma l_{it} + \theta k_{it} + \theta_1 state_{it} \times k_{it} + u_{it} \quad (7)$$

$$y_{it} = a + \alpha c_{it} + \beta i_{it} + \gamma l_{it} + \theta k_{it} + \vartheta state_{it} + \vartheta_1 state_{it} \times Institutional\ quality_{it} + \vartheta_2 Institutional\ quality_{it} + u_{it} \quad (8)$$

H2 is supported when β_1 and θ_1 are negative; and H4 is supported when $\vartheta < 0$ and $\vartheta_1 > 0$. Equation (7) and (8) are estimated with panel random effects.

EMPIRICAL RESULTS

The estimation results of the effect of legal ownership on innovation input are presented in Table 2.

Insert Table 2 about here

As evident in the negative and significant coefficients of 'private ownership', compared to SOEs (the base group), POEs devote significantly fewer financial resources (column 1) and human resources (column 4) for innovation. When state ownership is indicated by the continuous share of the government's investment in column 3 and 6, the positive and significant coefficients of 'state capital' suggest the critical role of the State's financial stake in firms' capital structure in deploying innovation resources. *Ceteris paribus*, as the firm receives 10% more financial investment from the government, it increases its innovation expenditure by 5% and R&D staff ratio by 10%. SOEs, given their association with state patronage in transition economies, are more likely to secure privileged access to public resources for technological innovations. Interestingly, the significantly positive coefficient of 'state affiliation' suggests that regardless of legal ownership type, a stronger connection with the government and public institutional bodies increases the use of innovation inputs. These findings render full support

for H1a and partial support for H1b. To specifically test H1b, we add an interaction term between 'private ownership' and 'state affiliation'. Here, the interaction coefficients suggest a positive moderating effect of government connection in helping private firms gain access to valuable innovation resources. In practice, non-state firms with political connections are more likely to receive financial support in the form of subsidies to acquire technologies and hire technical employees for their innovation activities. Consistent with Tran and Santarelli (2021), this indicates the importance of building networks with government bodies as a source of social capital for POEs to obtain "constitutive legitimation" for survival and thriving in the marketplace.

Table 3 presents the results of the effect of legal ownership on the process of transforming innovation input into innovation output.

Insert Table 3 about here

H2 addresses the moderating effect of legal ownership on the relation between innovation input and innovation output. We hypothesize that, for a given level of innovation inputs, SOEs produce fewer innovation outcomes than POEs do. This hypothesis is tested through the interaction between *state ownership* and innovation input (measured as *innovation intensity* and *R&D staff ratio* respectively) in Table 3. The estimated results, however, do not support our prediction. SOEs are more successful than their private counterparts in converting innovation input into realized output. As a result, we fail to support H3 for the case of Vietnam. Two reasons can be suggested for the finding that state ownership strengthens the positive effect of innovation input on innovation output. First, the still dominant centrally planned institutions in Vietnam continue to favour SOEs in "a wide range of factors—institutional commitment, elite sponsorship, and government support" (DiMaggio and Powell, 1983: 149).

SOE patenting is more pioneering and frequent than that of POEs (Lazzarini et al., 2021). Political constraints that require 'innovating by plan', and the pressures to supply a wide range of customers during the transition, has resulted in SOEs, as Schumpeterian socialist firms, being invested with substantial technological capabilities to produce more diversified patent portfolios (Kogut and Zander, 2000). Moreover, both the innovation process and the IP registration process require significant time, effort, and resources. While the dual agency problem in SOEs allows their managers to enjoy resource discretion and managerial autonomy in exploring more inventions and creating new patents that they can use for career advancement (Poctzer, 2017), POE managers, in contrast, suffer financial constraints and face higher employment risks in the pursuit of intellectual property rights. The Cobb-Douglass IPP estimation (column 5) is, in general, consistent with our main models' results.

Insert Table 4 about here

Table 4 re-estimates the innovation input equation accounting for the effect of institutional quality in moderating the relationship between state ownership and innovation input. Regardless of the measures adopted for state ownership and innovation input, we observe negative (and statistically significant when state ownership is measured by share of state capital) coefficients on the interaction terms. This implies that SOEs located in high-quality institutional environments are likely to employ fewer innovation resources than their non-state counterparts, which statistically supports H3. Although SOEs, through their connection to government, are endowed with more innovation resources, the evidence suggests that they do not have the same favourable access to resources when local institutional quality is improved. However, since the size of the coefficient on the interaction term is rather small, relative to the coefficients on *state ownership* and *institutional quality*, we are cautious in presenting support for H3.

Insert Table 5 about here

Table 5 re-estimates the innovation output equation to explore the moderating effect of institutional quality on the realization of SOEs' innovation output, which directly addresses H4. The negative (but weakly significant) coefficient of the interaction term between state ownership and PCI suggests a negative impact of institutional quality on SOEs' innovation output. Our hypothesis is rejected. However, this is not entirely surprising. From our earlier observations on the relationship between state-ownership and innovation output, SOEs record more intellectual property registrations than their private counterparts do. As local institutional quality is improved, SOEs have less favourable access to state-owned innovation resources, which, in turn, constrains their innovation activities and subsequently reduces the number of intellectual properties registrations they can obtain. The Cobb-Douglas IPP estimation suggests that institutional quality does not moderate the relationship between state ownership and innovation output.

ROBUSTNESS TEST

As suggested by Estrin and Pelletier (2018), the comparison between SOEs and POEs potentially suffers from selection bias and endogeneity issues. This is likely true for the case of Vietnam as, first, the government strategically and deliberately privatized the smaller and less efficient SOEs while keeping stakes in larger SOEs to help them improve their managerial or knowledge-based capabilities towards market-oriented principles. And second, the factors determining whether the firm is publicly or privately owned are also likely to affect innovation outcomes. Following Lazzarini and Musacchio (2018), we controlled for this potential selection bias by employing the propensity score matching model (PSM) to extract a matched sample between treated group (firms having state ownership) and control group (firms without

state ownership), based on which we re-test H1-H4. The matched sample allow us to isolate the single impact of legal ownership and ensure an equal distribution between treated group (SOEs) and control group (POEs) without being confounded by firm-specific differences.

We perform the four-step matching procedure suggested by Garrido et al. (2014). The matched pairs are extracted to form a new sample for re-testing Hypotheses 1, 2, 3, and 4. Appendix 1 presents sample size, mean, and median standardized differences across all covariates in original and matched samples. Of the four matching and weighting strategies, Mahalanobis matching has the best reduction in mean standardized difference. Appendix 2 presents covariate balance across treatment and control groups before and after Mahalanobis matching on the propensity score. Appendix 3 presents the estimation results of the average treatment effect on the treated (ATT) of differences between SOEs and POEs. After matching the treated and control group, in general, the effect of state ownership is to increase firms' innovation input and output, but this effect is only economically small and marginally statistically significant for innovation input, even inconclusive when it is measured by innovation intensity. Appendix 4 tests H1-H4 on the extracted matched sample. The estimated results continue to support our hypotheses.

CONCLUSION

This paper set out to contribute to a better understanding of the relationship between corporate ownership structures and innovation performance under the moderation effect of local institutional quality in transition economy firms. In particular, our goal was to bring new data, from a relatively understudied context, to shed light on important contingencies that may help explain past inconsistencies in the empirical literature. In doing so, we believe that the work makes four primary contributions.

Our first contribution is in advancing a framework that helps reconcile the contrary predictions of different theoretical approaches. Meyer and Peng (2016: 9) identify agency theory, resource dependence theory and institutional theory as the bedrocks of "an increased theoretical pluralism" in the business literature on emerging economies. The first two of these theories are frequently employed in isolation to hypothesise about relationships between ownership and innovation. And, whilst resource dependence theory predicts the relative advantage of SOEs in acquiring resources for innovation, from a traditional agency theoretical standpoint SOEs are plagued by low-powered incentives and dysfunctional involvement causing inefficiencies in transforming inputs into innovation outputs, relative to POEs. Here we were able to separately test these propositions and to explore the contingent effect of institutional quality on the relationships. Institutions determine the efficiency of markets and, thus, the transaction costs faced by firms. Higher quality institutions moderate the advantages state-ownership confers and ameliorate the disadvantages associated with private ownership. In the absence of effective institutions, private firms must place political capabilities on par with other strategic capabilities in building relationship with agents of the state (Peng et al. 2016). State ownership, on the one hand, creates an array of organizational issues – low-powered incentives (Dewenter and Malatesta, 2001: 301), weak monitoring (Dharwadkar et al., 2000), political capture (Megginson and Netter, 2001) – that hinder managerial ambition and dampen firm efficiencies. These are problems that more often happen in contexts in which institutions are qualitatively weaker, such as emerging economies (Musacchio and Lazzarini, 2014). On the other hand, advocates of economic nationalism attribute the "twin logics of the existence of SOEs" (Cuervo-Cazurra et al., 2014: 928) to their roles as a solution to market imperfections and social injustice and an engine for national economic development. Our extended agency model gives a more balanced view in which agency "liabilities" in fact may benefit SOEs, especially in the

sphere of technological innovation. Indeed, given relatively higher levels of managerial autonomy and being shielded by soft budget constraints, SOEs may outperform POEs in their innovation activities.

Our second contribution flows from the importance of institutions in shaping the incentives economic actors face and in the persistence of institutional variety across space (Berry et al, 2014). As Meyer and Peng (2016, p. 14) observe: "If institutions are central to explaining management phenomena…then the process of theory building needs to be conscientious of the contextual boundaries of the theory". It is critical that we guard against the fallacy of over-generalization. A robust evidence base requires rich studies from various contexts. Here we are able exploit a unique data set that both recognizes the lower levels of aggregation at which institutional variety may exist and persist, and the dynamic nature of institutional development. Institutions in transition economies experience more frequent variation and changes, such that analysis in the cross-section is unlikely to be sufficiently illuminating.

Our third contribution is in clearly separating the relationship between ownership, on the one hand, and innovation inputs and outputs on the other. Here we model, firstly, the relationship between ownership type and innovation inputs, before incorporating both innovation input and its interaction with ownership type into a model of innovation output. This approach helps shed new light on the inconsistent results found in the empirical literature. Although our results suggest that SOEs in Vietnam enjoy advantages in both acquiring resources for innovation and in transforming those resources into completed innovations, this is consistent with increasing acknowledgment that SOEs may be successful when facing certain institutional imperatives (Meyer and Peng, 2016), and the recent call for revising existing theories of SOE underperformance (Lazzarini and Musacchio, 2018)

Our final contribution is methodological. We test our hypotheses in a set of three equations in a dynamic panel data setting. While most of extant research uses a dummy variable to reflect state or private ownership, we adopt both a continuous measure and the familiar dummy to indicate state ownership. We also control for several important covariates at firm-, industry-, and province-level, and adopt advanced econometric models for estimating each equation. Importantly, considering the potential presence of the selection bias of legal ownership in earlier studies, we employ the propensity score matching model (PSM) to extract a matched sample between treated group (firms having state ownership) and control group (firms without state ownership). The estimated results on this extracted matched sample all statistically and significantly support our hypotheses.

In conclusion, our estimated results are consistent across all measures of state ownership and innovation input. First, while state ownership is positively related to innovation input, the opposite appears true for private ownership. However, those private firms that have government connections appear able to overcome innovation resource constraints. Second, innovation input contributes more to innovation output for SOEs than for POEs. SOEs are better able to convert their innovation input into measurable innovation output, suggesting that SOEs may receive extra rents from their state patronage, but such rents are likely to come at a cost: stronger government interventions when key government objectives are at stake (Lazzarini and Musacchio, 2018). Third, the resource buffering effect for SOEs declines when the institutional quality of the local environment is improved. When the government withdraws SOEs' preferential treatment, they experience resource constraints, and their innovation performance declines. Higher institutional quality, on the other hand, fosters a higher innovation output for POEs by easing their access to critical innovation resources. In other words, institutional quality moderates the countervailing processes of resource allocation and

resource utilization and reduces the innovation performance gap between state ownership and private ownership.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest with respect to the research reported in this paper.

NOTES

[1] Transitional institution was defined as "institutional change driven by gradual reforms thus produces institutions with the characteristic of transition" (Zhu, 2005: 1371)

[2] Following Ohemeng (2018: 1), we conceive bureaucratic entrepreneurs (or 'public sector entrepreneurs') as the "actors who help propel dynamic policy change in their community. Like other entrepreneurs, they engage in the act of creative discovery by creating or exploiting new opportunities to push forward their ideas". This entrepreneurial figure, typical of the public sector "identifies market opportunities within the political landscape [and] optimizes the performance-enhancing potential of innovation for the public sector organization" (Currie et al., 2008: 987).

[3] In a transitional context, SOEs face discretionary pressure from governments to pursue a complex mix of state objectives (Lazzarini and Musacchio, 2018). While developmental objectives create economic rents that can be captured by SOEs (Meyer et al., 2014), social and political objectives increase agency costs in SOEs. Although SOEs survive and thrive partly because "they have evolved to become a type of hybrid organization" (Bruton et

al., 2015a: 92), a mixed ownership structure combining both market and centrally planned institutional logics (Tran and Santarelli, 2021), the pursuit of diverging objectives under multiple layers of state involvement jeopardizes profit imperative while introducing additional agency and governance (Vo, 2018).

[4] We extend Lazzarini et al. (2021) by considering the moderating effect of political constraints as a boundary condition that reverses the base effect of SOEs' inventive outperformance in a transition institutional setting. First, the empirical context of Lazzarini et al. (2021) is OECD countries characterized by stronger institutions with efficient political constraints (laws, property rights, social norms, etc.). Such advanced institutional environments enable SOEs' managers to enjoy managerial autonomy and independence to pursue risky and pioneering inventive projects. However, our empirical context is an emerging transition economy with significant institutional voids where managerial autonomy must remain compatible with the masterplan from the State Planning Committee. The pursuit of diverging objectives under multiple layers of state involvement reduces managerial autonomy, promotes negative agentic behaviours, and exacerbate governance problems within transition SOEs, which obviously reduce their innovation capacity. Second, our sampled SOEs are mostly SMEs which are more vulnerable and likely to suffer from higher risk of political capture during the institutional transition; while SOEs in Lazzarini et al. (2021) are publicly traded and compete globally. They are more likely to be affected by beneficial political constraints from multiple stakeholders as an important monitoring mechanism to prevent abuse in policy making and resource usage.

[5] Institution is defined as a set of rules that constrain human behaviours (North, 1990) and as a device to stabilize expectations and coordinate "millions of people in a coherent order" (Lachmann, 1970) (in Tran, 2019: 3). Specifically, in this study, we refer to 'institutional quality' as the quality of local governance which varies widely among regions/provinces in a country.

[6] "Institutional logics represent frames of reference that condition actors' choices for sensemaking, the vocabulary they use to motivate action, and their sense of self and identity." (Thornton et al., 2012: 2). While market institutional logics refers to a cognitive model in which human behaviors and economic actions are guided by self-interest and economic rationality, nonmarket institutional logics refer to the assumption that an individual's action is "motivated by and oriented toward a goal higher than individual self-interest", such as family relationships, social networks, or local community (Foo et al., 2020: 291).

[7] Remarkable reforms in political institutions during the transition include separating the power and function of the Communist Party, the government, and the Parliament; delegating more power to local government

(decentralization); reducing bureaucracy by contracting the size of the government or removing unnecessary business licenses and introducing the "one door – one stamp" initiative since 1997.

[8] The state sector only creates 10% employment but consumes 70% total social investment, 50% total state investment, 60% commercial credit, and 70% of ODA (Official Development Assistance) (BBC, 2013).

[9] The official application of the Enterprise Law in January of 2000 marked a crucial step in reducing discrimination against POEs and boosting the development of a strong private sector. It was significantly easier for private enterprises not only to access capital, land, and labour but also to enter a wide range of industries, from mining, construction, and manufacturing to banking, education, and healthcare which had been mostly dominated by SOEs. In addition, Vietnam's joining WTO in 2007 induced the full liberalization of foreign trade, deregulation of financial markets, and privatization of SOEs. This explains for the drastic increase of the number of POEs during the 10-year period 2000-2010.

[10] The reasons for excluding foreign ownership are two-fold: First, while the traditional literature, primarily concerning developed economies, argued that privatization brought in the benefits of technological diffusion from foreign ownership of former SOEs, the role of foreign ownership in middle income and transition economies was not significant due to the poor market regulatory institutions (Estrin et al., 2009). Second, foreign-invested firms played a minimal role in the transition process of Vietnam, as the country adopted the private sector-led growth model which prioritized supporting new and young private firms to replace out-of-date SOEs as the main engine of national economic growth, and simultaneously applied measures to restrict foreign ownership to maintain local control of resources (Tran, 2019).

[11] According to the assessment of the OECD and World Bank (2014), very few Vietnamese private firms have developed in-house R&D. The government supports only 3% of innovation expenditure of SOEs in critical sectors. Further, the awareness and knowledge about the importance of innovation was low during our study period (NOIP, 2016) since Vietnam was expected to absorb low-skill, low-wage manufacturing jobs when China moves up the value chain (Albano, 2017). Due to serious resource-constraints and weak R&D capabilities, Vietnamese SMEs, comprising about 98% of total enterprises, conduct their innovation with non-R&D investment or do not have R&D strategies (Albano, 2017). Such non-R&D innovation activities have largely been neglected by annual census surveys (where our data come from) which mainly focus on R&D investment and science-based innovation (Le, 2020).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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TABLE 1A
Descriptive Statistics and Pair-wise Correlation Matrix

Var	Mean	Std	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1)	0.073	0.26	1.00																	
(2)	0.927	0.26	-1.00	1.00																
(3)	3.37	15.9	0.93*	-.93*	1.00															
(4)	0.02	0.15	0.68*	-.68*	0.82*	1.00														
(5)	0.003	0.32	0.00	-0.00	0.00*	0.00*	1.00													
(6)	0.008	0.19	0.00	-0.00	0.00	0.00	0.06*	1.00												
(7)	59.03	5.19	-.05*	0.05*	-.05*	-.04*	-.01*	-.00*	1.00											
(8)	0.022	0.15	0.03*	-.03*	0.03*	0.01*	-0.00	0.00*	0.03*	1.00										
(9)	0.05	0.22	0.06*	-.06*	0.07*	0.04*	-0.00	-0.00	0.02*	0.15*	1.00									
(10)	0.103	0.31	0.19*	-.19*	0.21*	0.16*	-.00*	-.01*	-.06*	0.06*	0.08*	1.00								
(11)	0.48	0.41	0.03*	-.03*	0.04*	0.02*	-.01*	-0.00	0.00*	0.03*	0.09*	0.04*	1.00							
(12)	7.81	6.39	0.32*	-.32*	0.35*	0.28*	-.00*	-.01*	-.03*	0.03*	0.14*	0.14*	0.07*	1.00						
(13)	2.74	1.35	0.34*	-.34*	0.37*	0.26*	-.01*	-.02*	-.05*	0.16*	0.23*	0.31*	0.17*	0.26*	1.00					
(14)	0.03	0.06	0.04*	-.04*	0.04*	0.03*	0.99	0.00	0.00	0.01*	-.01*	-.02*	-.05*	0.05*	-.04*	1.00				
(15)	0.013	0.23	-001*	0.01*	-.01*	-.01*	0.00	0.00	0.01*	0.01*	0.00*	-.01*	0.00	-.02*	-.01*	-.04*	1.00			
(16)	0.31	2.43	-0.00	0.00	-.00*	-0.00	0.00	-0.00	0.00*	-.00*	-.01*	-.00*	-.01*	-.03*	-.01*	0.14*	-.00*	1.00		
(17)	1882	2264	-.07*	0.07*	-.08*	-.07*	-.00*	0.00	0.03*	-.08*	0.03*	-.03*	0.08*	-.04*	-.11*	-.18*	0.01*	-.02*	1.00	
(18)	1238	1326	-.02*	0.02*	-.02*	-.03*	-0.00	0.01*	-.01*	-.02*	0.13*	-.11*	0.09*	0.04*	-.06*	-.00	0.01*	-.01*	0.13*	1.00

Note: *: significant at 1% level

(1) state ownership dummy; (2) private ownership dummy; (3) % of state capital; (4) state affiliation; (5) innovation expenditure; (6) R&D staff ratio; (7) institutional quality PCI; (8) industrial zone dummy; (9) export dummy; (10) diversification dummy; (11) debt ratio; (12) firm age; (13) firm size; (14) industry competition; (15) industry profitability; (16) industry growth; (17) industry life cycle; (18) population density.

TABLE 1B
Descriptive Statistics for State Ownership and Private Ownership

Variables	Sources of Data	Definition	State Ownership				Private Ownership				T-test
			Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max	
State capital	Enterprise census	The percentage of capital contributed by the government	81.589	0.013	50	100	0.000	0.000	0	0	diff<0
Innovation intensity	Enterprise census	The ratio of innovation expenses over a firm's total sales	0.007	0.468	0	42.748	0.004	0.359	0	94.73	diff=0
R&D staff ratio	Enterprise census	The ratio of R&D employees over a firm's total labor force	0.009	0.054	0	1	0.002	0.037	0	1	diff<0
IP registrations	Enterprise census	The number of intellectual property registrations (IP) acquired by the firm in each year	0.286	7.136	0	358	0.002	0.181	0	20	diff<0
Institutional quality	PCI index dataset	The quality of local governance and administrative reforms in 63 provinces	57.836	5.559	36.39	77.2	59.289	4.908	36.39	77.2	diff>0
Industrial zone	Enterprise census	If the firm is located in an industrial zone	0.047	0.212	0	1	0.021	0.144	0	1	diff<0
Export	Enterprise census	If the firm engages in export activities	0.127	0.333	0	1	0.048	0.216	0	1	diff<0
Diversification	Enterprise census	If the firm engages in diversification activities	0.407	0.491	0	1	0.082	0.274	0	1	diff<0
Debt ratio	Enterprise census	The ratio of total debt to total assets	0.549	0.382	0	9.01	0.481	0.401	0	75	diff<0
Firm age	Enterprise census	The number of years that the firm is in operation since inception	18.503	14.151	0	76	7.679	5.189	0	70	diff<0
Labor size	Enterprise census	The logarithmic transformation of total employment	5.124	1.302	0	9.604	2.599	1.253	0	10.845	diff<0
Industry competition	Enterprise census	The Herfindahl index, a common measure of market concentration	0.038	0.073	0.000	1	0.022	0.052	0.000	1	diff<0
Industry profitability	Enterprise census	The industry-level return on assets (total operation profit/ total assets)	0.008	0.359	-17.28	0.701	0.014	0.149	-44.66	3.849	diff>0
Industry growth	Enterprise census	The industry-level annual growth of sales	0.296	0.763	-0.971	56.412	0.299	2.192	-0.996	657.2	diff=0
Industry life cycle	Enterprise census	The industry-level ratio of gross entries to total firms	1125.5	1824.8	0	9407	2068.9	2270.3	0	9789	diff>0
Population density	Provincial Annual Report	The number of people per square kilometre in each province	1100.3	1240.1	39	3731	1303.1	1356.9	39	3731	diff>0
Distance to capital	Authors' calculation	The distance in kilometre from the province to the capital city, Hanoi.	791.79	741.76	0	2033.3	979.86	752.20	0	2033.3	diff>0

diff = mean(POE) - mean(SOE)

TABLE 2
Legal Ownership and Innovation Input (Testing H1; N= 526,000)

Variables	**Innovation intensity**			**R&D staff ratio**		
	(1)	(2)	(3)	(4)	(5)	(6)
Private ownership	-1.07**	-1.12**		-1.85**	-1.92**	
	(0.079)	(0.063)		(0.094)	(0.093)	
State capital			0.005**			0.01**
			(0.001)			(0.002)
State affiliation	1.04**	0.34**	1.44**	0.42**	0.24*	1.22**
	(0.09)	(0.07)	(0.098)	(0.108)	(0.11)	(0.126)
Private ownership * state affiliation		**13.23****			**13.83****	
		(0.554)			**(0.94)**	
Institutional quality	0.11**	0.011*	0.11**	0.031**	0.009	0.03**
	(0.008)	(0.007)	(0.008)	(0.009)	(0.009)	(0.009)
Industrial zone	0.87**	0.69**	0.86**	1.16**	1.15**	1.16**
	(0.096)	(0.079)	(0.096)	(0.125)	(0.124)	(0.125)
Export	1.18**	0.88**	1.17**	1.12**	1.09**	1.11**
	(0.07)	(0.06)	(0.073)	(0.089)	(0.09)	(0.089)
Diversification	-0.24**	-0.17**	-0.196**	-0.42**	-0.41**	-0.35**
	(0.06)	(0.053)	(0.064)	(0.079)	(0.08)	(0.079)
Debt ratio	-0.38**	-0.27**	-0.38**	-0.38**	-0.37**	-0.37**
	(0.08)	(0.07)	(0.08)	(0.088)	(0.087)	(0.088)
Firm age	0.02**	0.02**	0.026**	0.05**	0.05**	0.06**
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Firm size	0.79**	0.68**	0.84**	0.77**	0.78**	0.87**
	(0.02)	(0.016)	(0.019)	(0.022)	(0.022)	(0.021)
Industry competition	3.12**	2.53**	3.09**	4.26**	4.25**	4.29**
	(0.297)	(0.245)	(0.297)	(0.359)	(0.359)	(0.359)
Industry profitability	0.098	0.089	0.101	0.61**	0.64**	0.61**
	(0.078)	(0.067)	(0.078)	(0.216)	(0.218)	(0.214)
Industry growth	-0.043	-0.037	-0.041	-0.17**	-0.18**	-0.17**
	(0.038)	(0.032)	(0.038)	(0.059)	(0.061)	(0.059)
Industry life cycle	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**
	(0.000)	(0.00)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	0.00**	0.00	0.00**	0.00*	0.000	0.00*
	(0.000)	(0.00)	(0.000)	(0.000)	(0.000)	(0.000)
Year dummies	10.08**	4.77**	10.26**	6.01**	5.8**	7.12**
Prov dummies	15.00**	12.62**	15.07**	31.03**	30.71**	31.4**
Intercept	-17.1**	-9.32**	-18.19**	-13.27**	-11.93**	-15.2**
	(0.51)	(0.42)	(0.506)	(0.607)	(0.608)	(0.603)
LR chi2	11170**	14117**	11012**	11502**	11703**	11148**

*: significant at 5% level; **: significant at 1% level. Robust standard errors are in parentheses.
Year-fixed effects and province-fixed effects are added, but not shown.
Left-censored: 520,376; Uncensored: 5,624.

TABLE 3
Legal Ownership, Innovation Input, and Innovation Output (Testing H2; N= 526,000)

Variable	SOE / POE dummy		Share of state capital		Cobb-Douglass IPP
	(1)	(2)	(3)	(4)	(5)
State ownership	0.175**	0.489**	0.003**	0.002**	0.000
	(0.028)	(0.032)	(0.000)	(0.000)	(0.001)
State ownership * innovation intensity		**1.145****		**0.886****	**0.028****
		(0.228)		**(0.234)**	**(0.007)**
State ownership * R&D staff ratio		**-0.375****		**-0.354****	**0.024***
		(0.006)		**(0.006)**	**(0.013)**
Innovation intensity/ expenditure	0.056**	0.053**	0.055**	0.051**	0.008**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R&D staff (Knowledge capital)	0.051**	0.337**	0.055	0.324**	0.028**
	(0.002)	(0.004)	(0.002)	(0.004)	(0.006)
Institutional quality (PCI)	0.008**	0.025**	0.008**	0.025**	
	(0.002)	(0.002)	(0.002)	(0.002)	
Industrial zone	-1.007**	-1.089**	-1.015**	-1.181**	
	(0.046)	(0.046)	(0.046)	(0.046)	
Export	0.317**	0.343**	0.313**	0.348	
	(0.022)	(0.023)	(0.023)	(0.023)	
Diversification	-0.279**	-0.342**	-0.289**	-0.312**	
	(0.018)	(0.018)	(0.018)	(0.018)	
Debt ratio	-0.347**	-0.417**	-0.370**	-0.472**	
	(0.031)	(0.032)	(0.031)	(0.032)	
Firm age	0.009**	0.006**	0.009**	0.008**	
	(0.001)	(0.001)	(0.001)	(0.001)	
Firm size (Labor resources)	0.441**	0.595**	0.429**	0.611**	0.001**
	(0.007)	(0.008)	(0.007)	(0.008)	(0.000)
Physical resources					-0.0002*
					(0.000)
Industry competition	0.369**	0.246**	0.214**	0.144**	
	(0.049)	(0.051)	(0.051)	(0.052)	
Industry profitability	0.037**	0.048**	0.041**	0.054**	
	(0.009)	(0.009)	(0.009)	(0.009)	
Industry growth	-0.071**	-0.083**	-0.068**	-0.079**	
	(0.012)	(0.013)	(0.012)	(0.013)	
Industry life cycle	-0.000*	-0.000**	-0.000**	-0.000**	
	(0.000)	(0.000)	(0.000)	(0.000)	
Distance to capital	-0.0001**	-0.000**	-0.000**	-0.000**	
	(0.000)	(0.000)	(0.000)	(0.000)	
Year dummies	364**	168**	204**	164**	
Intercept	0.337**	-1.923**	0.399**	-1.742**	-0.000
	(0.122)	(0.131)	(0.122)	(0.131)	(0.001)
Inflate (state ownership)	-3.339**	-3.152**	-0.037**	-0.035**	
	(0.089)	(0.089)	(0.001)	(0.089)	
Wald chi2	14960**	19947**	15117**	19815**	147.9**

*: significant at 5% level; **: significant at 1% level. Robust standard errors are in parentheses. Year-fixed effects are added, but not shown. State ownership as the predictor of the excess zeros.

TABLE 4
Institutional Quality, State Ownership, and Innovation Input (Testing H3; N= 526,000)

Variable	SOE dummy		Share of state capital	
	Innovation exp.	**R&D staff**	**Innovation exp.**	**R&D staff**
	Model 1	Model 2	Model 3	Model 4
State ownership	9.179** (0.821)	0.797** (0.056)	0.202** (0.012)	0.016** (0.001)
State * PCI	**-0.003 (0.016)**	**-0.002 (0.001)**	**-0.001** (0.000)**	**-0.000** (0.000)**
Institutional quality (PCI)	0.14** (0.041)	0.023** (0.003)	0.123** (0.041)	0.022** (0.003)
Industrial zone	5.44** (0.798)	0.366** (0.056)	5.679** (0.800)	0.378** (0.056)
Export	8.39** (0.568)	0.536** (0.038)	8.464** (0.571)	0.536** (0.038)
Diversification	-0.797 (0.521)	-0.091** (0.035)	-1.229* (0.525)	-0.119** (0.035)
Debt ratio	-1.78** (0.668)	-0.061 (0.038)	-1.535* (0.665)	-0.049 (0.038)
Firm age	0.224** (0.021)	0.020** (0.001)	0.181** (0.021)	0.017** (0.001)
Firm size	6.65** (0.165)	0.304** (0.009)	6.331** (0.165)	0.283** (0.009)
Industry competition	29.78** (2.678)	2.178** (0.176)	28.96** (2.695)	2.129** (0.177)
Industry profitability	0.803 (0.569)	0.197** (0.081)	0.787 (0.574)	0.202* (0.083)
Industry growth	-0.625* (0.357)	-0.083** (0.026)	-0.635* (0.358)	-0.083** (0.026)
Industry life cycle	-0.001** (0.000)	-0.000** (0.000)	-0.001** (0.000)	-0.000** (0.000)
Population density	0.000 (0.000)	0.000** (0.000)	0.000 (0.000)	0.000** (0.000)
Intercept	-86.4** (2.681)	-4.764** (0.163)	-86.35** (2.683)	-4.744** (0.163)
LR chi2	7529**	5698**	7682**	5862**
Left-censored	390,277	388,351	390,277	390,277
Uncensored	4,218	6,144	4,218	4,218

*: significant at 5% level; **: significant at 1% level. Robust standard errors are in parentheses. Year-fixed effects and province-fixed effects are added, but not shown.

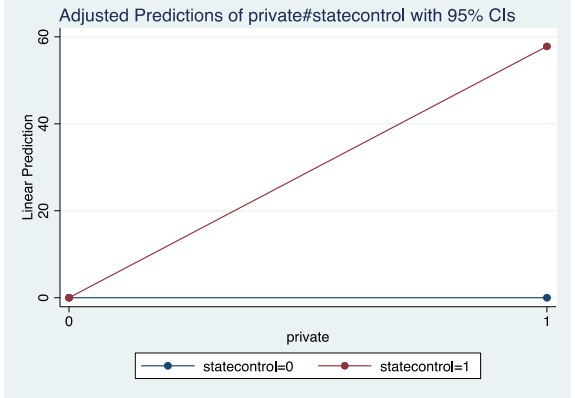
TABLE 5

Institutional Quality, State Ownership, and Innovation Output (Testing H4; N=526,000)

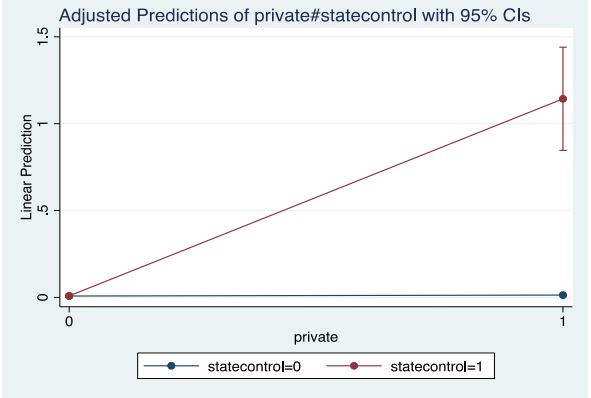
	SOE dummy		Share of state capital		Cobb-Douglas IPP
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
State ownership	1.148**	3.169**	0.003**	0.005**	0.014
	(0.229)	(0.224)	(0.000)	(0.001)	(0.026)
State * PCI	**-0.007***	**-0.037****	**-0.000****	**-0.000***	0.000
	(0.004)	**(0.004)**	**(0.000)**	**(0.000)**	(0.000)
Institutional quality (PCI)	-0.041**	-0.009**	-0.049**	-0.014**	0.0001**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.000)
Innovation expenditure	0.055**		0.056**		0.017**
	(0.001)		(0.002)		(0.002)
R&D staff		0.073**		0.259**	0.036**
		(0.002)		(0.004)	(0.005)
Industrial zone	-1.017**	-1.034**	-0.927**	-0.872*	
	(0.054)	(0.054)	(0.057)	(0.058)	
Export	0.048	0.035	0.029	0.007	
	(0.032)	(0.032)	(0.035)	(0.036)	
Diversification	-0.979**	-0.959**	-1.082**	-1.002**	
	(0.027)	(0.026)	(0.028)	(0.028)	
Debt ratio	-0.507*	-0.265**	-0.715**	-0.584*	
	(0.037)	(0.038)	(0.041)	(0.042)	
Firm age	0.003**	0.002**	0.008**	0.007**	
	(0.001)	(0.000)	(0.001)	(0.001)	
Firm size	0.285**	0.205**	0.317**	0.445**	0.001**
	(0.007)	(0.007)	(0.008)	(0.009)	(0.000)
(Labor resources)					
Physical resources					-0.000**
					(0.000)
Industry competition	0.646**	0.059	1.101**	0.411**	
	(0.078)	(0.079)	(0.078)	(0.084)	
Industry profitability	-1.591**	0.191	-2.868**	-0.936**	
	(0.231)	(0.198)	(0.235)	(0.256)	
Industry growth	0.156**	0.303**	0.116**	0.289**	
	(0.018)	(0.018)	(0.019)	(0.019)	
Industry life cycle	-0.000*	-0.000	-0.000*	-0.000	
	(0.000)	(0.000)	(0.000)	(0.000)	
Population density	-0.000**	-0.000**	-0.000**	-0.000**	
	(0.000)	(0.000)	(0.000)	(0.000)	
Intercept	4.344**	2.687**	5.064**	1.725**	-0.003*
	(0.177)	(0.177)	(0.117)	(0.148)	(0.001)
Inflate	0.000**	0.000**	0.000**	0.000**	
	(0.000)	(0.000)	(0.000)	(0.000)	
LR chi2	12189.27**	12564.23**	11635.5**	14575.2**	130.06**

*: significant at 5% level; **: significant at 1% level. Robust standard errors are in parentheses. Year-fixed effects and province-fixed effects are added, but not shown.

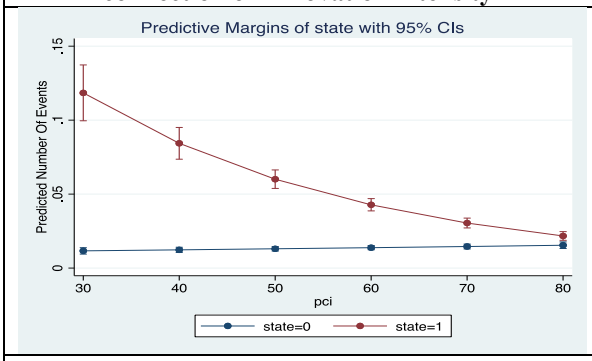
Figure 2: Interaction plots



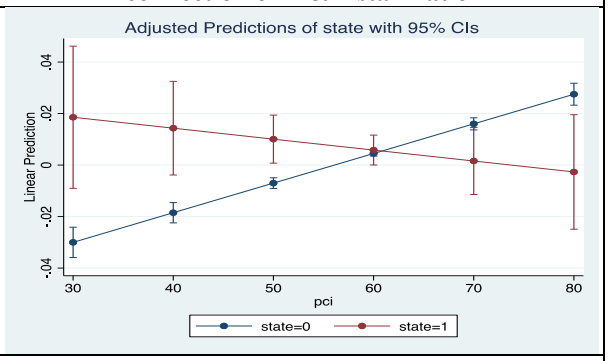
Interaction between private and government connection on innovation intensity



Interaction between private and government connection on R&D staff ratio



Interaction between state ownership and institutional quality on innovation output



Interaction between state ownership and institutional quality on innovation intensity

Appendix 1: Sample size, mean, and median standardized differences across all covariates in original and matched samples

Matching type	Total sample size	No. of treated observations	No. of comparison observations	Mean standardized difference in covariates (%)	Median standardized difference in covariates (%)
Nearest neighbor	65,750	4,805	60,945	7.6	7.4
Caliper 1:1 with replacement	65,750	4,805	60,945	0.7	0.8
Kernel matching	65,748	4,803	60,945	3.5	1.1
Mahalanobis matching	65,750	4,805	60,945	0.2	0.2

Appendix 2: Covariate balance across treatment and control groups before and after Mahalanobis matching on the propensity score

Variable	Original sample					Mahalanobis matched sample				
	Mean treatment	Mean control	Stdized difference	% Bias reduction	t-test	Mean treatment	Mean control	Stdized difference	% Bias reduction	t-test
Industrial zone	0.039	0.072	-20.1	-67.9	-7.19	0.039	0.038	0.2	97.9	0.11
Export	0.007	0.008	-1.6	81.6	-0.6	0.007	0.007	0.0	100	-0
Diversify	0.329	0.318	2.9	95.7	1.16	0.329	0.326	0.8	98.9	0.3

Firm age (<10 years)	0.539	0.569	-7.4	91.6	-3	0.539	0.541	-0.2	99.8	-0.08
Firm age (9<x <30)	0.323	0.368	-11.4	80.6	-4.6	0.323	0.322	0.2	99.6	0.09
High debt (ratio > 1)	0.022	0.022	-0.2	98.5	-0.07	0.022	0.022	0	100	0
High PCI (PCI>50)	0.892	0.863	9.9	-2.5	4.32	0.892	0.892	-0.1	99.3	-0.03
Innovation intensity	0.016	0.024	-1.6	29.5	-0.51	0.016	0.017	-0.3	88.7	-0.09

Appendix 3: Differences of innovation input/output between SOEs and matched POEs (Average treatment effect on treated - ATT)

		Innovation input		Innovation output
Variable	**Year**	**Innovation intensity**	**R&D staff ratio**	
State ownership	2007	0.016* (0.009)	0.004** (0.001)	0.634** (0.192)
	2008	0.013 (0.009)	0.005** (0.001)	0.613** (0.153)
	2009	0.001** (0.000)	0.003* (0.001)	0.813** (0.213)
	2010	0.005 (0.005)	0.004** (0.001)	0.825** (0.214)
	2011	-0.001 (0.001)	0.006** (0.002)	0.281* (0.103)
	2012	0.001* (0.000)	0.004** (0.001)	0.271* (0.104)
	2013	-0.001 (0.003)	0.001 (0.002)	0.263* (0.104)
	2014	-0.001 (0.002)	0.202 (0.169)	0.272* (0.103)

*: significant at 5% level; **: significant at 1% level. ATTs are computed using the Mahalanobis matching estimation

Appendix 4: Testing H1, H2, H3, H4 on the Matched Sample (N=42,114)

Variable	**Testing H1**	**Testing H2**	**Testing H3**	**Testing H4**
	Model 1	Model 2	Model 3	Model 4
POEs	-0.691** (0.077)			0.016** (0.001)
POEs * State affiliation	**0.591** (0.016)**			
State affiliation	0.329** (0.079)			
SOEs		2.195** (0.373)	4.645** (1.165)	1.267** (0.056)
SOEs * Innovation intensity		**-0.232** (0.089)**		
Innovation intensity		0.247** (0.031)		0.153** (0.003)
SOEs * PCI			**-0.058** (0.019)**	**-0.174** (0.008)**
Institutional quality (PCI)	0.014* (0.006)	0.015 (0.024)	0.079** (0.016)	0.171** (0.007)
LR chi2	2206**	5.06e+07**	1215**	12326**
Left-censored	40,957		40,957	
Uncensored	1,157		1,157	

*: significant at 5% level; **: significant at 1% level. Robust standard errors are in parentheses. Models 1 and 3 use random effects Tobit model. Models 2 and 4 use random-effects Poisson model. All firm- and industry-level control variables are included, but not shown.