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Can a Tiger Change Its Stripes? Reform of Chinese State-Owned Enterprises in the Penumbra of the State

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ABSTRACT

The majority of state-owned enterprises (SOEs) in China were privatized through ownership reforms over the last two decades. Using a comprehensive dataset of all medium and large enterprises in China between 1998 and 2013, we show that privatized SOEs continue to benefit from government support relative to private enterprises. Compared to private firms that were never state-owned, privatized SOEs are favored by low interest loans and government subsidies. These differences are more salient with the Chinese government's trillion-dollar stimulus package introduced after the 2008 global financial crisis. Moreover, both SOEs and privatized SOEs significantly under-perform in profitability compared to private firms. Nevertheless there are clear improvements in performance post-privatization. The tiger can change its stripes; however, the government's behavior seems to be sticky.

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I. Introduction

Conventional wisdom suggests that privatization of state-owned enterprises (SOEs) should reduce state favoritism, increase competition, and enhance firm performance. Summarizing the literature, Shleifer (1998) concluded that private ownership should generally be preferred to public ownership when the incentives to innovate and to contain costs are strong. Ehrlich et al. (1994) and Karpoff (2001) reached similar conclusions based on the argument that the principal of SOEs (i.e., the government) either cannot or does not choose to monitor the managers properly.

Empirical analyses, however, have produced mixed or ambiguous results. For example, DeWenter and Malatesta (2001) find that, among the 500 largest firms globally in 1975, 1985, and 1995, private enterprises have significantly lower costs and higher profits than SOEs. Yet when they examine a subsample of privatized firms, they find inconsistent results: performance increases post-privatization, while leverage and employment increase mainly pre-privatization. Market returns from privatization are positive in Hungary, Poland, and the United Kingdom but insignificant elsewhere.

One explanation for the conflicting evidence is that efficiency gains from privatization depend on a variety of internal and external factors. Internally, Shleifer and Vishny (1994) present a formal model to show that privatization enhances efficiency only if "control rights" over employment decisions are shifted to the plant manager. Externally, Vickers and Yarrow (1991) conclude that the attributes of the *environment* influence the efficiency gains from privatization. Boardman and Vining (1989) argue that studying the effects of privatization is relevant only for firms in competitive environments.

In this paper, we address two related questions. First, we examine what enterprise reform really means in the Chinese context. In China, reform generally means installing Western ownership and governance in existing state-owned or controlled enterprises. Have such reforms affected performance for former SOEs? Or do former SOEs continue to behave as if they were still state controlled? In other words, can the Chinese tiger (former SOE) change its stripes? To address this question, we associate a variety of performance measures, such as return on assets (ROA), total factor productivity (TFP) growth, and patent filings, with changes in state equity shares and changes in state control. While a number of studies have compared SOEs' performance with private enterprises—and most tend to find that SOEs perform worse—none of these papers explored whether *former SOEs* also performed worse (or as well as) private enterprises.

Second, we ask whether the environment facing former SOEs has changed. To the extent that current and former SOEs may be receiving extra support in the form of soft budget constraints—manifested often through subsidies, tax holidays, and the provision of low-interest loans—performance may be affected by a government that continues to support former SOEs in ways that may help or hurt their performance.

Using a comprehensive dataset of all medium and large enterprises in China between 1998 and 2013, we show that privatized SOEs continue to benefit from government support relative to private enterprises. Compared to private firms that were never state-owned, privatized SOEs are favored by industrial policies such as low interest loans and government subsidies. These differences are more salient with the Chinese government's trillion-dollar stimulus package introduced after the 2008 global financial crisis.

We also examine post-privatization performance. Both SOEs and former (but now private) SOEs significantly under-perform in profitability compared to private firms, suggesting a misallocation of resources. Nevertheless, there are clear improvements in performance post-privatization, especially when the performance measure is productivity or patent filings. The tiger can change its stripes; however, the government's behavior in terms of ongoing loan support is sticky.

Does this imply that Chinese SOEs can in fact be distinguished from private enterprises? The reflexive answer, on several grounds, is affirmative. Chinese SOEs have legal standing. Their ownership of many, although not all, state enterprises is transparent. Whether the enterprise's controlling shareholder, even if a minority shareholder, is state or non-state is also known. Still, there are grounds for doubt. One concern is that the registration, ownership, and nominal control of a firm may miss critical avenues of state influence, especially policies advantageous to state-owned firms and extensions of Party influence into the private sector. A further and more nuanced concern is the blurring of boundaries between the state and private interests.[2]

One clear implication of our research is the following: non-state firms that at any point in their history were state-owned are very different from non-state firms with no past experience of state ownership. These privatized enterprises, which we call "former SOEs", enjoy lower interest rates, larger loan facilities, and more subsidies while suffering poorer

[2] The blurring of boundaries involves simultaneous cooptation of private entrepreneurs by the state and state capture by private interests, the former through membership in state-sponsored industry associations and political bodies, the latter through corruption. Likely, both heavy-handed state intrusion into the private sector and more subtle forms of cooptation and capture have taken place, the consequence of which is that any simple state-private distinction based on registration, ownership, and nominal control may be of limited value.

performance than never-SOEs. Importantly, this result holds for both private firms and firms with legal-person ownership, which in the past has been treated as a stalking horse for state ownership. These results suggest that there also exists a substantial gray zone between state firms and private firms operating in the penumbra of the state. The challenge for researchers is to locate these firms more precisely and understand their role in China's rapid economic development.

Our evidence raises serious questions about the efficacy of reform initiatives when ownership changes but the environment does not. The evidence suggests that privatized SOEs could perform better if the government would also change its behavior and limit low interest loans which now favor both SOEs and former SOEs. Section II provides a brief literature review, and how this paper fits into the literature. Section III presents the data, framework for analysis and our hypotheses. Section IV presents results comparing policy treatment of SOEs, former SOEs, and private enterprises. Section V measures the impact of ownership changes on these three sets of enterprises, and Section VI concludes.

II. Literature Review

There is a large literature examining the relationship between state ownership and firm performance. Andrei Shleifer, writing in 1998 at the start of China's reform period, summarized the literature on the effects of privatization in the *Journal of Economic Perspectives*. He concluded that private ownership should generally be preferred to public ownership when the incentives to innovate and to contain costs need to be strong, especially when competition between suppliers, reputational mechanisms, and the possibility of provision by not-for-profit firms is brought into play. In essence, this is the case for the "dynamic vitality" of free enterprise. Shleifer also suggested that the pursuit by government officials of political goals

and personal income, as opposed to social welfare, further strengthens the case for private ownership. Similarly, Ehrlich et al. (1994) and Karpoff (2001) argue that public-sector ownership is always inferior to private sector ownership, because the principal (the government) either cannot or does not choose to monitor the managers properly. This approach focuses on *ownership* as the explanation for poor public-sector performance.

Consistent with the above arguments, most studies find that public-sector enterprises perform poorly relative to their private-sector counterparts. This is true both for financial performance and innovation. Boeing et al (2016) investigate the effect of different R&D activities on TFP of publicly listed Chinese firms for the time period 2001–2011. They find that privately-owned enterprises (POEs) benefit most from R&D investments. Furthermore, only POEs benefit from sophisticated R&D efforts (i.e., highly cited patented research and research in high-tech sectors). Wei et al (2017) find that although SOEs have received more subsidies from the government, their performance in innovation is lackluster compared to private enterprises. Furthermore, the elasticity of patent filings or patents granted with respect to expenditures on R&D is significantly higher for private firms than for SOEs, which suggests misallocations in public fiscal resources.

While the baseline comparison seems to be clear, other studies get mixed or ambiguous results. A typical illustration is provided by DeWenter and Malatesta (2001), who compare the 500 largest firms globally in 1975, 1985, and 1995. They find that return on asset (ROA) and return on equity (ROE) are significantly higher for private relative to public enterprises. In addition, they find that both leverage and employment to sales ratios are higher for public enterprises, consistent with the expectation that public enterprises have higher costs and lower profits. They then look at a subsample of privatized firms, where they find inconsistent results:

performance increases post-privatization, while leverage and employment increase mainly pre-privatization. Market returns from privatization are positive in Hungary, Poland, and the United Kingdom but insignificant elsewhere.

One explanation for the conflicting evidence is that efficiency gains from privatization depend on a variety of factors, including the degree of competition, the regulatory environment, the magnitude of market failure, and the administrative capabilities of the government. Peltzman (1971) questioned whether changing ownership alone can affect firm behavior. From the perspective of internal factors, Shleifer and Vishny (1994) present a formal model to show that privatization enhances efficiency only if "control rights" over employment decisions are shifted to the plant manager. From the perspective of external factors, Vickers and Yarrow (1991) conclude that the attributes of the *environment* influence the efficiency gains from privatization.

Along those lines, Boardman and Vining (1989) argue that studying the effects of privatization is relevant only for firms in competitive environments. In their review of the state of the literature, Megginson and Netter (2001) conclude that more research is needed to ". . . conclusively document whether reforms other than government divestiture can effectively serve as a substitute (or precursor) for privatization." Empirical studies have also shed light on the importance of environmental contingencies. For example, Bartel and Harrison (2003) use a 1981–1995 panel of all public and private manufacturing establishments in Indonesia and measure two important environmental factors: (1) soft budget constraints and (2) the degree of internal and external competition. They show that both changes in ownership and changes in the environment matter.

Most of the literature has focused on the question of whether SOEs perform worse in terms of innovation in China, and most tend to find that the answer is yes. However, none of these papers explored how *former SOEs* perform compared with private enterprises. The goal of this paper is to examine the performance of the same firm, before and after privatization. Doing so will allow us to tease out the effect of internal state ownership vs. external state support in the performance differences between SOEs and private enterprises.

III. Data, Framework, and Hypotheses

We begin by describing the data sources and then turn to our framework and hypotheses.

Data sources

The main source of data comes from the Annual Industrial Survey (AIS) of the National Bureau of Statistics of China. Our sample includes firm-level data of all medium and large enterprises in manufacturing-related industries from 1998 to 2013. While concerns about the quality of AIS have been raised (Brandt, Van Biesebroeck and Zhang, 2014), it remains to date the most comprehensive firm-level data in China, with a survey of all enterprises with annual revenue greater than 5 million RMB and greater than 20 million RMB beginning in 2011.[3] Notably, although the AIS has been widely utilized in recent empirical studies on China (Aghion et al., 2015; Berkowitz, Ma and Nishioka, 2016; Chen et al., 2016; Hsieh and Song, 2015; Song, Storesletten and Zilibotti, 2011), we are one of the first to substantially extend the data series after the 2008 global financial crisis. While this extension is not without the usual caveats regarding data quality, we believe it is an important step towards understanding the Chinese reform, especially intertwined with the crisis.

[3] This threshold has been changed several times throughout the sample.

We supplement the AIS data with sector-year level price indices from the Dios database to put all nominal values in constant 1998 values.[4]

Typology of firms

A critical first step in understanding the efficacy of ownership reform is to understand the ownership of firms before and after the reform. There has been disagreement in the definition of different types of firms in the literature. We propose a typology of firms that sheds light on the landscape of firm ownerships in China and provides a first step to understanding reforms.

We first group firms into two broad categories: state-owned enterprises (SOEs) and privately-owned enterprises (POEs). There are three indicators in the AIS data that suggest the ownership of a firm: state control, capital ownership shares, and registration types. State control is a categorical variable indicating whether the firm's controlling shareholder, not necessarily the majority shareholder, is state-owned, collectively owned, or anything else. We follow Hsieh and Song (2015) and define state control as a binary variable equal to one if the controlling shareholder is the state.[5] Capital ownership shares include all six sources of capital ownership amounts—state, collective, legal person, individual, foreign, and "Hong Kong, Taiwan, and Macau"—which sum to the total paid-in capital of the firm. We define a firm's state capital share as its state capital amount as a percentage of the total paid-in capital. The third indicator for firm ownership is its registration type with the government. As pointed out in Hsieh and Song (2015), the use of registration types as a measure of firm ownership suffers

[4] Throughout, sectors are defined at the two-digit sector code level, which yields 29 manufacturing sectors.

[5] The specific coding of the state control variable is as follows: 1 - state absolute control, 2 - state relative control, 3 - collective absolute control, 4 - collective relative control, 5 - others. The rule of defining state control changed in 2005: before 2005 (inclusive), control is defined to be by the state if ownership is either state absolute control (1) or state relative control (2); after 2005: control is defined to be by the state only if ownership is state absolute control (1).

from large inaccuracy and we also discard it. Following Hsieh and Song (2015), we define a firm as state-owned if state control is equal to one or the state capital share exceeds 50 percent. For robustness, Appendix tables repeat our analysis where SOE is defined as either state control being equal to one or having any positive state capital shares. All other firms are treated as privately owned. Among the private firms, we further differentiate firms with positive legal person capital as legal person-owned (LPO) as it is difficult to pin down the ultimate ownership of these capital. Table 1 summarizes the resulting distribution of firm ownership types. Note that the number of LPO firms, by our definition, fluctuated over time and comprised nearly 35 percent of total firms in 2013.

SOE reforms

We now describe the privatization reform of SOEs in China during our sample period. Figure 1 tracks the government's aggressive reform agenda since 1998 - while the majority of SOEs exited, privatized SOEs in 2013 account for 15% of the number of firms in 1998. SOEs in 2013 only constitute 23% of the number of SOEs in 1998.

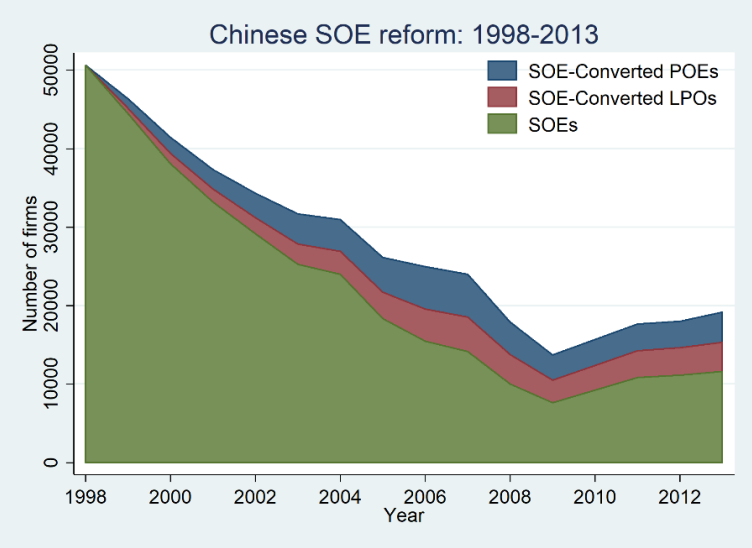

Figure 1: Number of SOEs and Privatized SOEs

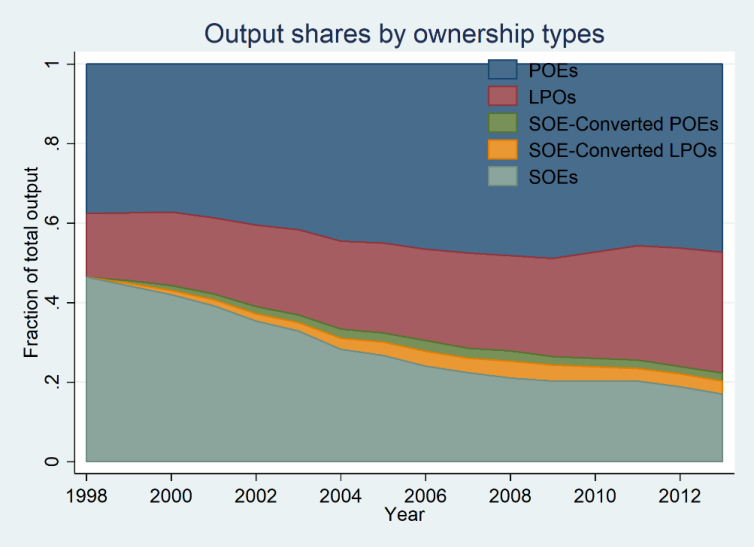

Figure 2: Output Shares of SOEs, Former SOEs, and Always POEs

These SOEs and privatized SOEs constitute a large portion of the Chinese economy measured by their total output value (Figure 2). Comparing the two panels, we can see that the average size of privatized SOEs is smaller than the average of those who remained SOEs, reflecting the "grasping the large, letting go of the small" policy.

Empirical Framework and Hypotheses

In our analysis, we will estimate if government policies and firm performance vary with ownership differences. We will focus on the difference between SOEs, former SOEs, and always POEs. We will also separately estimate the role of LPO enterprises for those that have always had LPO status and those that shifted from SOE status to LPO status, due to early evidence suggesting that state and LPO ownership are indistinguishable in terms of their impact on firm performance (Wang, Xu, and Zhu, 2004). Consequently, we will separately measure the impact of five ownership categories: always private, always SOE, always LPO, former SOE now private, and former SOE now LPO. We do not include other categories, e.g., from private to SOE, because they are negligible in our sample period.

To test the hypothesis that policies or performance are affected by ownership, we estimate the following equation:

$$Outcome_{ijt} = a_0 + \sum_{n=1}^{5} a_n Ownership_{ijt} + a_6 Z_{ijt} + f_i + D_t + \epsilon_{ijt}$$

Our primary outcome variables are a set of environment measures including interest subsidies and loans, as well as output subsidies. Our performance measures include both financial as well as economic measures of performance. These include ROA, TFP growth, and patent filings. Controls Z include firm level controls as well as sector level j controls such as the share of foreign investment in the sector, export orientation of the sector, and tariffs. The firm fixed effect is captured by f_i, and D_t represents year dummies.

We test two main hypotheses regarding the impact of ownership in the Chinese context. Our first hypothesis is regarding the impact of government support in the form of loans and subsidies. This hypothesis explores the role of the environment and how it differs by ownership categories:

Hypothesis 1a: Allocation of government support in the form of subsidies, tax breaks or low interest loans favors both SOEs and former SOEs.

Hypothesis 1b: Allocation of government support in the form of subsidies, tax breaks or low interest loans favors SOEs but not former SOEs

Our second hypothesis explores the impact of *privatization—moving from public ownership to private ownership*—on performance:

Hypothesis 2a: Privatization is associated with better performance for the same firm.

Hypothesis 2b: Privatization leads former SOEs to behave like private enterprises.

Hypothesis 2c: Privatization leads former SOEs to improve performance, but they still perform worse than their always privately-owned peers.

We test these two sets of hypotheses in the remainder of this paper. Section IV reports our tests of Hypotheses 1a and 1b while Section V reports tests of Hypotheses 2a, 2b, and 2c.

IV. Government Policies vis-à-vis SOEs, privatized SOEs, and always POEs.

We compare government policies towards SOEs, privatized SOEs, and always POEs to test if there exists any policy favoritism towards SOEs and if so, whether such favoritism persists after privatization. These policies include financing policies (loan amounts and interest rates) and government subsidies. We begin with visual images and then move to econometric evidence to establish statistical significance and magnitudes. We also compare how these policy biases (if they exist) responded in the 2008 global financial crisis, during which the Chinese government issued a trillion-dollar stimulus package in the form of low-interest loans.

Interest rates on loans

Access to low-interest loans and other financing options are important for the growth of small firms (Song, Storesletten and Zilibotti, 2011). Figure 3 gives a first look at the average interest rates paid by different types of firms in China. Interest rates are defined as annual interest payment divided by the firm's current liabilities. Figure 3 makes it clear that even without controlling for firm heterogeneity, (always) private firms pay much higher interest rates than private firms that were formerly state-owned. Before the 2008 crisis, the difference was over one percentage point (100 basis points) more in interest rates for private firms relative to former SOEs. This difference not only persists over time but also widened after 2008 to two percentage points (200 basis points). In contrast, the difference between SOEs and privatized SOEs is

somewhat smaller. Interest rates for privatized SOEs are still 100 basis points higher than those paid by SOEs, but the difference did not change significantly over time. Note also that the *highest* interest rates are paid by LPOs that were never SOEs.

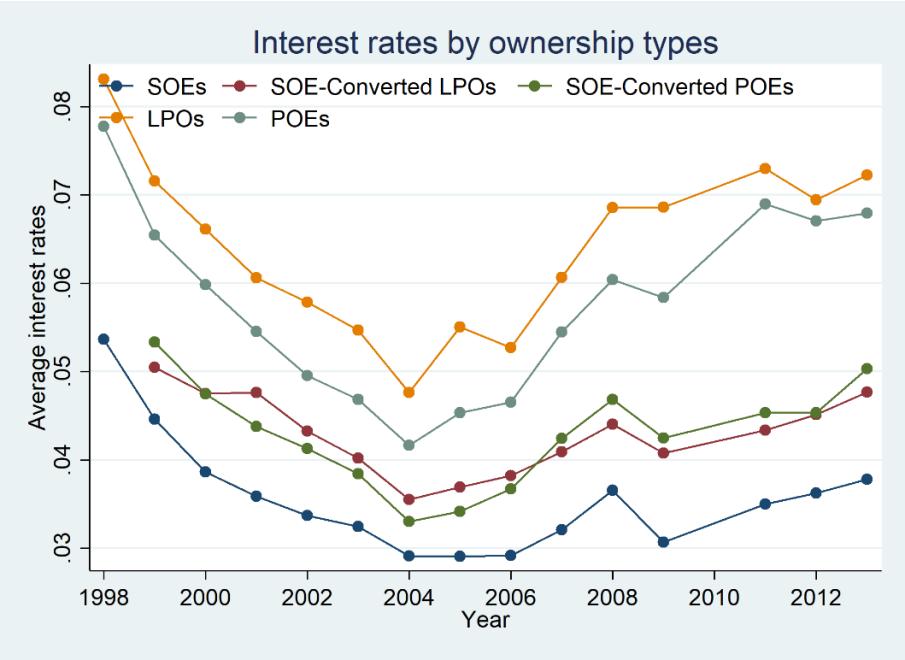

Figure 3: Interest Rates: SOEs, Privatized SOEs, and Always POEs

Volume of Loans

We next compare the volume of loans by ownership category. Loan volumes are defined as current liabilities divided by firm output. The story is similar to the interest rate trends, as illustrated in Figure 4. Current SOEs have the highest ratio of liabilities to output, although the ratio declined dramatically over the sample period. Private enterprises have historically had a much lower loan ratio, and that ratio has declined only slightly. Former SOEs sit squarely between the two extremes, with loan ratios above the private sector but below SOEs. One interesting parallel with interest rates is the reversal in declining loan ratios with the financial crisis. Both SOEs and former SOEs show a reversal, while the uptick in loan ratios for private

enterprises is much more muted. With respect to the volume of loans, POEs and LPOs, whether or not former SOEs, are indistinguishable.

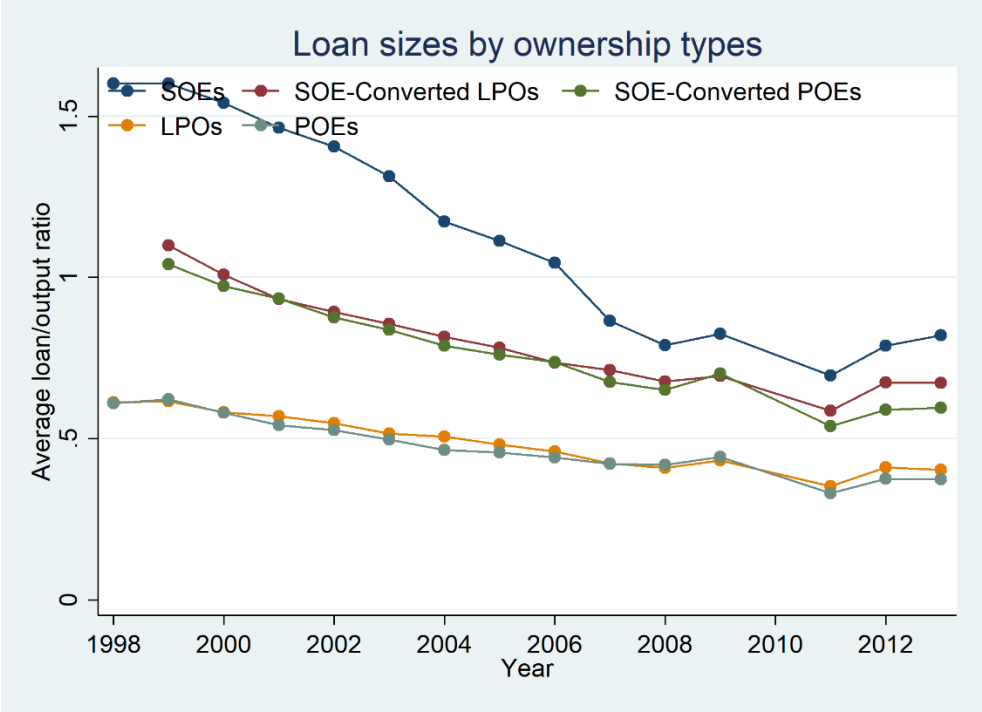

Figure 4: Volume of Loans: SOEs, Privatized SOEs, and Always POEs

Subsidies

We conclude this section with an examination of the allocation of subsidies. Figure 5 (left) shows the fraction of different ownership classes receiving some subsidies from the state. The results are again consistent with former SOEs occupying a grey area in between actual SOEs and always POEs. POEs have the lowest percentage of firms receiving subsidies, with the percentage climbing from above 5 percent in 1998 to over 15 percent in 2013. SOEs receive the highest fraction of support, with the percentage rising from nearly 15 percent in 1998 to a whopping 45 percent in 2013. Former SOEs are between these two extremes, with less than 15 percent receiving subsidies in 1998 and between 25 and 35 percent in 2013. Similar results show in the amounts of subsidies received by firms with different ownership classes as well in

Figure 5 (right). With respect to subsidies in proportion to output, POEs and LPOs, whether or not former SOEs, are again indistinguishable.

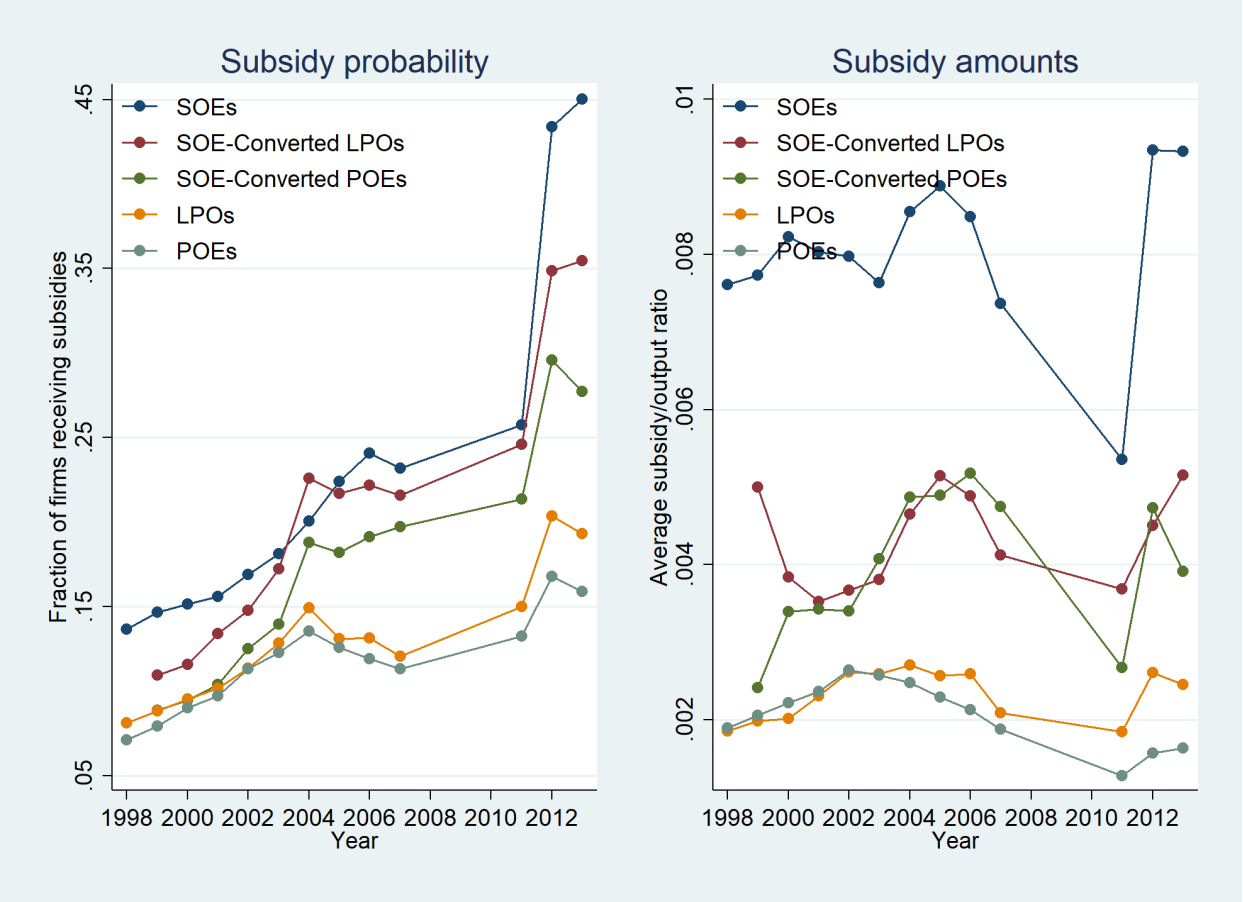

Figure 5: Subsidies: SOEs, Privatized SOEs, and Always POEs

Quantifying the differences

Tables 2 and 3 provide regression analysis that confirms the broad trends outlined in the previous figures. In Table 2 we see that relative to SOEs, private firms, whether POEs or LPOs, paid interest rates of up to 270 basis points higher (column 2, rows 3 and 4, Table 2) and widened over time (column 4, rows 8 and 9, Table 2). However, former SOEs paid rates that were only 70 basis points higher, indicating that they were significantly favored relative to the private sector (column 2, rows 1 and 2, Table 2). While interest costs fell for all firms post-

crisis (column 6, row 5, Table 2), the discount was again much steeper for SOEs and former SOEs than private enterprises (column 6, rows 13 and 14, Table 2). Columns 3, 5 and 7 compare interest rates across ownership types within firms (e.g., firms changing from private to SOE to former SOE). Differences in interest rates are smaller (26 basis points) but significant and driven primarily by post-crisis differential treatment (column 7, rows 11-14, Table 2).

Table 3 presents results where the dependent variable is not implicit interest rates paid but loan quantities allocated to enterprises. As in Figure 4, loans are defined as current liabilities divided by the value of output. The second column of Table 3 indicates that private enterprises received 72 (LPOs) to 74 (POEs) percent less loans (as a share of output) than SOEs. Privatized SOEs fared slightly better, receiving 45 percent less loans than SOEs. Over time, however, the spread between loan allocations to SOEs and other establishments has narrowed, as reflected in the positive differential trend in loans for LPOs and POEs in column 4. Over the entire period, the gap in loans between SOEs and private enterprises declined over time by 5 percent annually. Both privatized SOEs and always private enterprises received more loans to catch up with SOEs post-crisis. Controlling for firm fixed effects again shows more muted relationships: SOEs received slightly more loans than private enterprises and former SOEs, and the gap narrowed post-crisis.

Table 4 shows differences in the amounts of subsidies received across ownership types. On average, private enterprises received 5500 RMB less than SOEs in subsidies for each million RMB in the value of their output annually, whereas former SOEs received 3600 RMB less than SOEs (column 2, rows 1-4, Table 4). This gap narrows between SOEs and former SOEs but further widens for private enterprises during the sample period (column 4, rows 6-9, Table 4). Post crisis, SOEs and former SOEs received similarly more subsidies, while private

enterprises received much less to no additional subsidies than before (column 6, rows 10-14, Table 4). These results persist after controlling for firm fixed effects although magnitudes are smaller.

To summarize, the evidence suggests that current SOEs were heavily favored over the sample period in terms of interest rate terms, loan amounts, and subsidies. POEs and LPOs that were formerly SOEs fell in between the two groups, with more favorable treatment than establishments that were always private but less favorable treatment than current SOEs. We now shift from government treatment to evaluating performance differentials.

V. Performance Comparisons: ROA, TFP, and Patent Filings.

Return on Assets

Figure 6 shows ROA for our five categories of enterprises, where ROA is defined as total profits divided by total assets.

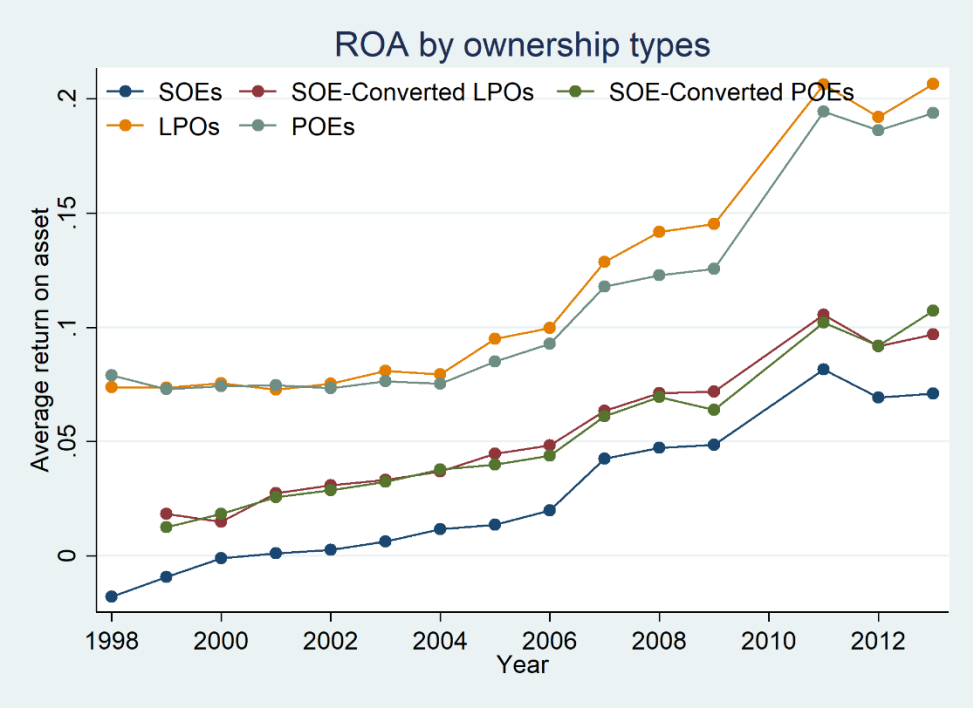

Figure 6: ROA: SOEs, Privatized SOEs, and Always POEs

At the beginning of the sample period, SOEs had on average a negative ROA but it quickly shifted to positive after two years. All groups of enterprises have experienced rising ROAs, but both the levels and the growth rates have been higher for private enterprises. Beginning in 2004, ROAs in the private sector increased even more rapidly, leading the already sizable gap of nearly 10 percentage points to increase even more. Former SOEs were again in between the two extremes, exhibiting slightly higher returns than SOEs but significantly lower than purely private enterprises. The ROAs of POEs and LPOs, whether or not former SOEs, are indistinguishable.

Table 5 presents econometric evidence confirming the observations in Figure 6 and decomposing the differences in profitability into contributions of government treatment and ownership types. The bottom of Table 5 shows a complex relationship between soft budget constraints and firm profitability. Profitability declines with loan amounts and increases with direct subsidies, neither surprising. However, and nearly unique to China, higher interest rates are associated with higher profitability, likely due to the disproportionate flow of near benchmark-rate commercial bank loans to low-performing SOEs.[6] After controlling for the differential government treatment, private enterprises still exhibited ROAs that were 3 percentage points higher than SOEs, whereas former SOEs showed slightly lower ROAs (column 2, rows 1-4, Table 5). Post crisis, profitability increased more for private enterprises

[6] While we have no data on the identity of lenders, the following from Hachem (2018: 302) is apt: "State-owned firms in China can borrow at rates much closer to the benchmark because of government support, so it stands to reason that trust companies are lending [at approximately 2.5 percentage points above benchmark rates] to private firms that are still financially repressed and/or local governments that may not be very sensitive to interest rates. Trusts also have to reach for higher yields because the WMPs to which they are linked exceed the deposit rate ceiling, a spread that reflects the shadow cost of the liquidity regulation to the sponsoring bank."

than former SOEs, who also became increasingly more profitable than SOEs (column 6, rows 10-14, Table 5). Similar results remain after controlling for firm fixed effects.

Productivity Comparisons

In the remainder of the paper, we focus on two other measures of performance, using either productivity growth or patent filings. Unfortunately, the Chinese Census Bureau stopped making intermediate input purchases available after 2007, so we are not able to calculate TFP after 2007. All our research on productivity growth presented in this paper consequently only covers the period 1998 through 2007. For discussions regarding how TFP is calculated, the reader is referred to Aghion et al (2015), or Du, Jefferson and Harrison (2014). We employ two approaches to measure TFP growth. The first approach estimates a production function with firm fixed effects and then calculates the productivity residual after subtracting share weighted inputs from total output. The second approach, taken from Olley and Pakes (1996), employs a similar approach but adjusts for complications such as the endogeneity of input choice. The results are consistent across the different methodologies for calculating TFP.

Table 6 begins with the full unbalanced panel. We separate ownership into two effects, "*stateshare*," which varies between 0 and 100 and indicates the percentage of equity owned by the state, and "*statecontrol*," which is the dummy variable coded 1 for state control. We also control for a number of other factors that affect productivity, such as tariff rates in inputs, outputs, and downstream sectors, foreign investment in the sector, export orientation of the sector, and whether the establishment receives interest subsidies ("index_interest"), tax breaks ("index_tax"), or subsidies ("index_subsidy"). We also include both establishment fixed effects and year effects in all specifications, so we are effectively measuring what drives productivity growth, not productivity levels.

In Table 6, we see that the coefficients on both *stateshare* and *statecontrol* are significant and negative. This indicates that moving to private ownership either through equity holdings or releasing state control raises productivity growth at the enterprise level. For *stateshare*, the coefficient of -0.0147 in the first column indicates that productivity growth increases by 1.47 percent when *stateshare* moves from 100 to 0. The coefficient on *statecontrol* is slightly higher, indicating that productivity growth would rise by nearly 2 percentage points if control were to shift to the private sector.

Tables 7 and 8 repeat the same exercise but only retain establishments that were present across all years. There are very few enterprises that were present across all years, leading to a 90% drop in sample size. When we restrict the sample to only these enterprises, neither *stateshare* nor *statecontrol* are generally significant. The only exception is when we restrict the sample to only exporting enterprises, defined as those with some share of output exported abroad. In that case, the coefficient on *statecontrol*, but not *stateshare*, is significant and negative. In Table 8 we keep the same sample but interact *statecontrol* and *stateshare*. In this specification, the interaction is significant and negative. We hypothesize that the coefficient is not significant in Table 7 due to a high degree of multicollinearity in the balanced panel between ownership and equity participation.

Impact of former SOE status

Table 9 explores the impact of being a former SOE on both productivity and resource allocations using the shorter 1998-2007 sample. The results in columns (1) and (2) measure the impact of having been an SOE on productivity growth. The coefficient on *former SOE* is not statistically significant, indicating that POEs that were once SOEs grow neither more nor less quickly than their private counterparts. The tiger can change his stripes, particularly when it

comes to the impact of ownership on productivity growth. State share and state ownership are both associated with poorer productivity growth, as reported in Tables 7 and 8.

The last four columns of Table 9 are robustness checks on our earlier estimates testing for the impact of ownership on allocation of tax breaks, subsidies, and low-interest loans. The results indicate that former SOEs are significantly more likely to benefit from low-interest loans relative to their private sector counterparts.

Patent Filings

Finally, we turn to patent activities during a shorter sample of 1998-2009, where we obtain firms' patent filings data from He, Tong, Zhang, and He (2016). During this time, innovation activities have significantly increased in China both in the number of firms filing at least one patent annually and the number of patents filed per firm. We explore differences in patent filings across ownership types.

Table 10 illustrates our findings in total patent filings (including utility, invention and design patents). Columns 1-4 compare the number of firms that file at least one patent in a year across ownership types, weighted by firm sizes (total assets). On average, private enterprises are 30 percent more likely to file a patent in a year than SOEs per each million RMB in total assets (average total assets are about 0.1 million RMB), whereas former SOEs are 23 to 26 percent more likely than SOEs to file a patent (column 1, rows 1-4, Table 10). Results are similar for the number of patents shown in columns 5-8: Private enterprises filed 0.5 to 0.8 more patents a year than SOEs and former SOEs per each million RMB in total assets (column 5, rows 1-4, Table 10). The gaps between private enterprises and SOEs (as well as former SOEs) in both likelihood of patenting and patenting intensity have narrowed over time. Results are similar after controlling for firm fixed effects though less precisely estimated.

Closing the Soft Budget Constraints Gap

Our evidence in Tables 9 and 10 demonstrates that both ownership and the environment facing former SOEs—namely the provision of soft budget constraints—affect firms' performance in ROA and patent filings. Furthermore, the previous section suggests that former SOEs still receive extra support in the form of these soft budget constraints when compared to always POEs, and thus can further benefit from closing the gap in the environment they face.

We decompose the effect of ownership changes and potential gains from further closing the soft budget constraints gap. First, note that changing ownership status from SOE to former SOE has a direct effect on performance as well as an indirect effect through the interest rates, loan size, and subsidy amount that the firm receives. Consider, for example, LPOs that were formerly SOEs. Using the specification with year and sector fixed effects (column 2, Tables 2-5), LPO privatization leads to slightly lower ROA of -0.35 percentage points but higher ROA of 69.1/10000*44.621=0.308 percentage points (through interest rate), (-44.494)/100*(-4.285)=1.907 percentage points (though loan size), and (-3546.9)/1000000*2.857=-0.01 percentage points (through subsidy amount)—a total of 1.855 percentage points. Further closing the soft budget constraints gap for the LPOs that were formerly SOEs would increase its ROA by (271.17-69.1)/10000*44.621=0.902 percentage points (through interest rate), -(72.392-44.494)/100*(-4.285)=1.195 percentage points (through loan size), and -(5363.9-3546.9)/1000000*2.857=-0.005 percentage points (through subsidy amount)—a total of 2.092 percentage points. The results for POE privatization parallel those for LPOs. Table 11 in the Appendix presents decompositions of the potential gains from privatization on ROA and patent filings for LPOs and POEs separately—note that median total assets is about RMB 100 million. These results suggest that closing the soft budget constraints gap for former SOEs can achieve a

substantial gain (an additional 104%-113%) in ROA and a modest gain (an additional 8.6%-9.6%) in patent likelihood. The results on ROA, in particular, suggest that the full benefits of privatization of former SOEs have yet to be achieved.

VI. CONCLUSION

Privatization has been a crucial part of economic form in China. However, we have limited understanding how privatization change the performance of privatized companies, as privatization changes two conditions at the same time. On the one hand, ownership change may lead to stronger incentives for innovation and budget control. On the other hand, the privatized firm may lose the privileged treatment it once enjoys. So net outcomes are not clear. Using a comprehensive dataset of all medium and large enterprises in China between 1998 and 2013, spanning the stimulus package following the 2008 financial crisis, we show that privatized SOEs continue to benefit from government support relative to private enterprises, receiving low interest loans and government subsidies, especially after 2008. Moreover, both SOEs and privatized SOEs significantly under-perform in profitability compared to private firms, despite some improvements in performance post-privatization. We also found, contrary to earlier research, that firms with legal-person shareholders behave like other private firms—LPOs are not stalking horses for SOEs. In sum, the tiger can change his stripes—performance outcomes improve post-privatization. However, the government's behavior seems to be quite sticky—former SOEs retain ready access to large loans, concessionary interest rates, and outright subsidies.

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Table 1: Number of Firms by Ownership Types

Year	State owned	Privately owned		Total
		LPO	POE	
1998	50655	22868	66355	139878
1999	44437	24267	66428	135132
2000	38068	27506	70938	136512
2001	33215	31674	81473	146362
2002	29177	35436	92983	157596
2003	25291	43605	107483	176379
2004	23989	62896	163013	249898
2005	18343	64019	155513	237875
2006	15493	71880	176882	264255
2007	14178	89829	205228	309235
2008	10018	66256	152768	229042
2009	7634	53340	122129	183103
2011	10844	90965	172043	273852
2012	11143	99814	175472	286429
2013	11627	109608	196445	317680

Notes: 2010 data are omitted. SOEs are firms that either have state control or have state capital shares greater than 50%. All other firms are treated as privately owned. LPOs are firms with positive legal person capital shares. Other privately owned firms are POEs.

Table 2: Relationship between Ownership Categories and Implicit Interest rates

	1	2	3	4	5	6	7
SOE-Converted LPO	33.81***	69.10***	-9.6	146.03***	28.22**	86.58***	3.49
	6.4	6.39	6.86	15.04	14.12	7.7	7.78
SOE-Converted POE	30.64***	66.81***	-5.13	109.45***	28.35**	73.69***	5.5
	5.8	5.8	6.55	12.82	12.37	6.71	7.15
LPO	255.44***	271.17***	26.31***	269.36***	-52.79***	262.39***	-8.4
	2.5	2.63	6.63	4.47	8.09	2.95	6.82
POE	187.55***	218.06***	25.91***	198.41***	-51.67***	201.82***	-3.64
	2.28	2.42	6.68	3.76	7.96	2.63	6.87
Trend				-8.13***	-15.33***		
				0.52	0.61		
Trend: SOE-Converted LPO				-7.71***	1.12		
				1.6	1.46		
Trend: SOE-Converted POE				-4.28***	1.62		
				1.45	1.35		
Trend: LPO				1.25**	12.09***		
				0.59	0.71		
Trend: POE				3.28***	11.99***		
				0.54	0.66		
Post 2008						-174.11***	-211.26***
						7.22	7.6
Post 2008: SOE-Converted LPO						-0.9	64.65***
						14.26	12.48
Post 2008: SOE-Converted POE						19.48	67.01***
						13.66	11.95
Post 2008: LPO						80.12***	153.08***
						7.03	7.27
Post 2008: POE						100.76***	139.93***
						6.73	6.98
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				2000614			

Notes: Dependent variable is interest rates measured by interest payment divided by current liabilities in basis points (0.01 percentage points). *** p<0.01, ** p<0.05, * p<0.1

Table 3: Relationship between Ownership Categories and Loans

	1	2	3	4	5	6	7
SOE-Converted LPO	-55.416***	-44.494***	-6.157***	-62.310***	-4.929***	-48.626***	-6.347***
	0.437	0.436	0.418	1.06	0.894	0.525	0.477
SOE-Converted POE	-56.810***	-46.542***	-10.112***	-61.393***	-6.407***	-50.019***	-9.735***
	0.397	0.396	0.4	0.907	0.785	0.459	0.44
LPO	-84.859***	-72.392***	-3.229***	-100.538***	-2.988***	-78.915***	-3.994***
	0.17	0.178	0.391	0.31	0.488	0.199	0.403
POE	-85.661***	-74.304***	-3.542***	-101.323***	-2.405***	-80.381***	-4.275***
	0.156	0.164	0.393	0.263	0.479	0.178	0.405
Trend				-6.400***	0.694***		
				0.036	0.038		
Trend: SOE-Converted LPO				3.923***	-0.198**		
				0.112	0.091		
Trend: SOE-Converted POE				3.524***	-0.491***		
				0.102	0.084		
Trend: LPO				5.104***	-0.056		
				0.04	0.043		
Trend: POE				5.005***	-0.160***		
				0.037	0.04		
Post 2008						-70.354***	5.735***
						0.492	0.456
Post 2008: SOE-Converted LPO						35.626***	2.817***
						0.971	0.755
Post 2008: SOE-Converted POE						32.564***	0.952
						0.927	0.722
Post 2008: LPO						42.541***	3.233***
						0.473	0.43
Post 2008: POE						41.745***	3.177***
						0.454	0.413
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				3166862			

Notes: Dependent variable is loan amount measured by current liabilities divided by total output in percentage points.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Comparing Subsidies Received Across Ownership Categories

	1	2	3	4	5	6	7
SOE-Converted LPO	-3605.9***	-3546.9***	39.3	-4219.2***	-158.1	-3652.9***	60.1
	123.2	124.1	137.6	275.2	278.9	139.2	150.9
SOE-Converted POE	-3722.1***	-3727.5***	-298.4**	-4405.1***	-373.2	-3696.8***	-201.3
	109.6	110.4	128.8	237	245.9	120.1	136.9
LPO	-5627.5***	-5363.9***	-450.6***	-5581.7***	-421.3***	-5432.2***	-392.8***
	44.7	47.1	125.9	78.9	152.7	50.4	128.7
POE	-5917.6***	-5592.8***	-447.5***	-5220.4***	-263.7*	-5491.0***	-350.6***
	40	42.7	126.7	66.4	149.7	44.7	129.5
Trend				48.1***	45.2***		
				10.3	12.5		
Trend: SOE-Converted LPO				68.3**	14.9		
				32.2	31.3		
Trend: SOE-Converted POE				77.1***	0.2		
				29.8	29.1		
Trend: LPO				10.7	-5.8		
				11.7	14.5		
Trend: POE				-65.7***	-26.6**		
				10.7	13.4		
Post 2008						774.7***	954.4***
						156.8	176.6
Post 2008: SOE-Converted LPO						94.9	-526.4*
						319.5	306.7
Post 2008: SOE-Converted POE						-512.8	-942.7***
						313.9	300.1
Post 2008: LPO						-155.5	-433.0**
						156.3	177.9
Post 2008: POE						-859.3***	-622.2***
						150.2	170.3
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				2445945			

Notes: Dependent variable is the amount of subsidies received per $1 million firm output. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Comparing Return on Assets across Ownership Categories

	1	2	3	4	5	6	7
SOE-Converted LPO	1.591***	-0.350**	-1.012***	0.755**	1.158***	-0.107	-0.437***
	0.153	0.152	0.153	0.328	0.3	0.171	0.167
SOE-Converted POE	0.987***	-0.496***	-0.450***	0.336	1.193***	-0.379***	-0.03
	0.136	0.136	0.143	0.283	0.265	0.147	0.151
LPO	5.148***	3.238***	0.920***	2.021***	-1.366***	2.957***	0.131
	0.06	0.062	0.145	0.099	0.172	0.066	0.147
POE	5.007***	3.433***	1.196***	1.735***	-1.415***	2.859***	0.315**
	0.054	0.056	0.146	0.084	0.169	0.059	0.148
Trend				0.359***	0.220***		
				0.013	0.014		
Trend: SOE-Converted LPO				-0.006	-0.072**		
				0.039	0.034		
Trend: SOE-Converted				0.004	-0.014		
				0.036	0.032		
Trend: LPO				0.293***	0.403***		
				0.015	0.016		
Trend: POE				0.358***	0.453***		
				0.013	0.015		
Post 2008						4.969***	3.673***
						0.193	0.199
Post 2008: SOE-Converted LPO						1.895***	1.681***
						0.388	0.341
Post 2008: SOE-Converted POE						1.563***	1.707***
						0.388	0.338
Post 2008: LPO						4.322***	5.231***
						0.193	0.203
Post 2008: POE						5.559***	5.810***
						0.185	0.193
Interest rate	45.280***	44.621***	19.842***	44.566***	19.724***	44.530***	19.698***
	0.186	0.185	0.217	0.185	0.217	0.185	0.217
Loan size	-4.618***	-4.285***	-2.637***	-4.323***	-2.632***	-4.312***	-2.641***
	0.019	0.019	0.025	0.019	0.025	0.019	0.025
Subsidy amount	4.274***	2.857***	18.454***	3.253***	18.492***	3.195***	18.562***
	0.898	0.888	0.953	0.888	0.953	0.888	0.953
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				1504468			

Notes: Dependent variable is return on asset measured as total profits divided by total assets in percentage points.
*** p<0.01, ** p<0.05, * p<0.1

Table 6
Unbalanced Panel for 1998 through 2007
Dependent Variable is Productivity
Includes Firm Fixed Effects and Time Effects in All specifications

VARIABLES	(1) TFP_OP_all	(2) TFP_olsFE_all	(3) TFP_OP_all	(4) TFP_olsFE_all
cic_change	-0.0182***	-0.0197***	-0.0167***	-0.0179***
	(0.00139)	(0.00121)	(0.00139)	(0.00121)
index_subsidy			0.00910***	0.0129***
			(0.00135)	(0.00129)
index_tax			0.0244***	0.0253***
			(0.000952)	(0.000938)
index_interest			-0.0120***	-0.0141***
			(0.00106)	(0.000981)
exportshare_sector	0.612***	0.336***	0.695***	0.380***
	(0.0418)	(0.0341)	(0.0446)	(0.0404)
stateshare	-0.0147***	-0.0154***	-0.0139***	-0.0143***
	(0.00295)	(0.00285)	(0.00292)	(0.00283)
ownership	-0.0189***	-0.0171***	-0.0184***	-0.0164***
	(0.00376)	(0.00363)	(0.00373)	(0.00362)
horizontal	0.143***	0.270***	0.192***	0.251***
	(0.0386)	(0.0341)	(0.0387)	(0.0344)
backward	0.775***	1.919***	1.057***	2.236***
	(0.153)	(0.111)	(0.148)	(0.111)
forward	0.520***	0.527***	0.522***	0.503***
	(0.0368)	(0.0208)	(0.0398)	(0.0232)
lnTariff			0.0193***	-0.00895**
			(0.00419)	(0.00370)
lnbwTariff			-0.0742***	-0.111***
			(0.0119)	(0.0109)
lnfwTariff			-0.115***	0.0998***
			(0.0173)	(0.0147)
Observations	1,195,731	1,195,731	1,159,527	1,159,527
R-squared	0.164	0.184	0.170	0.191
N	381,279	381,279	372,845	372,845

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7
Balanced Panel for 1998 through 2007
Last 4 columns are for only exporting enterprises

VARIABLES	(1) TFP_OP	(2) TFP_olsFE	(3) TFP_OP	(4) TFP_olsFE	(5) TFP_OP	(6) TFP_olsFE
index_subsidy	0.00934***	0.0120***			0.00684	0.0105**
	(0.00263)	(0.00270)			(0.00506)	(0.00443)
index_tax	0.0182***	0.0185***			0.0238***	0.0239***
	(0.00199)	(0.00204)			(0.00406)	(0.00381)
index_interest	-7.54e-05	-0.00133			0.00884*	0.00697
	(0.00220)	(0.00226)			(0.00498)	(0.00434)
exportshare_sector	0.370***	0.409***			0.446***	0.224***
	(0.0599)	(0.0633)			(0.0710)	(0.0719)
stateshare	-0.00422	-0.00534	-0.0124	-0.0177	-0.0107	-0.0141
	(0.00612)	(0.00616)	(0.0128)	(0.0117)	(0.0116)	(0.0108)
ownership	-0.00457	-0.00443	-0.0302**	-0.0290**	-0.0166	-0.0156
	(0.00704)	(0.00720)	(0.0141)	(0.0140)	(0.0119)	(0.0125)
horizontal	0.108	0.168**			0.180*	0.221**
	(0.0660)	(0.0702)			(0.103)	(0.0958)
backward	2.468***	2.623***			2.064***	3.058***
	(0.333)	(0.354)			(0.454)	(0.393)
forward	0.251***	0.253***			0.580***	0.578***
	(0.0892)	(0.0906)			(0.113)	(0.0619)
lnTariff	-0.0484***	-0.0509***			-0.000548	-0.0105
	(0.00562)	(0.00585)			(0.0120)	(0.0101)
lnbwTariff	-0.0571***	-0.0610***			0.0950**	0.00350
	(0.0154)	(0.0167)			(0.0409)	(0.0359)
lnfwTariff	-0.125***	-0.141***			-0.361***	-0.121**
	(0.0228)	(0.0246)			(0.0669)	(0.0520)
Observations	84,775	84,775	24,494	24,494	24,322	24,322
R-squared	0.541	0.524	0.343	0.406	0.402	0.465
N	8,567	8,567	3,984	3,984	3,969	3,969

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8
Balanced Panel for 1998 through 2007
Combining Ownership Control and State Equity in one variable = Ownership*Stateshare

	All Observations in Balanced Panel		Only Exporters in Balanced Panel	
	(1)	(2)	(3)	(4)
VARIABLES	TFP_OP_all	TFP_olsFE_all	TFP_OP_all	TFP_olsFE_all
index_subsidy	0.00572*	0.0111***	0.00668	0.0104**
	(0.00347)	(0.00324)	(0.00507)	(0.00444)
index_tax	0.0193***	0.0198***	0.0238***	0.0239***
	(0.00234)	(0.00230)	(0.00406)	(0.00381)
index_interest	-0.000608	-0.00421	0.00902*	0.00710
	(0.00296)	(0.00272)	(0.00499)	(0.00435)
exportshare_sector	0.837***	0.475***	0.446***	0.224***
	(0.0883)	(0.0881)	(0.0710)	(0.0719)
Horizontal	0.216***	0.269***	0.182*	0.222**
	(0.0705)	(0.0649)	(0.103)	(0.0959)
Backward	1.118***	2.308***	2.062***	3.057***
	(0.273)	(0.217)	(0.455)	(0.394)
forward	0.515***	0.473***	0.580***	0.578***
	(0.0816)	(0.0475)	(0.113)	(0.0620)
lnTariff	-0.00532	-0.0275***	-0.000472	-0.0104
	(0.00836)	(0.00757)	(0.0120)	(0.0101)
lnbwTariff	-0.0823***	-0.152***	0.0952**	0.00347
	(0.0245)	(0.0229)	(0.0410)	(0.0359)
lnfwTariff	-0.159***	0.1000***	-0.361***	-0.122**
	(0.0337)	(0.0296)	(0.0669)	(0.0520)
Ownership*Stateshare	-0.0142**	-0.0185***	-0.0196*	-0.0262**
	(0.00685)	(0.00664)	(0.0113)	(0.0107)
Constant	1.946***	1.736***	2.186***	2.128***
	(0.0735)	(0.0623)	(0.144)	(0.113)
Observations	84,775	84,775	24,322	24,322
R-squared	0.362	0.400	0.402	0.465
Number of idnew	8,567	8,567	3,969	3,969

Robust standard errors in parentheses. All specifications include time effects and firm fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table 9

Behavior of Former SOEs and Government Support 1998 through 2007

VARIABLES	(1) TFP_OP_all	(2) TFP_olsFE_all	(3) index_tax	(4) index_subsidy	(5) index_interest	(6) index_interest
cic_change	-0.0167***	-0.0179***	-0.00237	-0.00979***	0.0236***	0.0234***
	(0.00139)	(0.00121)	(0.00151)	(0.000860)	(0.00128)	(0.00128)
index_subsidy	0.00910***	0.0129***				
	(0.00135)	(0.00129)				
index_tax	0.0244***	0.0253***				
	(0.000952)	(0.000938)				
index_interest	-0.0120***	-0.0141***				
	(0.00106)	(0.000981)				
exportshare_sector	0.695***	0.380***	0.00768	0.0580***	-0.0430*	-0.0448*
	(0.0446)	(0.0404)	(0.0268)	(0.0144)	(0.0236)	(0.0236)
stateshare	-0.0139***	-0.0144***	-0.0257***	0.00414	-0.0102***	-0.0105***
	(0.00291)	(0.00283)	(0.00405)	(0.00299)	(0.00353)	(0.00355)
ownership	-0.0179**	-0.0208**	-0.0120	-0.0113	0.0337***	0.0346***
	(0.00841)	(0.00813)	(0.0118)	(0.00918)	(0.0101)	(0.0102)
Former SOE	0.000571	-0.00513	-0.00321	-0.0116	0.0680***	0.0688***
	(0.00907)	(0.00873)	(0.0129)	(0.00995)	(0.0110)	(0.0111)
horizontal	0.192***	0.251***	0.0404	-0.00515	-0.0135	-0.0111
	(0.0387)	(0.0343)	(0.0285)	(0.0195)	(0.0254)	(0.0263)
backward	1.057***	2.235***	-0.122*	-0.00551	-0.786***	-0.812***
	(0.148)	(0.111)	(0.0716)	(0.0488)	(0.0698)	(0.0734)
Forward	0.522***	0.503***	-0.00407	0.00389	-0.0988***	-0.0907***
	(0.0398)	(0.0232)	(0.0159)	(0.0110)	(0.0138)	(0.0144)
lnTariff	0.0193***	-0.00896**	0.0117***	0.00515**		0.00919***
	(0.00419)	(0.00370)	(0.00340)	(0.00245)		(0.00285)
lnbwTariff	-0.0742***	-0.111***	-0.00806	-0.00342		0.00350
	(0.0119)	(0.0109)	(0.00777)	(0.00446)		(0.00580)
lnfwTariff	-0.115***	0.0998***	-0.0191*	-0.0236***		-0.0154*
	(0.0173)	(0.0147)	(0.0103)	(0.00742)		(0.00933)
Observations	1,159,527	1,159,527	1,183,777	1,183,124	1,171,784	1,160,150
R-squared	0.170	0.191	0.003	0.006	0.003	0.003
N	372,845	372,845	378,093	377,928	376,131	373,000

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Comparing Patent Filings across Ownership Categories

	Probability of patent filing per $1 million total assets				Number of patent filings per $1 million total assets			
	1	2	3	4	5	6	7	8
SOE-Converted LPO	0.2285**	0.2701**	0.3007	0.3456	0.3125	-0.3698	0.5776	0.5918
	0.095	0.114	0.2553	0.2769	0.6968	0.8156	1.8715	1.9816
SOE-Converted POE	0.2593***	0.3090***	0.0593	0.1092	0.97	0.6727	-0.9974	-1.4351
	0.0819	0.1032	0.2086	0.2321	0.6006	0.7384	1.5295	1.661
LPO	0.3196***	0.1144	0.3020***	0.3611***	0.7905***	0.5819	0.4343	0.5147
	0.0371	0.1054	0.0654	0.1271	0.2719	0.7546	0.4797	0.91
POE	0.2871***	0.1074	0.3516***	0.4329***	0.4929**	0.2069	0.7557*	0.5892
	0.0333	0.1062	0.0537	0.1228	0.2443	0.7602	0.3938	0.8788
Trend			0.0173	-0.0093			0.2554***	0.1972**
			0.0106	0.0128			0.0774	0.0917
Trend: SOE-Converted LPO			-0.0161	-0.0434			-0.0508	-0.179
			0.0402	0.0418			0.2949	0.2994
Trend: SOE-Converted POE			0.0303	0.0011			0.3304	0.3289
			0.034	0.0357			0.2493	0.2556
Trend: LPO			-0.0006	-0.0601***			0.0581	0.0087
			0.0129	0.0161			0.0942	0.1154
Trend: POE			-0.0155	-0.0753***			-0.0541	-0.0759
			0.0114	0.0144			0.0833	0.1029
Interest rate	-1.2371***	0.2037	-1.2369***	0.2101	-5.8484***	-1.0719	-5.8469***	-1.0601
	0.1223	0.1724	0.1223	0.1724	0.8969	1.2337	0.8969	1.2337
Loan size	-0.1908***	-0.1471***	-0.1901***	-0.1486***	-0.5907***	-0.4767***	-0.5893***	-0.4778***
	0.0112	0.0181	0.0113	0.0181	0.0823	0.1294	0.0825	0.1295
Subsidy amount	1.1876**	0.3346	1.1776**	0.3527	3.6958	-1.7745	3.6386	-1.7754
	0.5295	0.6979	0.5295	0.6979	3.8821	4.995	3.8823	4.9951
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes		Yes		Yes		Yes	
Firm Fixed Effects		Yes		Yes		Yes		Yes
N	1179625							

Notes: Dependent variable for columns 1-4 is an indicator for whether a firm has any patent filing in a year, weighted by total assets in millions. Dependent variable for columns 5-8 is the number of patent filings, weighted by total assets in millions. Interest rate, loan size, and subsidy amount are all measured in levels. *** p<0.01, ** p<0.05, * p<0.1

Appendix

Gains from Privatization: Ownership Change vs. Environment Change

Table 11: Decomposing Potential ROA and Patenting Gains from Privatization

	Return on asset (%)	Probability of patent filing (per RMB 100 million total assets)
LPO:		
Ownership: SOE privatization	1.855	0.0301
Environment: former SOE to private		
Interest rate	0.902	-0.0025
Loan size	1.195	0.0053
Subsidy amount	-0.005	-0.0002
Additional gains from closing policy gap	**2.092**	**0.0026**
Total potential gains from privatization	3.947	0.0327
POE:		
Ownership: SOE privatization	1.786	0.0335
Environment: former SOE to private		
Interest rate	0.675	-0.0019
Loan size	1.190	0.0053
Subsidy amount	-0.005	-0.0002
Additional gains from closing policy gap	**1.859**	**0.0032**
Total potential gains from privatization	3.645	0.0367

Alternative SOE Definition: State control=1 or State capital share>0

Table 12: Relationship between Ownership Categories and Implicit Interest rates

	1	2	3	4	5	6	7
SOE-Converted LPO	46.25***	81.81***	-11.06*	166.14***	28.46**	100.61***	1.98
	5.85	5.85	6.27	13.65	12.88	7.07	7.16
SOE-Converted POE	35.23***	72.91***	-11.68*	119.81***	20.05*	80.89***	-1.16
	5.3	5.31	5.99	11.76	11.37	6.19	6.6
LPO	250.63***	266.02***	22.25***	264.23***	-59.16***	257.63***	-11.60*
	2.43	2.56	5.96	4.43	7.41	2.89	6.15
POE	181.70***	212.23***	21.07***	192.45***	-59.33***	196.16***	-7.42
	2.19	2.33	6.03	3.68	7.3	2.54	6.21
Trend				-8.11***	-15.37***		
				0.49	0.57		
Trend: SOE-Converted LPO				-8.62***	0.85		
				1.45	1.33		
Trend: SOE-Converted POE				-4.80***	1.85		
				1.32	1.22		
Trend: LPO				1.14**	12.53***		
				0.57	0.67		
Trend: POE				3.18***	12.52***		
				0.52	0.63		
Post 2008						-169.35***	-205.34***
						6.88	7.17
Post 2008: SOE-Converted LPO						-8.38	59.36***
						13.02	11.38
Post 2008: SOE-Converted POE						13.74	64.77***
						12.36	10.81
Post 2008: LPO						73.68***	150.56***
						6.69	6.82
Post 2008: POE						94.87***	137.26***
						6.36	6.5
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				2000614			

Notes: Dependent variable is interest rates measured by interest payment divided by current liabilities in basis points (0.01 percentage points). *** p<0.01, ** p<0.05, * p<0.1

Table 13: Relationship between Ownership Categories and Loans

	1	2	3	4	5	6	7
SOE-Converted LPO	-54.799***	-44.022***	-6.390***	-65.295***	-7.399***	-48.553***	-6.976***
	0.399	0.398	0.38	0.956	0.807	0.48	0.436
SOE-Converted POE	-55.451***	-45.083***	-9.973***	-61.674***	-7.326***	-48.711***	-9.820***
	0.363	0.363	0.365	0.828	0.717	0.423	0.405
LPO	-80.137***	-67.808***	-3.246***	-95.903***	-3.849***	-74.221***	-4.040***
	0.165	0.173	0.352	0.307	0.448	0.194	0.364
POE	-80.858***	-69.665***	-3.622***	-96.599***	-3.562***	-75.598***	-4.422***
	0.15	0.158	0.356	0.257	0.439	0.172	0.367
Trend				-6.208***	0.575***		
				0.034	0.035		
Trend: SOE-Converted LPO				4.177***	0.118		
				0.101	0.082		
Trend: SOE-Converted POE				3.607***	-0.298***		
				0.092	0.076		
Trend: LPO				4.962***	0.080*		
				0.039	0.041		
Trend: POE				4.862***	0.003		
				0.035	0.038		
Post 2008						-67.781***	5.662***
						0.471	0.431
Post 2008: SOE-Converted LPO						34.836***	4.085***
						0.885	0.686
Post 2008: SOE-Converted POE						31.404***	1.851***
						0.841	0.654
Post 2008: LPO						40.120***	3.495***
						0.451	0.403
Post 2008: POE						39.267***	3.553***
						0.43	0.385
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				3166862			

Notes: Dependent variable is loan amount measured by current liabilities divided by total output in percentage points. *** p<0.01, ** p<0.05, * p<0.1

Table 14: Comparing Subsidies Received Across Ownership Categories

	1	2	3	4	5	6	7
SOE-Converted LPO	-3436.6***	-3365.2***	133.3	-4265.1***	-169.5	-3525.6***	110.2
	111.8	112.7	125.1	247.5	251.6	126.9	137.8
SOE-Converted POE	-3455.4***	-3420.5***	-307.9***	-3818.9***	73.4	-3343.9***	-131
	99.9	100.9	117.7	215.7	224.1	110.4	126
LPO	-5312.8***	-5047.7***	-554.0***	-5280.1***	-563.9***	-5115.9***	-510.2***
	43.6	46	113.4	78.2	139.9	49.4	116
POE	-5580.2***	-5255.5***	-547.9***	-4887.6***	-427.1***	-5151.3***	-471.3***
	38.6	41.3	114.6	64.9	137.1	43.3	117.1
Trend				44.1***	37.8***		
				9.8	11.8		
Trend: SOE-Converted LPO				98.3***	31.2		
				28.9	28.1		
Trend: SOE-Converted POE				39.7	-55.9**		
				26.8	26.2		
Trend: LPO				14.1	-0.3		
				11.3	13.9		
Trend: POE				-63.2***	-17.8		
				10.3	12.7		
Post 2008						753.5***	863.5***
						149.5	166.4
Post 2008: SOE-Converted LPO						326.3	-271.1
						288.6	277.4
Post 2008: SOE-Converted POE						-763.8***	-1260.2***
						280.4	268.6
Post 2008: LPO						-149.1	-372.2**
						149.2	168
Post 2008: POE						-857.0***	-528.7***
						142.6	159.8
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				2445945			

Notes: Dependent variable is the amount of subsidies received per $1 million firm output. *** p<0.01, ** p<0.05, * p<0.1

Table 15: Comparing Return on Assets Across Ownership Categories

	1	2	3	4	5	6	7
SOE-Converted LPO	1.813***	-0.108	-0.957***	0.949***	1.059***	0.146	-0.391**
	0.14	0.139	0.14	0.297	0.273	0.157	0.153
SOE-Converted POE	1.272***	-0.239*	-0.366***	0.677***	1.102***	-0.065	0.066
	0.125	0.124	0.131	0.258	0.242	0.136	0.139
LPO	5.255***	3.351***	0.788***	2.157***	-1.445***	3.082***	0.051
	0.058	0.06	0.13	0.098	0.157	0.064	0.132
POE	5.105***	3.545***	1.071***	1.892***	-1.444***	2.980***	0.253*
	0.052	0.054	0.132	0.082	0.155	0.057	0.134
Trend				0.376***	0.239***		
				0.012	0.013		
Trend: SOE-Converted LPO				-0.011	-0.065**		
				0.035	0.031		
Trend: SOE-Converted POE				-0.015	0.002		
				0.033	0.029		
Trend: LPO				0.277***	0.400***		
				0.014	0.016		
Trend: POE				0.339***	0.444***		
				0.013	0.015		
Post 2008						5.208***	3.904***
						0.184	0.188
Post 2008: SOE-Converted LPO						1.715***	1.611***
						0.352	0.31
Post 2008: SOE-Converted POE						1.293***	1.765***
						0.346	0.302
Post 2008: LPO						4.043***	5.127***
						0.185	0.192
Post 2008: POE						5.289***	5.675***
						0.176	0.182
Interest rate	45.239***	44.562***	19.837***	44.499***	19.691***	44.464***	19.669***
	0.185	0.185	0.217	0.185	0.217	0.185	0.217
Loan size	-4.594***	-4.274***	-2.637***	-4.312***	-2.635***	-4.301***	-2.643***
	0.019	0.019	0.025	0.019	0.025	0.019	0.025
Subsidy amount	4.514***	3.030***	18.463***	3.427***	18.477***	3.375***	18.560***
	0.898	0.888	0.953	0.888	0.953	0.888	0.953
Year Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects		Yes		Yes		Yes	
Firm Fixed Effects			Yes		Yes		Yes
N				1504468			

Notes: Dependent variable is return on asset measured as total profits divided by total assets in percentage points.
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Comparing Patent Filings across Ownership Categories

	Probability of patent filing per $1 million total assets				Number of patent filings per $1 million total assets			
	1	2	3	4	5	6	7	8
SOE-Converted LPO	0.1681*	0.2398**	0.2603	0.4024	0.0154	-0.4291	0.5297	1.1257
	0.0872	0.1048	0.2318	0.2515	0.6391	0.7504	1.6996	1.8001
SOE-Converted POE	0.2623***	0.3255***	0.0727	0.1528	1.5336***	0.5054	-1.1244	-3.9536***
	0.0755	0.0954	0.1936	0.2143	0.5534	0.6825	1.4195	1.5334
LPO	0.3319***	0.1057	0.3287***	0.3450***	0.8686***	0.7541	0.4979	0.7378
	0.0362	0.0949	0.0651	0.1171	0.2653	0.679	0.4772	0.8379
POE	0.2928***	0.0949	0.3697***	0.4198***	0.5048**	0.3546	0.7803**	0.9361
	0.0321	0.0961	0.0525	0.1129	0.2356	0.6878	0.3852	0.808
Trend			0.0189*	-0.0119			0.2503***	0.2158**
			0.01	0.0121			0.0735	0.0866
Trend: SOE-Converted LPO			-0.0204	-0.0557			-0.0911	-0.2859
			0.0367	0.0382			0.269	0.2733
Trend: SOE-Converted POE			0.0275	-0.0014			0.4484*	0.7099***
			0.0315	0.033			0.231	0.2361
Trend: LPO			-0.0041	-0.0590***			0.0616	0.0001
			0.0125	0.0157			0.0916	0.1121
Trend: POE			-0.0185*	-0.0755***			-0.0549	-0.1121
			0.0109	0.0138			0.0798	0.0986
Interest rate	-1.2431***	0.2052	-1.2428***	0.2135	-5.8591***	-1.0729	-5.8565***	-1.0476
	0.1223	0.1724	0.1223	0.1724	0.8969	1.2337	0.8969	1.2337
Loan size	-0.1896***	-0.1467***	-0.1886***	-0.1480***	-0.5880***	-0.4771***	-0.5862***	-0.4772***
	0.0112	0.0181	0.0112	0.0181	0.0821	0.1294	0.0823	0.1295
Subsidy amount	1.1982**	0.3359	1.1867**	0.3556	3.7108	-1.7668	3.6403	-1.7755
	0.5295	0.6979	0.5295	0.6979	3.8817	4.995	3.8819	4.995
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes		Yes		Yes		Yes	
Firm Fixed Effects		Yes		Yes		Yes		Yes
N	1179625							

Notes: Dependent variable for columns 1-4 is an indicator for whether a firm has any patent filing in a year, weighted by total assets in millions. Dependent variable for columns 5-8 is the number of patent filings, weighted by total assets in millions. Interest rate, loan size, and subsidy amount are all measured in levels. *** p<0.01, ** p<0.05, * p<0.1