STATE-OWNED ENTERPRISES IN EUROPE - FIRM PERFORMANCE AND AGGREGATE EFFECTS

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Abstract

Since the late 2000s, shocks and crises of various types have led to a revival of state intervention around the world. This paper builds a large firm-level dataset to analyze state ownership of firms in Europe for the period 2002-18. We confirm the underperformance of state-owned enterprises (SOEs) relative to privately-owned enterprises (POEs) found in earlier literature for this recent period for a range of firm-level performance indicators. We also examine the impact of SOEs on private firms. We find that larger SOE presence in an industry is associated with lower productivity growth and lower productivity levels among private firms in that industry, but does not affect industry dynamics in terms of entry and exit. This suggests potential aggregate productivity gains from reallocating resources from SOEs to POEs. Further, we show that employment is more stable and crisis-resistant at SOEs, and that SOEs are a more stable source of downstream input demand for other firms. Leveraging our dataset's cross-country nature, we find that SOEs are complements to, rather than substitutes for, lower quality institutions.

Keywords: State ownership, Firm performance, Productivity, Spillover effects, Privatization, Business dynamism

JEL Codes: H11, L25, L32, O47, P31, P52

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1   Introduction

The Great Depression and World War II led to more active government involvement in the economy. Many politicians believed the state should own firms in strategic industries. This view was based on market failures and the belief that state-owned enterprises could pursue socially beneficial goals. By the 1980s, however, the perceived inefficiency of state-owned enterprises due to incentive and agency problems shifted the focus toward privatization. Fueled by privatization successes in the UK and the collapse of the Soviet Union, market-oriented reforms, including privatization, were promoted in developing countries under the Washington Consensus as a necessary condition for economic growth during the 1990s and 2000s. More recently, renewed state ownership of firms became part of the policy response to the Great Recession. Despite reversals, state ownership persists in many parts of the world, with majority-owned state-owned enterprises accounting for significant shares of assets and jobs in OECD countries (see e.g. Borisova et al., 2012; Megginson, 2017; and OECD, 2017). Additionally, China's rapid economic growth has highlighted the potential role of state-owned enterprises for growth. Notwithstanding overall state ownership has declined in China, most of the country's largest companies have remained state-owned (Hsieh and Song, 2015) or are still implicitly linked to the government.

Within this context, we construct a large firm-level panel dataset of state ownership of firms in 29 European countries to present a balanced and nuanced view on state ownership. By not confining ourselves to firms listed on stock exchanges, or firms from specific countries or industries, we are able to present a comprehensive view on the occurrence and evolution of state ownership. We consider a wide range of firm-level indicators observed over nearly two decades to compare the performance of state-owned enterprises (SOEs) and privately-owned enterprises (POEs). We also provide evidence of performance differences for the more recent 2013-18 post-crisis period. We then analyze how SOEs may affect POE productivity through spillover effects and analyze how SOE presence both directly and indirectly affects aggregate productivity (growth). As a counterbalance to the analysis of traditional efficiency outcomes, we also analyze how SOEs may arise to achieve socially desirable outcomes.

We construct our dataset based on underlying Orbis Europe (Amadeus) data. We track firms' state ownership over time by meticulously analyzing annual data on firms' ownership structures from multiple annual versions of Orbis. We combine three sets of information available in the database to identify state ownership of firms. We use both information on the firms' legal structure itself and on the firms' shareholder and ultimate owner legal structure. Thirdly, we set up a procedure to analyze shareholder and ultimate owner names for further indications of state ownership. We use all firms active in the business economy from 29 European countries. Importantly, this large-scale approach circumvents the limitations of prior research by not confining ourselves to firms listed on stock exchanges, or firms from specific countries or industries.

Our final dataset contains 97 million firm-year observations from 2002 to 2018. We identify roughly 0.5% firms as state-owned at the beginning and end of our sample, with more elevated levels of about 0.7% at the time of the Great Recession. State shares in SOEs are concentrated around stakes slightly above 50% and above 95%. SOE presence is most pronounced in industries related to utilities and transportation, but also non-negligible in all other industry groups. These observations hold across countries with different legal traditions but are least pronounced in countries with an

English legal tradition. Notwithstanding privatisation efforts following the Washington consensus policy advice, countries with a socialist legal tradition show higher levels of SOE presence in our dataset.

We create a sample of matched firms to estimate performance differences between SOEs and POEs for a range of different firm-level outcomes and compare firms in tight country-industry-year cells. We find that SOEs employ more workers at a higher cost, are less productive and profitable, and face lower effective tax rates. SOEs are less financially constrained and are also less leveraged than their private counterparts. These effects are often substantial: e.g. employment at SOEs is 17.4% larger than at comparable POEs, TFP is 12.9% lower, and profit margins are 11.8%-points lower. These results are confirmed throughout a large array of robustness checks regarding the identification of state ownership, the type of matching, and alternative sample constellations. We also provide additional evidence from privatizations and nationalizations in a difference-in-difference setting in addition to our basic results. Both sets of results confirm the underperformance of SOEs. Our results also hold in the more recent period as we confirm performance differences for the 2013-18 post-crisis period.

The results are not unique to majority state-owned SOEs. Majority ownership is not a necessary condition for underperformance relative to POEs to materialize and differences between minority and majority state-owned SOEs seem neither systematically ranked, nor systematically different from one another for the range of performance indicators.

The fact that SOEs have 13% lower TFP levels than POEs implies lower aggregate productivity in countries where SOEs account for a larger share in total economy value added. We additionally find that SOEs show 2.2% lower TFP growth rates than POEs. This is an indication of the potential for aggregate productivity growth through reallocation of resources from SOEs to POEs, which is further strengthened by our analysis of privatizations. A back-of-the-envelope calculation based on our data reveals an increase in aggregate productivity of 1.17% when hypothetically reallocating all resources of SOEs to POEs. Our estimates imply that such a reallocation further implies that aggregate productivity growth would be 0.2%-points higher annually.

In addition to these direct effects, we also investigate how SOEs may indirectly affect aggregate outcomes through spillover effects on POEs. To do so we calculate the share of SOEs in industry total operating revenue (alternatively total assets) by country-industry-year groups and relate these indicators of state presence to POEs' TFP levels and growth rates. We find –controlling for industry-year and country-year fixed effects– that state presence is significantly negatively associated with POEs' TFP levels and growth rates. Specifically, a one standard deviation lower SOE share in total assets in a given country-industry-year is associated with a 1.56% (0.49%) higher productivity level (growth rate) for POEs.

We also investigate how state presence relates to business dynamism. Business dynamism is an important driver of aggregate productivity as competitive pressures drive inefficient firms out of the market, induce productive incumbent firms to expand, and new competitive ones to enter (see Anderton et al., 2020 and Garcia-Macia et al., 2019). Our analysis shows, however, that the presence of SOEs in a given industry does not seem to affect the birth, death, or churn rate in that industry.

The previous analyses were focused on efficiency and may have obscured other goals of state own-

ership. As far as these goals are driven by welfare improvement and not by electoral gain, state ownership may be beneficial. Therefore our analysis may not have captured the potential benefits of state ownership. In the final section of our paper, we present several empirical exercises (that our data allow for) that recognize that state ownership may be motivated to tackle market failures or target other 'socially desirable' outcomes.

First, if underperformance of state-owned firms is 'intentional' because state ownership is to tailor firms away from efficiency towards other goals we expect performance differences to be larger in those countries where policymakers would place a higher weight on socially desirable goals. To test this we leverage the cross-country nature of our dataset and analyze whether countries that are more collectivist or have a socialist legacy show larger performance differences. We indeed find that this is the case. E.g. in a one standard deviation more 'collectivist' country, TFP in SOEs is 18% lower than in POEs rather than 12% in a less collectivist country.

Second, we define and analyze firm-level outcomes available through our data that are more closely related to what one would view as socially desirable outcomes beyond efficiency-related outcomes. We first hypothesize that governments may use SOEs as a tool for stabilizing their economy. To test for such stabilizing effects, we calculate the firm-level variability of employment and material input use. SOEs exhibit a less volatile behavior than POEs. We find a 12% (16%) lower standard deviation for employment (material input use). We further show that the effect roughly doubles in crisis periods while remaining significant in non-crisis periods strengthening the interpretation of SOEs as a tool for stabilizing the economy.

SOEs' mandate beyond profit maximization may also allow them to invest in long-term, high-risk innovation projects with significant public benefits (Tõnurist and Karo, 2016). Our data allow us to test for differences in patenting between SOEs and POEs. Results indicate that SOEs are less likely to patent. Patents are, however, not the best possible innovation variable to test as patents are precisely a solution to the incentive problem induced by innovation's non-rival and non-excludable characteristics.

Finally, SOEs may be a way of overcoming low-quality institutions. Under such a view, lower-quality institutions should be associated with smaller performance differences between SOEs and POEs. On the other hand, it is precisely governments that are responsible for institutions such as the protection of property rights. Governments that attach less weight to the quality of institutions are unlikely to set up mechanisms to overcome agency problems within SOEs. Results indicate that higher-quality institutions mitigate performance differences, favoring the latter interpretation of the relationship between SOEs and institutions.

Related literature   Our work is related to a large literature on the relative performance of SOEs versus POEs. The prevailing consensus is that POEs generally outperform SOEs across various performance criteria. Earlier work includes e.g. Dewenter and Malatesta (2001) who use a global dataset to compare SOEs and POEs and find lower profitability and higher labor intensity at SOEs, or La Porta and López-de Silanes (1999) who quantify the benefits of privatizations in Mexico in the period 1983–1991. Megginson and Netter (2001) surveys much of the earlier literature to support the consensus (see also Shleifer, 1998).

The transition from plan to market in Eastern Europe proved to be a fertile setting for studying privatization. The multitude of studies on transition countries is surveyed by Djankov and Murrell

(2002) and Estrin et al. (2009): private ownership is associated with higher levels of productivity, increased profitability, higher revenues, higher rates of exports, and reduced likelihood of defaulting on debt. Studies like Frydman et al. (1999) and Brown et al. (2006) demonstrate the importance of the organisation of the privatisation process for these effects. Frydman et al. (1999) find that only privatization to outsiders of the firm is effective and Brown et al. (2006) find strong positive effects of foreign privatization for four transition countries, but smaller and more mixed effects of domestic privatization across countries.

The more recent literature has also turned attention to the Chinese experience. Chen et al. (2021) find that POEs are 53% more productive, but that the benefits of privatization take several years to fully materialize. They further show that the average effect hides heterogeneity with the productivity gap being larger in consumer-oriented and high-tech industries, and smaller for larger firms and in more liberal times. In a meta-study, Aguilera et al. (2021) show that the political ideology of the government and its interactions with political institutions is another (cross-country) modifier of the performance difference.

Whereas most of the literature points to the overall underperformance of SOEs, Lazzarini and Musacchio (2018) find that SOEs underperform only when faced with shocks that prioritize their social and political objectives. These findings are based on a worldwide sample of listed SOEs indicating that stock market listing may induce SOE managers to focus on profit maximization like in POEs.

The pursuit of socially desirable goals rather than profit maximisation have received less attention in the literature. While some authors have highlighted that this might be the case (see e.g. Bałtowski and Kozarzewski, 2016; Estrin et al., 2019; and Mülhenkamp, 2015), Matuszak and Kabacinski (2021) is one of the scarce studies that explicitly addresses the relationship between the pursuit of socially desirable goals and the relative performance of SOEs.

Finally, our work also relates to increasing attention for the slowdown of aggregate productivity growth around the world. Many potential drivers and explanations have been analyzed (see Goldin et al., 2024), among which the role of firm-level dynamics, including entry-exit and misallocation (see e.g. Anderton et al., 2020; Foster et al., 2008; Garcia-Macia et al., 2019; Gopinath et al., 2017; and Hsieh and Klenow, 2009). Contributing to this literature, we analyze from the micro (firm-level) perspective how state ownership and the allocation of resources to SOEs relates to aggregate productivity (growth).

The paper is structured as follows. In section 2, we briefly review theoretical insights from the literature regarding the rationales behind state firms behaving differently from their private counterparts. Section 3 elaborates on the construction of our dataset and provides an overview of the presence, evolution, and other facts of state ownership in Europe. Section 4 evaluates performance differences between SOEs and POEs for a wide range of indicators of firm-level performance and presents several robustness checks. Section 5 considers spillover effects of SOEs on both POE productivity and business dynamism and relates SOE presence to macroeconomic productivity growth via these channels. Section 6 presents several empirical exercises to analyze whether SOE presence could be motivated by (and be successful in) attaining other socially desirable goals than profit maximisation, counterbalancing the analysis in sections 4 and 5 as to provide a nuanced view on state ownership. We conclude with a discussion in section 7.

2 Theoretical perspectives on state ownership

Governments may opt to set up SOEs as a response to market failures. High fixed costs of entry in combination with a 'small' market may only allow for the profitable establishment of a single firm. The government may then choose to grant such a natural monopoly to an SOE to prevent market power abuse and ensure equitable access (Megginson and Netter, 2001). Even when market characteristics allow for multiple firms, authorities may still prefer to assign production of goods with a societal objective (e.g. defense or healthcare) to an SOE to exert control or as a response to inadequate market provision (see e.g. Lazzarini and Musacchio, 2018 and Megginson and Netter, 2001). The existence of externalities provides another rationale for state ownership. If private firms do not fully consider the full societal impact of their actions, state ownership can be a way to address externalities (e.g. education). Governments may also use state ownership to strategically establish or strengthen nascent industries that would be too risky (Lazzarini and Musacchio, 2018) or require levels of capital investment too high for private entities (Lin et al., 2020).

Notwithstanding the potential role of SOEs in overcoming market failures, state ownership of firms is also associated with various deficiencies. Agency problems, soft budget constraints, inefficient bureaucratic structures, deficient monitoring, or the use of SOEs for political goals have all been shown to negatively affect SOE performance relative to POEs (see e.g. Hart et al., 1997; La Porta et al., 2002; Megginson and Netter, 2001; Shleifer, 1998; and Vickers and Yarrow, 1991). In SOEs, managers (agents) may lack incentives to align with the owner's objectives (principal), here the state. Several factors contribute to this principal-agent problem. First, as ownership and control are separated, managers do not directly face the consequences of their actions (Chen et al., 2017; Goldeng et al., 2008; and Gupta, 2005). Second, incentive schemes linking firm performance to manager remuneration are often absent in SOEs (Estrin et al., 2009 and Lazzarini and Musacchio, 2018). Third, SOEs often face soft budget constraints: in case of financial distress the state will continue provide resources leading managers to attach lower priority to economic viability (Borisova et al., 2012; Lazzarini and Musacchio, 2018; Megginson and Netter, 2001; and Vickers and Yarrow, 1991). Fourth, effective monitoring may also be hampered by the fact that SOEs are often unlisted, preventing assessment through stock markets, or that direct product market competition is limited, preventing comparison with private peers (see Fan et al., 2007; Goldeng et al., 2008; and Gupta, 2005). Further, assessing managerial quality in SOEs lacks the benchmark of managerial labor markets in POEs when managers are politically appointed (Chen et al., 2017). Even if monitoring mechanisms exist, principals often lack the incentives to properly monitor SOE managers because they do not directly face the consequences of poor performance themselves, or because several agencies and ministries are in charge with no clear ultimate responsibility (Lazzarini and Musacchio, 2018). Principals themselves may also be engaged in corruption (Wang et al., 2008) or prioritize political objectives (e.g. Boubakri et al., 2005; Gupta, 2005; and La Porta et al., 2002).

Finally, some research indicates that governments are able to improve the performance of state firms without resorting to privatization through incentive mechanisms. Dewenter and Malatesta (2001); Megginson and Netter (2001); and Pinto et al. (1993) find that a significant portion of performance improvements observed in privatized firms occur in the years leading up to privatization. Implementing internal supervisory mechanisms and reducing the government's role in appointing

managers lead to more effective incentives and constraints on SOE managers in China and Poland, eventually resulting in improved performance (Aivazian et al., 2005 and Pinto et al., 1993).

3 Data and estimation sample

In this section, we first document how we construct our dataset and how we identify state ownership from the raw data. We then show some facts on the data and discuss how we arrive at our final estimation sample.

3.1 Data construction

Raw data To construct our dataset we use raw data from annual versions of the Amadeus and Orbis Europe database provided by Moody's (previously Bureau Van Dijk).[1] Moody's sources raw firm-level data from country-specific data providers (see Kalemli-Ozcan et al., 2015, for an overview of data providers) and aggregates information into a single database that allows for cross-country comparisons. The data has been used extensively in previous research (see e.g. Autor et al., 2020 and Gopinath et al., 2017). For our purposes it is important that each version of the database provides financial information for a period of maximum 10 years and only concurrent (most recent) ownership details. To track state ownership over time and to obtain longer time series of firm-level financial information, we therefore use 20 annual versions of Amadeus/Orbis and compile a single dataset following the procedures outlined in Merlevede et al. (2015).[2] Our final dataset covers the 2002-2018 period for 29 European countries.[3] We limit the dataset to firms active in the business economy reporting unconsolidated accounts.[4] In total we have 97 million firm-year observations on ownership structures. Depending on the financial item we analyze, the number of observations varies and depends on reporting requirements that differ by country and firm size. Data coverage is often more comprehensive for larger firms that are mandated by law to disclose more information than small firms. One should bear this caveat in mind, but as our analysis of SOEs is primarily based on a matched sample (*cf. infra*) and SOEs are typically large, we are confident our results provide relevant insights on SOEs.

State ownership identification Key to our analysis is to determine whether a firm is state-owned. We define state ownership broadly as encompassing all government levels (local, state, national, etc). We identify state firms in a multi-layered approach. Firstly, we rely on the firm's 'legal structure' as reported in Amadeus/Orbis. The terminology of legal forms is country-specific, but always contains a legal categorization refering to state ownership (e.g. 'State Enterprise' or 'Municipal company'). This unambiguously points towards state ownership and enables immediate classification. Secondly, we scrutinize the 'type' of identified shareholders and global ultimate owner

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[1] We include information from Amadeus for years before 2016 and switch to Orbis from 2016 onward. We exclude firms that first appear in Orbis but existed before 2016 because we cannot track their status as SOE before 2016. This exclusion does not substantially impact our estimation results.

[2] Firms have a unique identifier in the database allowing for straightforward linking between different versions. Occasional identifier changes are accounted for using a file of identifier changes provided by Moody's.

[3] Austria, Belgium, Bulgaria, Czech Republic, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, and United Kingdom

[4] Excluding non-business firms implies we only assess the impact of state-owned businesses, not state activities in non-profit like healthcare and education.

(GUO), two variables available from Amadeus/Orbis. These classifications are uniform across countries and versions. Types marked as "Public authority", "State", "Government", or combinations of them, indicate the presence of one or more state shareholders or a state GUO. Thirdly, we identify potential state ownership from shareholder and GUO names. We first mark names that include specific words that refer to potential state ownership and are not picked up by the previous two layers that are directly indicated by the data provider. A complete list of terms used to identify potential state shareholders or state GUOs based on owner name, is provided in Table A.1 in appendix. These words include e.g. "City" or "Ministry", and are translated into the languages of the countries present in our data set. Further, we expand the list of keywords to encompass country-specific terms like the Spanish "Ayuntamiento". We then manually check the potential shareholders or GUOs to flag them as state-related or not. When a firm's GUO is flagged as state-related based on layer two or three, we classify the firm as SOE since the global ultimate owner is defined as the owner ultimately controlling the firm. We further classify a firm as being an SOE as long as state-related shareholders possess at least 10% of the shares. We also construct variables for minority- (10-50%) and majority-owned (>50-100%) SOEs.[5] If a GUO or the legal form indicates state ownership, a firm is always identified as a majority-owned SOE. We handle occasional missing information in a single version by forward-filling our state ownership variables, followed by backward-filling in case the first year is missing.[6] When all data related to a firm's legal structure and ownership is absent, the firm is discarded from our dataset.

3.2 State ownership in Europe

In this section, we present characteristics of state ownership in Europe derived from our dataset. Out of the total number of observations (97,695,447), 0.52% of the firm-year observations are identified as state-owned.[7]
Panel A of Figure 1 shows that since the start of the 21st century, the proportion of state-owned firms relative to the total number of firms present in Europe did not portray a continuous, monotonous trend. Following the Great Recession in 2008, state ownership sharply increased as governments attempted to mitigate the impact of the economic downturns. Among all observed firms in the 29 European countries in our dataset, we identify roughly 0.5% state-owned firms at the beginning and end of our sample, with more elevated levels of about 0.7% around the Great Recession.

Most state-owned firms are majority state-owned: 330,918 are majority state-owned, i.e. strictly more than 50%, versus 43,423 minority state-owned. Panel B of Figure 1 shows the distribution of state ownership shares for the year 2017. It is clear from the figure that ownership shares are concentrated around stakes slightly above 50% and above 95% (mostly 100% in this category). These two categories make up around 75% of the data together which indicates that most state firms are fully controlled by their respective state owners. Other stakes are more likely to be minority stakes that are more common relative to stakes between 60 and 90% that are very rare. This distribution

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[5]We do not have information on golden shares.

[6]For example, when a firm is identified as privately-owned in year $t+1$ and state-owned in year $t+3$, but no information is available in years t, $t+2$ and $t+4$, we assume private ownership between year t and $t+2$, and government ownership in year $t+3$ and $t+4$. This procedure results in a full panel structure. Alternative variations, such as exclusively filling intermediate values, yield comparable outcomes.

[7]We provide more summary statistics in Table A.2 in appendix.

Figure 1

(a) Proportion of SOEs to all firms by year   (b) Distribution of state ownership stakes (2017)
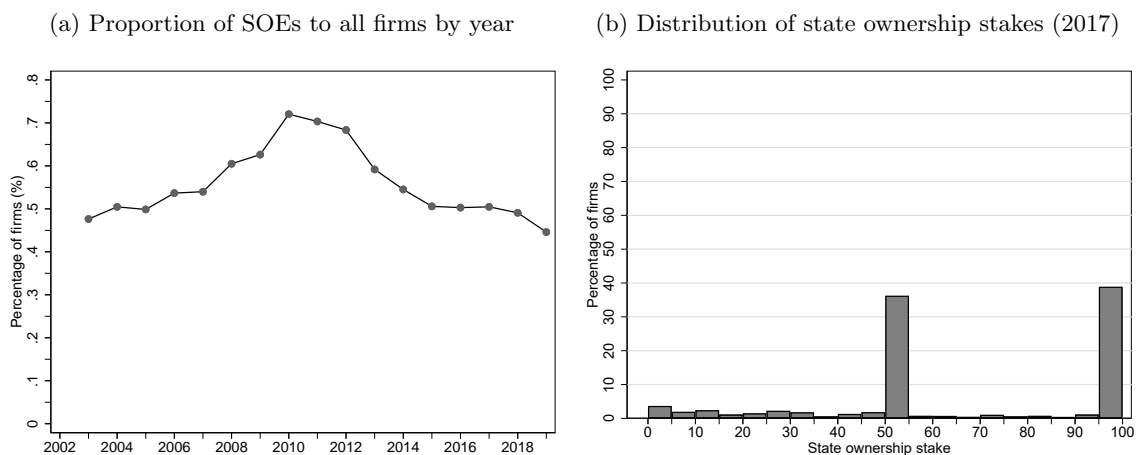
NOTES: Panel B: histogram of share of firms within 5% (non-zero) state ownership stake bins.

has been unchanged over time (see Figure A.2 in Appendix).

While panel A of Figure 1 shows the evolution of the percentage of state-owned firms, it does not necessarily reflect their overall importance in the economy given that stat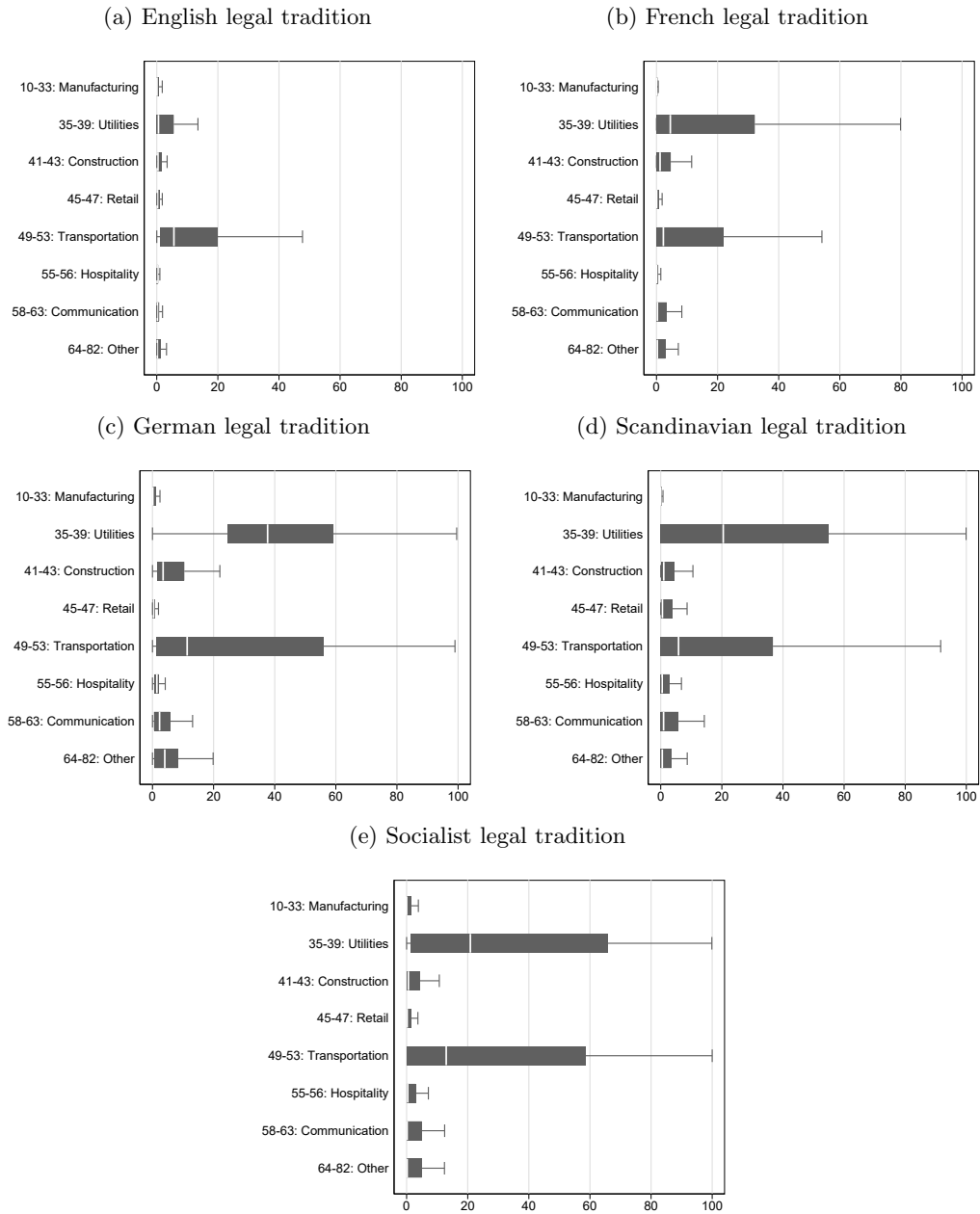e-owned firms may be larger than private firms on average. Therefore we calculate the share of total assets held by SOEs in the total assets held by all firms for a given country-industry-year combination (an industry is a NACE 2-digit category). This quantifies the importance of state firms taking into account firm size. Figure 2 uses several boxplots to show these numbers in context. First, we group countries into five subsets in each panel of Figure 2 based on legal traditions (La Porta et al., 1999): English (United Kingdom, Ireland), French (Belgium, France, Greece, Italy, Netherlands, Portugal, Spain), German (Austria, Germany, Switzerland), Scandinavian (Denmark, Finland, Norway, Sweden), and Socialist (Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Russia, Slovenia, Slovakia, Ukraine). Within each panel we group 2-digit industries in NACE sections as indicated in the figure. The boxplots thus reflect country and industry dimensions limited to the indicated aggregates and the time dimension.

SOE presence is common and most pronounced in industries related to utilities and transportation. State ownership is also non-negligible, though less prevalent, in all other industry groups. These observations hold across legal traditions, but are least pronounced in the English legal tradition. This is in line with La Porta et al. (2002) who indicate that English governments have low tendencies towards interventionism given the roots of this legal tradition, i.e. the desire of the political class to limit the power of the Crown. Countries with Socialist legal traditions are characterized by high levels of government intervention. On the one hand, this is not unexpected given the design of Soviet Union as a country with limited opportunities for (formal) private initiative, notably in strategic industries. On the other hand, following the Washington consensus policy advice these countries went through massive privatisation episodes following the collapse of communism. Other legal origins take a middle position between these extremes with German and Scandinavian leaning closer towards Socialist than French. This is confirmed in Table A.3 in Appendix A.3 by means of a regression analysis. Further, in Table A.4 in Appendix A.3 we also show by means of a regression analysis a strong negative correlation between indicators of financial and economic development, as

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Figure 2: SOE share in total assets over industry aggregates across legal origins

(a) English legal tradition

(b) French legal tradition

(c) German legal tradition

(d) Scandinavian legal tradition

(e) Socialist legal tradition

NOTES: Unit of observation in boxplots is country-year-NACE 2-digit, outside values not shown.

well as institutional quality, and SOE presence. These facts also validate our dataset as they are in line with the big patterns one would expect to observe from existing literature on institutions and state ownership. In the next sections, we continue by analyzing SOEs' performance and effects on other firms in the economy.

3.3   Estimation sample

We construct a matched sample to estimate differences between SOEs and privetaly-owned firms (POEs) more precisely. We use propensity score matching (PSM), a non-parametric technique to select pairs of similar firms. PSM enables us to compare SOEs and POEs with more similar observable characteristics, such that, conditional on balanced matching, differences can be entirely attributed to the treatment, i.e. state ownership.[8] Specifically, we define our treatment group as firms that are state-owned at least at some point in time and compare these to firms that were never state-owned. We estimate a discrete choice model to obtain the likelihood ('propensity score') that a firm receives treatment ('is state-owned'). We consider the following covariates: the natural logarithms of lagged total assets and the age of the firm, and lagged dummy variables indicating whether the firm is foreign-owned or listed on a stock exchange. We estimate probit models by country-industry groups. Propensity scores outside the common support range are not retained.

To obtain our estimation sample each firm in the treatment group (state-owned in at least one year) is matched to privately-owned firm with the most proximate propensity score. We match SOEs to POEs in the first year of state ownership and retain these matched firms for the entire time span. Firms are matched on a one-to-one basis within year-country-industry division groups. The matching procedure substantially reduces differences between the treatment and control groups (balancing property test results are provided in Appendix A.4). We also test robustness of our results for several alternative matching approaches (*cf. infra*).

4   State ownership and firm performance

In this section, we estimate differences in economic and financial performance between SOEs and POEs. We provide evidence for a long period, for many countries, and for a large number of listed and non-listed firms. This contrasts with most existing evidence that is typically based on limited data for a single country or for a smaller sample of listed firms: our data has information on 29 countries and 98.9% of the SOEs are not listed.

Specification   We estimate specification (1) on the matched sample for various performance indicators to obtain estimated performance differences as $\hat{\beta}_1$:

$$Performance_{ijct} = \beta_0 + \beta_1 SOE_{ijct} + \beta_2 X_{ijct} + \gamma_{jct} + \epsilon_{ijct} \tag{1}$$

with firm i, country c, industry j and year t. X_{ijct} is a vector of control variables including firm age (logs), lagged firm size (real total assets, real turnover, logs), a foreign ownership dummy[9],

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[8]PSM may not entirely rule out self-selection if unobservable characteristics are driving both the selection into treatment and the outcome of interest.

[9]Note that foreign-owned firms are companies with at least 10% of their shares held by a direct shareholder from another country, or with a foreign Global Ultimate Owner (GUO).

and a dummy indicating whether a firm is listed. γ_{jct} are country-industry-year interaction fixed effects. Industries are defined as NACE Rev. 2 2-digit entries. By including country-industry-year interaction fixed effects we control for factors common to all firms in a given combination and thus compare SOEs and POEs within the same country, industry, and year. We choose not to adopt firm-level fixed effects as a baseline because this would imply that performance differences are identified from within-firm changes, i.e. privatizations or nationalizations, whereas our goal is to estimate and document performance differences as precisely as possible (hence our matching approach) within tight country-industry-year cells. We do provide evidence from privatizations or nationalizations in addition to our basic estimations below. We cluster standard errors at the country-industry-year level when estimating (1).

We consider the following firm-level performance indicators as dependent variables: $Empl$ is the log number of employees; $Wage$ is the log of real wage costs per employee; TFP is the log of total factor productivity estimated by WLP-methodology (Wooldridge, 2009); RoA is return on assets calculated as net income over total assets; $Profit$ is the operating profit margin calculated as operating P/L over sales; $Leverage$ is calculated as long-term debt over total assets; $FinCon$ is an indicator of financial constraints from Mulier et al. (2016); $IntRate$ is the implicit interest rate calculated as interest expenses over liabilities, multiplied by 100; $TaxRate$ is the effective tax rate calculated as tax expenses over P/L before taxes, multiplied by 100. In the specification with the effective tax rate as dependent variable, the operating profit margin is added as an additional control variable.

Results   Table 1 presents the results of estimating (1) on our sample of matched firms. In panel A we find significant average performance differences between SOEs and privately-owned firms. In column 1 we find that SOEs employ on average 17.4% more employees than POEs, at a 2.8% higher wage cost. This likely reflects a combination of lower management efficiency (creating inertia, as discussed in section 2), electoral motivations of politicians, and SOEs being more likely to target other goals than profit maximization. For similar reasons state ownership is also associated with lower TFP (-12.9%) and lower profitability: return-on-assets of state-owned firms is 2.7%- points lower, operating profit margins are 11.8%- points lower. Given the literature on SOEs' "soft budget constraints", i.e. easy access to funding and, if necessary, government bailout, we expect that SOEs are less financially constrained and pay lower (implicit) interest rates, which could result in higher leverage ratios. SOEs indeed are less financially constrained (estimated to be 0.065 lower) and pay interest rates that are on average 0.45%- points lower than private firms. SOEs do have leverage ratios that are 2.44%- points lower. SOEs also pay 0.40%- points lower effective tax rates. On the one hand, governments may design policies to reduce the tax burden for SOEs. State firms could also be subject to tax deductions by targeting socially desirable outcomes. On the other hand, we expect SOEs to be less likely to resort to tax-avoiding strategies. Our results tilt the balance towards the former reasoning as the dominating one. Overall the estimated coefficients in panel A point towards state-owned firms employing more workers at a higher cost, being less productive and profitable, and facing lower effective tax rates. SOEs are less financially constrained and less leveraged than their private counterparts.
Our data allow us to present more recent post-Great Recession evidence on performance differences between SOEs and POEs. Panel B of Table 1 shows that these differences have been preserved in

Table 1: State-ownership and performance: Evidence from the matched sample

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
	A - State ownership dummy								
SOE	0.174***	0.028***	-0.129***	-0.028***	-0.118***	-0.024***	-0.065***	-0.450***	-0.404**
	(15.77)	(6.12)	(-18.95)	(-24.94)	(-21.00)	(-12.70)	(-11.32)	(-23.76)	(-2.05)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.176	0.341	0.140	0.050
	B - Post crisis period (2013-18)								
SOE	0.232***	0.058***	-0.131***	-0.028***	-0.122***	-0.026***	-0.063***	-0.475***	-0.118
	(14.05)	(7.97)	(-10.88)	(-14.81)	(-15.28)	(-9.05)	(-6.85)	(-18.29)	(-0.43)
N	267471	163222	112356	302878	207504	299444	186478	190058	189748
Adj. R^2	0.634	0.713	0.732	0.039	0.100	0.170	0.353	0.112	0.042
	C - Minority/majority state ownership								
SOE-minority	0.029**	-0.021***	-0.141***	-0.028***	-0.154***	-0.014***	-0.012	-0.238***	-1.020**
	(1.97)	(-2.78)	(-13.17)	(-14.49)	(-11.12)	(-4.85)	(-1.28)	(-6.21)	(-2.50)
SOE-majority	0.192***	0.035***	-0.126***	-0.027***	-0.113***	-0.026***	-0.071***	-0.475***	-0.326
	(16.45)	(7.07)	(-16.88)	(-23.72)	(-19.61)	(-13.10)	(-11.66)	(-24.30)	(-1.56)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.176	0.341	0.140	0.050
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as net income over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities, multiplied by 100; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes, multiplied by 100. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. Panel C distinguishes SOEs with government stakes between 10% and 50%, between 50 and 55% (tight majority), and 100% (wholly-owned), with privately-owned firms as reference category. Panel C is estimated on a 2013-2018 sample. *t*-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the 2013-2018 period, i.e. the most recent part of our dataset. For most performance indicators estimated differences are virtually the same. Only employment and wage differences are considerably larger, and the tax rate difference is no longer significant in the post-crisis period.

In Panel C of Table 1 we analyze whether minority and majority-state-owned firms show different relative performances to POEs. Regarding employment, wages, leverage, and implicit interest rates, we find stronger performance differences vis-a-vis POEs for majority state ownership than for minority ownership but both effects are statistically significant. We find the opposite for productivity, profitability, and the effective tax rate: minority state ownership is linked to larger performance differences relative to POEs than majority state ownership. Both effects are again statistically significant. Only for financial constraints we find that majority-owned SOEs have a significantly lower degree of financial constraints whereas minority-owned SOEs do not significantly differ from POEs. Overall these results suggest that majority state ownership of SOEs is not a necessary condition

for negative performance effects relative to private firms to materialize. Further, the differences between minority and majority seem neither systematically ranked, nor systematically different from one another for the range of performance indicators.[10]

Robustness   In Appendix A.6 we report the results of several robustness checks. Table A.7 shows the results from estimating (1) on matched samples obtained from alternative matching strategies. Results are robust to the use of a more restrictive matched sample in which only matched combinations of firms with differences in propensity scores below the 90th percentile are retained to reduce the impact of 'poor' matches. Results are also robust to a matching procedure in which firms are matched on a year-by-year basis (i.e. in each year an SOE may be matched with a different POE). Using entropy balancing as an alternative approach neither affects results. Further, Table A.8 in the Appendix presents the results of regressions using a stable sample, such that estimations for each dependent variable are based on the same firm-year observations. We do so both for matched and unmatched samples. This mostly confirms our baseline results.[11] In Table A.9 in the Appendix, we also estimate our baseline specification using the three layers of SOE identification separately (*cf. supra*). Results continue to hold for each of these layers.

Our findings are also robust to various alternative specifications and (sub)samples, which we present at length in Table A.10. First, estimating the same specifications on the original, unmatched sample, we confirm the direction and significance of our baseline effects. Typically estimated coefficients are larger, suggesting that matching makes sense. Using the full sample, we also weigh firms by their respective sizes, which does not influence results. Second, filling missing values of ownership information based on earlier or later years yields similar results, with no one-directional over- or underestimating. Third, excluding firms from Russia and Ukraine from our sample given the substantially different historical backgrounds and governance structures in these countries, we find similar significant effects, though smaller in size. Fourth, we divide our sample into pre- and post-crisis parts. We confirm our main findings for both periods, but find slightly stronger effects post-crisis. Fifth, findings also hold for a subsample of manufacturing firms. Sixth, replacing the state ownership dummy with its lag yields similar results. Finally, when using firm and year fixed effects rather than country-industry-year fixed effects, earlier findings largely continue to hold using this more restrictive set fixed effects. Note that this approach isolates the impact of changes in state ownership on firm-level outcomes over time.

Privatisation & nationalisation   Since our approach is targeted towards obtaining precise estimates of performance differences, we refrain from making strong causal interpretations above. In Table 2 we use our data to perform three exercises that facilitate a causal interpretation and confirm our earlier results.

We first use the time dimension of our data and exploit nationalizations and privatizations in our data in a difference-in-differences approach. To analyze privatizations in panel A of table 2, we use a sample that is comprised of firms that are always state-owned (control) and state-owned firms that are privatized (treatment) at some point and remain private for the remaining years in the

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[10]In Appendix A.5 we allow for further heterogeneity between 'tight majority'-SOEs and 'wholly-owned'-SOEs. Overall, these findings suggest that among the two wholly-owned SOEs are most strongly linked to lower real and financial performance.

[11]We do, however, find significant, opposite signs for leverage and tax rates using a stable and balanced matched sample. Note that the sample size decreases substantially using these assumptions.

Table 2: State-ownership and performance: Evidence from privatizations and nationalizations

|	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
					A - Privatization				
Privat	-0.117***	0.002	0.097***	0.016***	0.110***	0.017***	0.050***	0.406***	-0.257
	(-9.26)	(0.35)	(11.68)	(10.22)	(13.79)	(8.57)	(8.19)	(14.94)	(-0.94)
N	212584	131842	90226	236676	160094	229617	140411	149747	146649
Adj. R^2	0.604	0.735	0.720	0.050	0.120	0.202	0.378	0.142	0.046
					B - Nationalization matched				
Nation	0.152***	0.031***	-0.118***	-0.030***	-0.125***	-0.022***	-0.056***	-0.440***	-0.859***
	(12.72)	(5.53)	(-12.76)	(-21.27)	(-17.50)	(-10.76)	(-8.13)	(-20.52)	(-3.50)
N	488724	287970	194229	535439	347042	532193	307345	343163	322929
Adj. R^2	0.593	0.708	0.716	0.038	0.100	0.164	0.334	0.146	0.056
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Panels A compares firms that are privatized and remain private with firms that are always state-owned. Panels B compares nationalized firms with firms that are never state-owned (without matching). Panel C includes estimations from Heckman selection models, with selection into government ownership governed by Probit models of government ownership on $ElectionYear_{c,t}$, $GovIdeology_{c,t}$, $ln(age)_{i,t}$, $ln(RoA)_{i,t-1}$, $ln(leverage)_{i,t-1}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as P/L over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

dataset. In panel B we analyze nationalizations. We focus on privately-owned firms that become and remain state-owned as a treatment group and use the matched always private firms as a control group. Both panels qualitatively confirm our earlier results. In panel A we find that privatization has a significant negative impact on employment (-12%), but not on wages. Privatization further significantly improves total factor productivity with 9.8%, return on assets with 1.6%-points and the profit margin with 11%-points. Firms become more leveraged (+1.7%-points), pay higher interest rates (+0.4%-points), and face more financial constraints. The tax rate is unaffected by privatization. Point estimates are slightly smaller than in panel A of Table 1 but confirm the performance differences found there. Panel B confirms these findings for nationalizations, but logically we find opposite effects compared to privatizations. Coefficients for nationalizations seem slightly larger in absolute values. Compared to the privatization effects, nationalizations also lead to significant wage increases (+3%) and lower tax rates (-0.9%-points).

We also modeled the dynamic effects of privatization in an event-study type difference-in-difference set-up. Figure 3 shows the results for employment and TFP that are typical of the time pattern we find for all indicators.[12] There is no immediate effect in the year of privatization ($t = 0$). The

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[12] Appendix A.7 shows results for the other variables.

Figure 3: Dynamic effects of privatizations: Results for employment and total factor productivity

(a) Employment (log)   (b) TFP (log)
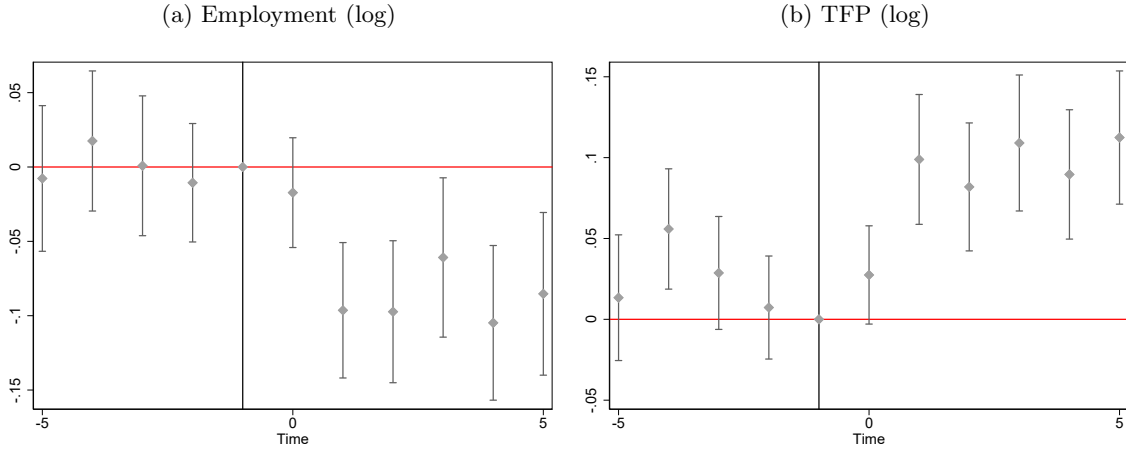
first year after privatization shows a significant performance improvement. Later years show the improvement is sustained, but we find no indications of further improvement vis-a-vis non-privatized SOEs.

Overall we find that our analysis of nationalizations and privatizations qualitatively leads to similar outcomes as above which strengthens the case for a causal interpretation.

5   State ownership and macroeconomic productivity (growth)

Recent years have seen increasing attention for the slowdown of aggregate productivity growth around the world and many potential drivers have been analyzed (see Goldin et al., 2024). In this section we investigate from the micro (firm-level) perspective how state ownership contributes to aggregate productivity (growth). We do so mainly within the context of the literature on (mis)allocation and decomposition of aggregate productivity growth (see Foster et al., 2008; Garcia-Macia et al., 2019; Hsieh and Klenow, 2009; and Melitz and Polanec, 2015). Specifically we analyze different margins along which state ownership may contribute to lower productivity growth. We first analyze TFP *growth* of SOEs versus POEs. Second, we analyze potential spillover effects of SOE presence on private firms' productivity (growth). Finally, we analyze how SOE presence affects business dynamism, i.e. the entry and exit of firms.

TFP   From the above we already know that SOEs have 13% lower TFP levels implying lower aggregate productivity when SOEs account for a larger share in a country's total value added. This is an indication of the potential for aggregate productivity growth through reallocation. In the first column of Table 3 we further estimate a similar specification but now with TFP *growth* as a dependent variable. We find that SOEs also show 2.21% lower TFP growth rates than POEs.

Since SOEs account for 9% of value added across countries and years in our micro data, reallocating these resources to the average private firm would imply a direct productivity boost of roughly 1.17%. In addition to the static TFP level gains, the reallocation would also lead to higher subsequent TFP growth. Given that POEs have on average a 2.21%-points higher TFP growth rate than SOEs overall annual productivity growth could be 0.20%-points higher.[13]

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[13]Note that this holds for SOEs in the business economy, not in e.g. education or healthcare.

Table 3: State-ownership and TFP: TFP growth differential and spillovers to private firms

	(1) TFP growth	(2) TFP	(3) TFP	(4) TFP growth	(5) TFP growth
	SOE vs POE	SOE spillovers to POE			
SOE dummy	-0.024*** (-7.43)				
SOE presence (ttl assets, std)		-0.016*** (-3.60)		-0.005*** (-2.68)	
SOE presence (turnover, std)			-0.019*** (-3.62)		-0.006** (-2.45)
N	187,730	15,401,785	15,400,737	11,957,142	11,956,188
Adj. R^2	0.134	0.593	0.593	0.143	0.143
Sample	Matched	All private	All private	All private	All private
Level of TFP	Y	n.a.	n.a.	Y	Y
Controls	Y^1	Y	Y	Y	Y
FE	C-I-Y	C-Y, I-Y	C-Y, I-Y	C-Y, I-Y	C-Y, I-Y

NOTES: Column headings indicate dependent variables. TFP is the log of total factor productivity estimated by WLP-methodology. TFP growth is the y to $y+1$ growth rate thereof. Control variables include $ln(age)_{i,t}$, $ln(total assets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed, lags of the Herfindahl index, the market share of the four largest enterprises in a given industry, and the market share of the firm under observation within C-I-Y combinations. [1] does not include industry concentration controls. Fixed effects are country-year and industry-year dummies, or country-industry-year dummies, as indicated. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

This calculation excludes potential 'spillover' effects of SOE presence on POE productivity. Our next exercise is precisely the estimation of potential productivity spillovers. To do so we calculate the share of SOEs in industry total operating revenue or total assets by country-industry-year groups as in (2) with Y operating revenue or total assets for firm i in industry j in country c at time t (see also Cevik, 2020):

$$SOEpresence_{jct} = \frac{\sum_{i \in jc} SOE_{it} * Y_{it}}{\sum_{i \in jc} Y_{it}} \qquad (2)$$

To estimate the effect of state presence we relate TFP levels and growth rates of POEs to the variable $SOEpresence$. As in our estimations above, we control for lagged firm size, age, and listed and foreign dummies in our estimations. Additionally, we include lags of the Herfindahl index, the market share of the four largest enterprises and the market share of the firm under consideration within country-industry-year combinations. Since $SOEpresence$ is measured at the country-industry-year, we control for country-year and industry-year fixed effects separately. Standard errors are clustered at the country-industry-year level.

$$TFP(growth)_{ijct} = \beta_0 + \beta_1 SOEpresence_{jct} + \beta_2 HHI_{jct-1} + \beta_3 MS4_{jct-1} + \beta_4 MS_{ijct-1}$$
$$+ \beta_5 X_{ijct} + \gamma_{ct} + \gamma_{jt} + \epsilon_{ijct} \qquad (3)$$

Table 4: State-ownership and performance: spillover to other firms and industry dynamics

	(1) BirthRate	(2) DeathRate	(3) ChurnRate	(4) BirthRate	(5) DeathRate	(6) ChurnRate
SOE presence (ttl assets)	0.012*	0.0001	0.012			
	(1.80)	(0.03)	(1.30)			
SOE presence (turnover)				0.011	-0.005	0.006
				(1.24)	(-1.01)	(0.50)
N	5980	5980	5968	5971	5970	5959
Adj. R^2	0.580	0.257	0.501	0.580	0.257	0.502
Controls	Y	Y	Y	Y	Y	Y
C-Y & I-Y FE	Y	Y	Y	Y	Y	Y

NOTES: Units of observation are country-industry-year combinations. Column headings indicate dependent variables. $BirthRate$ is the enterprise births divided by active enterprises according to Eurostat, $DeathRate$ is the enterprise deaths divided by active enterprises according to Eurostat, $ChurnRate$ is the sum of birth and death rates according to Eurostat. Control variables include lags of the Herfindahl index, the market share of the four largest enterprises in a given industry, industry enterprise growth according to Eurostat, and industry turnover growth according to Eurostat. Fixed effects are country-year and industry-year dummies. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Columns 2 to 5 in Table 3 show the results from estimations on the full sample of private firms. We find significant negative spillover effects of SOE presence for TFP levels and growth rates, and for the turnover and total assets definition of $SOEpresence$. The estimated coefficients imply that a one standard deviation decrease in the SOE share in total industry total assets (turnover) would be associated with a 1.6% (1.9%) higher TFP level and a 0.5% (0.6%) higher TFP growth. These spillover results suggest a further potential gain in aggregate productivity through reallocation. Clearly, other socially desirable outcomes being achieved through SOE presence are not accounted for in this exercise.

Business dynamism   Business dynamism is another important factor for aggregate productivity as competitive pressures drive inefficient firms out of the market, induce productive incumbent firms to expand, and new competitive ones to enter (see Anderton et al., 2020 and Garcia-Macia et al., 2019). Business dynamism thus may affect aggregate productivity through improvements in resource allocation. Therefore we now also present an exercise where we allow SOE presence to affect business dynamism. Specifically, we retrieve data from Eurostat on business birth, death, and churn rates.[14]   These data are available at the country-industry-year level which is our unit of observation in this exercise. We then regress these variables on the share of SOEs in country-industry-year groups calculated in (2) above. Following Anderton et al. (2020), we include industry enterprise and turnover growth (both retrieved from Eurostat) as control variables in the estimation. We further include (lags of) the Herfindahl index for industry concentration and market share of the four largest enterprises in a given industry, as industries with higher concentration tend to be less dynamic irrespective of SOE presence.

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[14]The churn rate is defined as the sum of birth and death rate and indicates the overall dynamism of the industry.

$$BusinessDynamism_{jct} = \beta_0 + \beta_1 SOEpresence_{jct} + \beta_2 HHI_{jct-1} + \beta_3 MS4_{jct-1}$$
$$+ \beta_4 EnterpriseGrowth_{jct-1} + \beta_5 TurnoverGrowth_{jct-1} + \beta_6 X_{ijct} + \gamma_{ct} + \gamma_{jt} + \epsilon_{ijct} \quad (4)$$

The results are shown in Table 4. Throughout the table, we find no significant effects on industry dynamics. The presence of SOEs in a given industry thus does not seem to affect the business birth rate, death rate, or churn rate in that industry.

Overall, these findings imply that the presence of SOEs may affect productivity (growth) through (mis)allocation effects but not through business dynamism.

6   Socially desirable outcomes

The previous analyses analyze SOEs through the lens of firm performance based on profit maximization and efficiency considerations. But unlike at private firms, decision making at state-owned firms is not necessarily driven purely by profit-maximizing behavior. As discussed in section 2, SOEs may differ from POEs in their objectives and operations, often prioritizing socio-economic goals like employment stability, economic development, and public welfare over pure profit maximization (e.g. Lazzarini and Musacchio, 2018 and Megginson and Netter, 2001). Governments and politicians may thus influence decision-making processes in SOEs towards more socially desirable goals (or for electoral gain). In this section we pursue several exercises –that our data allow for– that may lend support to such a view of the SOE.

Collectivism   If other more socially desirable goals than profit maximization drive SOE behavior and performance we may expect relative performance differences between SOEs and POEs to be more pronounced in countries that place a higher value on such goals. To test the latter effect on the relationship between state ownership and firm performance we estimate specification (5). Specifically, we augment (1) with an interaction effect between the state ownership dummy and a variable proxying the weight attached to socially desirable outcomes over profit maximization ($WSDG$). Note that the level effect is absorbed by the country-industry-year interaction fixed effects included in specification (5).

$$Performance_{ijct} = \beta_0 + \beta_1 * SOE_{ijct} + \beta_2 * SOE_{i,t} * WSDG_c + \beta_3 * X_{ijct} + \gamma_{jct} + \epsilon_{ijct} \quad (5)$$

We consider two measures to capture the weight attached to socially desirable outcomes. We consider *collectivist* which is an indicator that captures the degree to which a society emphasizes group needs and interdependence, and is developed by Hofstede (1980). As an alternative to the continuous variable *collectivist* we use a dummy variable *socialist* that indicates whether a country has a socialist legal tradition. The classification is taken from La Porta et al. (1999).[15]   Collectivist

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[15]Note that *collectivist* and *socialist* are time-invariant and only vary across countries.

Table 5: Non-profit maximisng culture and performance differences between SOEs and POEs

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
					A – Collectivist country				
SOE	0.157***	0.0318***	-0.114***	-0.0277***	-0.115***	-0.0220***	-0.0686***	-0.476***	-0.460**
	(13.09)	(7.11)	(-15.49)	(-26.97)	(-20.51)	(-12.21)	(-12.15)	(-25.79)	(-2.33)
SOE x collectivist	0.0473***	0.0467***	-0.0639***	-0.0126***	-0.00997	-0.0219***	-0.0559***	-0.238***	-0.871***
	(4.24)	(12.03)	(-8.79)	(-11.10)	(-1.52)	(-11.36)	(-10.60)	(-10.27)	(-4.09)
N	648351	390070	264650	704633	462286	702839	410912	467470	427593
Adj. R^2	0.591	0.689	0.703	0.038	0.099	0.176	0.331	0.140	0.043
					B – Socialist country				
SOE	0.175***	0.0511***	-0.138***	-0.0281***	-0.116***	-0.0258***	-0.0812***	-0.546***	-0.247
	(15.66)	(11.06)	(-19.34)	(-26.57)	(-21.12)	(-14.31)	(-14.56)	(-26.60)	(-1.29)
SOE x Inst.	0.0481***	0.0688***	-0.0472***	-0.0108***	0.00805	-0.0153***	-0.0441***	-0.276***	0.588***
	(4.40)	(13.66)	(-6.33)	(-9.72)	(1.44)	(-8.10)	(-7.45)	(-11.90)	(3.07)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.177	0.341	0.141	0.050

NOTES: Regressions based on matched data. Column headings indicate dependent variables. $Empl$ is the log number of employees; $Wage$ is the log of real wage costs per employee; TFP is the log of total factor productivity estimated by WLP-methodology; RoA is return on assets calculated as P/L over total assets; $Profit$ is the operating profit margin calculated as operating P/L over sales; $Leverage$ is calculated as long-term debt over total assets; $FinCon$ is an indicator of financial constraints from Mulier et al. (2016); $IntRate$ is the implicit interest rate calculated as interest expenses over liabilities, multiplied by 100; $TaxRate$ is the effective tax rate calculated as tax expenses over P/L before taxes, multiplied by 100. RoA, $Profit$, $Leverage$, $FinCon$, $IntRate$, and $TaxRate$ variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(total assets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

and socialist societies hold a stronger belief in common, societal objectives other than private profit maximization. Therefore we expect countries with a more collectivist or a socialist background to put more emphasis on outcomes other than profitability and efficiency and hence show larger differences between SOEs and POEs. In terms of (1) we expect β_1 and β_2 to carry the same sign for the different outcomes.

We present results in two panels in Table 5. Panel A shows that in more collectivist countries performance differences between SOEs and POEs are indeed significantly and considerable larger. A one standard deviation increase in 'collectivism' results e.g. in an employment differential of 20 rather than 15% and TFP is 18% lower rather than 12%. Return on assets is an additional 1.3%-points lower although the profit margin differential is not affected collectivism. Interest rate, tax rate, and financial constraint differentials are also magnified in collectivist countries. Panel B confirms these patterns when we use the 'socialist' dummy rather than 'collectivism' variable. These findings suggest that at least part of the underperformance of SOEs may be intentional because other outcomes are prioritized over profit maximization.

Stability In a second exercise, we focus on additional firm-level outcomes that are more reflective of socially desirable outcomes than traditional performance indicators. Governments may use SOEs as a tool for stabilizing the economy. To test for such stabilizing effects, we create the following variables for each firm: i) the log standard deviation of employees (over the period by firm); ii)

Table 6: State-ownership and performance: societal objectives

	(1) StDevEmpl	(2) StDevMatCost	(3) StDevEmpl	(4) StDevMatCost	(5) PatStock	(6) Patenter
	Firm-period obs.				Firm-year obs.	
SOE	-0.120***	-0.162***	-0.086***	-0.124***	-0.021***	-0.006***
	(-4.62)	(-7.26)	(-2.71)	(-4.62)	(-8.10)	(-10.42)
SOE x Crisis			-0.097*	-0.108**		
			(-1.78)	(-2.27)		
N	68704	66012	68704	66012	764467	829937
Adj. R^2	0.426	0.824	0.426	0.824	0.206	0.747
FE	C-I-period	C-I-period	C-I-period	C-I-period	C-I-Y	C-I-Y
Set of controls	1	1	1	1	2	2

NOTES: Column headings indicate dependent variables. *StDevEmpl* is the log standard deviation of employees by firm and period; *StDevMatCost* is the log standard deviation of material expenses by firm and period; *PatStock* is the log number of patents a given firm holds; *Patenter* is a dummy variable indicating whether the firm possesses patents. The periods used in columns 1 to 4 are 2004-2007, 2008-2011 and 2012-2015. Crisis refers to the second period (2008-2011), and encompasses the Global Financial Crisis and its aftermath. In these columns, the explanatory variable, SOE, indicates whether the given firm was state-owned for at least one year during each period. Control variable set 1 includes the mean of log employees, log turnover, log total assets, log TFP, and RoA by firm and period, as well as the maximum values of log age, and dummies for foreign ownership, the firm's listing, and the number of years of employment data used to calculate the dependent variable for the given firm. Control variable set 2 includes $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the log standard deviation of material input costs. We define these variables over three separate four-year periods (2004-2007, 2008-2011 and 2012-2015).

We then estimate specification (1) using these two variables as dependent variable. Since we aggregate observational units to three 4-year periods we retain (at most) three observations per firm and fixed effects are now defined as country-industry-*period* dummies. Control variables are firm-level period-average log of employees, log of real turnover, log of real total assets, log TFP, RoA, and log age. We further include dummies for foreign ownership and firm's listing status.[16] Finally, we also include the number of years of data used to calculate the dependent variable for the given firm.

Table 6 presents results in columns 1 to 4. In columns 1 and 2, we find that SOEs exhibit a less volatile behavior in terms of employment and the use of material inputs than POEs. For employment we find a 12% lower standard deviation, for material inputs a 16% lower standard deviation. In columns 3 and 4 we allow for this effect to be heterogenous and test whether stability considerations matter more in times of crisis. We refer to the 2008-2011 period as a crisis period since it encompasses the Global Financial Crisis and its immediate aftermath and test whether volatility is different in this period. We indeed find that SOEs show stronger stability over the crisis period. In times of crisis the effect roughly doubles while it remains significant in the non-crisis period.

Innovation SOEs' mandate beyond profit maximization may allow them to invest in long-term, high-risk innovation projects with significant public benefits (Tõnurist and Karo, 2016). As basic

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[16]We set the variables to one if the status holds in at least one year of the period since time variation in these variables is very limited.

knowledge is often of non-rival and non-excusable nature (Arrow, 1972 and Stiglitz, 1999), there are few incentives for private actors to engage in such research. SOEs thus may engage in R&D that produces public goods, generating positive externalities often underprovided by the private sector (Belloc, 2014; Mazzucato, 2011; and Salter and Martin, 2001).

Our dataset does include information on firms' patenting with the European Patent Office allowing us to test differences in patenting between SOEs and POEs. In column 5 and 6 of Table 6 we present the results of estimating (1) using either firms' patent stock or a dummy indicator of patenting activity as dependent variables. We find that SOEs are less likely to be patenting and have a lower patent stock. Unfortunately, patents are not the best possible outcome to test as they are precisely a solution to the incentive problem induced by innovation's non-rival and non-excusable characteristic. We therefore refrain from any sharp conclusion.

Institutions   Like state ownership is considered as a policy response to market failure (e.g. case of innovation), state ownership may similarly serve as a way of overcoming a low quality of institutions. Under such a view, lower quality of institutions should go hand in hand with smaller performance differences between POEs and SOEs or even SOEs outperforming POEs. On the other hand, it is precisely governments that are responsible for institutions like the protection of property rights or the control of corruption. Governments that attach less weight to the quality of these institutions are potentially poorly fit to set up mechanisms to overcome the agency problems within SOEs (cf. literature section). Under such a view one would thus expect larger differences between SOEs and POEs in low institutional quality environments.

To test this we leverage the cross-country diversity in institutions in our dataset and estimate specifications like (5), considering interaction effects with several institutional variables. For an easier interpretation of estimates between institutions, institutional variables are standardized such that β_2-estimates reflect the effect of a one standard deviation increase in the institution under consideration.[17]   We consider the following institutions: the level of property rights, control of corruption, the ease of enforcing contracts, the rule of law, and the level of democracy.

Table 7 contains the result. Overall, results indicate that better quality institutions mitigate performance differences between SOEs and POEs as the interaction term generally shows an opposite sign to the main association. Almost in all cases –i.e. independent of outcomes and institutions– interaction effects are significant. The estimated coefficients of the interaction terms are large in size as estimates imply a reduction of performance differentials by 20% to 60% following a one standard deviation improvement in the quality of institutions. Whereas these variables capture different aspects of the institutional environment and thus may give rise to different potential mechanisms, they all share that they are controlled by governments that are also managing SOEs. Our results thus suggest that governments that attach less weight to the quality of institutions are also running SOEs less efficiently or place higher weight on other than traditional performance outcomes. These results suggest that SOEs are complements to, rather than substitutes for, lower quality institutions.

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[17]Table A.11 in appendix provides an overview of the data sources of the institutional variables.

Table 7: Performance differences between SOEs and POEs: the role of institutions

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
					Level of property rights				
SOE	0.179***	0.0468***	-0.146***	-0.0280***	-0.125***	-0.0246***	-0.0748***	-0.497***	-0.145
	(16.27)	(10.84)	(-19.08)	(-24.51)	(-20.53)	(-11.99)	(-12.86)	(-24.24)	(-0.73)
SOE x Inst.	-0.0254**	-0.0589***	0.0440***	0.00414***	0.0179**	0.000650	0.0279***	0.159***	-0.632**
	(-2.41)	(-13.12)	(5.11)	(3.42)	(2.41)	(0.28)	(4.27)	(6.98)	(-2.49)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.176	0.341	0.141	0.050
					Control of corruption				
SOE	0.173***	0.0613***	-0.141***	-0.0276***	-0.126***	-0.0250***	-0.0873***	-0.529***	-0.270
	(15.47)	(13.48)	(-19.43)	(-26.58)	(-22.07)	(-14.45)	(-15.21)	(-27.08)	(-1.32)
SOE x Inst.	-0.0340***	-0.0999***	0.0595***	0.0111***	0.0264***	0.0195***	0.0679***	0.271***	-0.488*
	(-2.92)	(-17.33)	(5.34)	(9.56)	(3.55)	(9.70)	(9.74)	(10.04)	(-1.90)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.177	0.341	0.141	0.050
					Ease of enforcing contracts				
SOE	0.208***	0.0304***	-0.125***	-0.0245***	-0.117***	-0.0203***	-0.0665***	-0.440***	-0.301
	(17.06)	(6.97)	(-16.79)	(-21.29)	(-20.48)	(-10.98)	(-11.28)	(-23.94)	(-1.49)
SOE x Inst.	-0.0911***	-0.0592***	0.0363***	-0.000350	0.0108*	-0.00973***	0.00685	0.172***	-0.220
	(-7.35)	(-9.82)	(4.28)	(-0.28)	(1.79)	(-5.65)	(0.97)	(8.80)	(-0.89)
N	536130	365193	249357	588125	445128	591024	397600	408193	410592
Adj. R^2	0.595	0.697	0.705	0.042	0.099	0.180	0.344	0.143	0.048
					Rule of law				
SOE	0.173***	0.0624***	-0.148***	-0.0277***	-0.126***	-0.0251***	-0.0881***	-0.539***	-0.261
	(15.55)	(13.94)	(-19.99)	(-26.63)	(-21.66)	(-14.41)	(-15.26)	(-26.89)	(-1.25)
SOE x Inst.	-0.0293**	-0.0974***	0.0832***	0.0115***	0.0267***	0.0185***	0.0667***	0.292***	-0.484*
	(-2.50)	(-16.54)	(7.12)	(9.55)	(3.40)	(9.03)	(9.23)	(10.68)	(-1.78)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.177	0.341	.141	0.050
					Level of democracy				
SOE	0.175***	0.0634***	-0.175***	-0.0265***	-0.136***	-0.0230***	-0.0935***	-0.504***	-0.314
	(15.83)	(10.63)	(-15.78)	(-26.96)	(-18.35)	(-13.44)	(-16.51)	(-24.78)	(-1.47)
SOE x Inst.	0.00845	-0.0823***	0.111***	0.00940***	0.0478***	0.0159***	0.0804***	0.208***	-0.249
	(0.87)	(-7.97)	(5.06)	(8.18)	(4.03)	(8.74)	(10.97)	(7.31)	(-0.78)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.177	0.341	0.141	0.050

NOTES: Regressions based on matched data. Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as P/L over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities, multiplied by 100; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes, multiplied by 100. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

7 Conclusion

Since the late 2000s, shocks and crises of various types have led to a revival of state intervention through industrial policy and state ownership around the world. This paper constructs a large firm-level dataset to present a timely analysis of state ownership of firms and its effects on the wider economy in Europe for the period 2002-18. We have constructed our dataset of time-varying state ownership by meticulously analyzing annual data on firms' ownership structures from multiple annual versions of Orbis Europe (Amadeus). By using all firms active in the business economy from 29 European countries we are able to provide a comprehensive and nuanced picture of state ownership. This advances our understanding as prior research typically has focused on samples limited to firms listed on stock exchanges, or firms from specific countries or industries.

In our dataset of almost 100 million firm-year observations about 0.5% firms is state-owned at both the beginning and end of our sample, with more elevated levels of about 0.7% at the time of the Great Recession. State shares in SOEs are concentrated around stakes slightly above 50% and above 95%. SOE presence is most pronounced in industries related to utilities and transportation, but is also non-negligible in all other industry groups. These observations hold across countries with different legal traditions but are least pronounced in countries with an English legal tradition. Notwithstanding privatisation efforts following the Washington consensus policy advice, countries with a socialist legal tradition show higher levels of SOE presence in our dataset.

Through a matching exercise we find substantial performance differences between SOEs and POEs within tight country-industry-year cells. We find that SOEs employ more workers and pay higher wages. SOEs are also less productive and profitable, and face lower effective tax rates. SOEs are less financially constrained and are also less leveraged than their private counterparts. These effects are substantial: e.g. employment at SOEs is 17.4% larger than at comparable POEs, TFP is 12.9% lower, and profit margins are 11.8%-points lower. These results are corroborated through a long list of robustness checks and a causal interpretation is strengthened through additional evidence from privatizations and nationalizations in a difference-in-difference setting. Our results also hold in the more recent period 2013-18 post-crisis period. The results are not unique to majority state-owned SOEs. Majority ownership is not a necessary condition for underperformance relative to POEs to materialize.

In addition to 12.9% lower TFP levels, we additionally find that SOEs show 2.2% lower TFP growth rates than POEs. A back-of-the-envelope calculation based on our data reveals a maximal potential increase in aggregate productivity of 1.17% when reallocating all resources of SOEs to POEs. Such a reallocation further implies that aggregate productivity growth would be 0.2%-points higher annually. In addition to these direct effects, we also investigate how SOEs may indirectly affect aggregate outcomes through spillover effects on POEs. We find that state presence is significantly negatively associated with POEs' TFP levels and growth rates. Specifically, a one standard deviation lower SOE share in total assets in a given country-industry-year is associated with a 1.56% (0.49%) higher POE productivity level (growth rate). SOE presence in an industry does not seem to affect business dynamism (birth, death, or churn rate) in that industry.

In the final section of our paper we have presented several empirical exercises to acknowledge that state ownership may be motivated to tackle market failures or target other 'socially desirable' outcomes. We first have leveraged the cross-country nature of our dataset to test whether performance differences are larger in countries that are more likely to place a higher weight on socially desirable goals. We indeed find evidence of larger differences in countries that are more collectivist or have a socialist legacy. We also have tested whether SOEs are used as a tool to stabilize the economy and have found that SOEs show a substantially lower firm-level variability of employment and material input use than POEs. In crisis periods this effect roughly doubles. SOEs may also be a tool to overcome low-quality institutions. Lower-quality institutions should then be associated with smaller performance differences between SOEs and POEs. Results indicate however that higher-quality institutions mitigate performance differences. This suggests that governments that attach less weight to the quality of institutions are probably also less likely to set up mechanisms to overcome agency problems within SOEs.

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A   Appendix

A.1   List of terms used to identify potential SOEs

This appendix contains terms referring to potential state ownership, used to flag firms for manual verification.

abu dhabi national energy	gemeinde	mestsky urad	provins
administra	generalitat	mestský úrad	provints
afdeling	gewest	miasto	provinz
ajuntament	gmina	miejski	prowincja
allam	gobierno	miestas	public investment
alue	gorod	minimushchestvo	r slovenia
apgabals	gouvernement	ministeerium	raion
apv	governia	ministère	regering
apygarda	government	ministero	regiao
arrondissement	governo	ministerstvo	região
auktorit	grad	ministrija	regierung
authority	grevskap	ministrstvo	region
autoridad	grofstva	ministry	région
autorit	grófstva	miniszsterium	regiune
autorizacao	gubernija	mubadala development	regjeringen
autorização	guvern	municĂpio	republiek
autorytet	hallitus	municipal	republik
avtoriteta	hatalom	municipio	republique
ayuntamiento	hatosag	municÍpio	riik
behorde	hatóság	municipiu	rzad
behörde	hrabstvi	myndighe	saudi arabian oil
bezirk	hrabství	national	saudi aramco
by	hungarian development bank	national pensions reserve fund	saudi basic industries
cetate	hungarian national asset management	national treasury management agency	sepi desarrollo empresarial
china aerospace	igaliojimai	nazionale	sfera
china petrolium	industriale finanziaria	nazione	sinopec
cidade	intercommun	novada	social security
circoscrizione	investment authority	nozare	sociedad estatal
citta	investment council	nprf	solidium
città	ireland strategic investment fund	obcina	sovereign
city	isif	obec	sritis
ciudad	istituto finanziaria	oblast	staat
comarca	istituto per la ricostruzione industriale	obshtina	stad
comitat	judet	ocmw	stat
commun	jurisdicao	oesterreichische industrieholding	state
comuna	jurisdição	okres	statul
comune	jurisdiccion	okrug	superannuation
comunidade	jurisdiction	omavalitsus	tartomany
comunita	kanslia	omrade	tartomány
condado	kaupunginhallitus	onkormanyzat	temasek
consiliul	kaupunki	ÖnkormÁnyzat	tinut
county	khazanah nasional berhad	opcina	uprava
departament	kommun	openbaar	urad
departemang	kommunal	opravneni	úrad
departement	kommune	oprávnení	urbe
département	kompetence	oras	valdiba
departementet	kormany	orasul	valdzia
development agency	kormány	organ	valdžia
development corp	kozseg	osakond	valitsus
development fund	község	overheid	valstija
didmiestis	krahvkond	pais	valsts
district	kraj	panstvo	valstybe
distrito	krajevna skupnost	panstwo	valta
dp world	kunnanhallitus	parpublica	valtio
drzava	kunta	piirikunta	varos
država	laani	pilnvaras	város
dubai world	lääni	pilseta	videk
duchovni urad	lan	pilsetas	ville
duchovní úrad	län	pokrajina	vlada
emirates national oil	land	polish national investment fund	vláda
empresa publica	landesholding	powiat	volitused
estado	linn	pravitel	vyriausybe
etat	maakond	provinca	wladza
état	maakunta	province	wojewodztwo
federal	magistrat	provincia	województwo
federale participatie	megye	província	zagrebacki holding
finpro-sociedade	mesto	provincie	zupanija
fylke	mestska	provincija	
gemeente	mestská samospráva		

A.2 Summary statistics of key variables

In Table A.2, we present summary statistics for all key variables in our dataset: i.e. those used as dependent variables in estimations. One may observe that information is not available for all firm-year combinations. For example, while the total number of observations with identified ownership type is 97,695,447, we typically only observe values for our performance and productivity indicators for around a third of the observations, with as low as 16,949,893 for TFP. Data regarding firm's ownership is available for most observations (97,695,447 of the 126,418,464). In our dataset, 0.52% of the firm-year combinations are identified as state-owned. Most of these government-owned firms are majority state-owned (330,918 are identified as majority state-owned, contrasting to 43,423 minority-owned).

The table also compares means of performance and productivity indicators between privately- and state-owned firms. Notably, state-owned enterprises tend to employ more personnel at a comparatively higher expense, exhibit lower profitability, and are subject to lower interest rates. It's important to note that the standard deviations for these metrics are substantial (not shown).

Table A.2: Summary statistics of key variables

Variable	Observations (2002-2018)	Mean	p10	p50	p90	Mean Private firms	Mean State firms
Number of employees	62,464,831	17.197	1	3	25	18.555	143.064
Wage per employee	27,495,032	33,101.10	2590.083	22,741.13	58,234.50	34,559.17	49,043.1
Log(TFP)	16,949,893	5.988	4.522	6.093	7.289	6.044	6.460
Revenue efficiency (output/employee)	42,389.295	302,804.7	5,131	71,761.88	372,552.90	308,744.2	878,816.7
Leverage	59,137,984	0.1881	0	0	0.5964	0.1865	0.1660
Implicit interest rate (1 = 1%)	26,001,117	3.3965	0.01015	1.6549	5.9057	3.4913	2.4168
Financial constraints (ASCL score)	27,828,023	2.1491	1	2	4	2.1820	2.6072
RoA	61,057,114	-0.0181	-0.2146	0.0192	0.2758	-0.0122	-0.0349
Operating profit margin	41,478,930	-0.0816	-0.2308	0.0357	0.4281	-0.0803	-0.3425
Tax rate (1 = 1%)	52,243,391	13.5259	-0.0003	12.0133	33.3299	13.7759	13.604
Patenter (dummy variable)	126,418,464	0.0046	0	0	0	0.0055	0.0097
Stock of granted patents	126,180,333	0.0072	0	0	0	0.0082	0.0478

Number of observations with identified ownership type: 97,695,447
Number of observations with identified state ownership: 510,862 (0.52%)
Number of observations with identified majority/minority state ownership: 330,918/43,423
Number of observations with identified ownership type (gaps and missing values filled): 126,416,882
Number of observations with identified state ownership (gaps and missing values filled): 668,231 (0.53%)

NOTES: Financial variables (leverage until tax rate) are winsorized at 0.5 and 99.5 percentiles within groups of state and non-state-owned firms.

A.3 Share of SOEs by country characteristics

As discussed in section 3.2 (and more notably in Figure 2), the prevalence of state ownership vastly differs between countries grouped by legal tradition. Especially countries with a Socialist legal tradition are characterized by greater importance of SOEs in their domestic economies. In the spirit of La Porta et al. (2002) we test this finding more formally by regressing the prevalence of SOEs on dummies indicating the legal origin of each country, controlling for time and industry fixed effects in (6) (La Porta et al. (2002) examine a similar relationship for the financial sector).

$$SOEpresence_{jct} = \beta_0 + \beta_1 * LegalOrigin_c + \gamma_j + \gamma_t + \epsilon_{jct} \qquad (6)$$

with $SOEpresence_{jct}$ being the share of SOEs in total assets, employment, and total turnover of each combination of country c, industry j, and year t, as defined in equation (2).

Table A.3: Share of SOEs in the economy by different legal origins

	(1)	(2)	(3)
		SOE share in	
	Operating revenue	Employees	Total assets
French	1.575***	1.291***	2.187***
	(5.32)	(4.27)	(6.45)
German	3.594***	2.759***	6.454***
	(9.94)	(7.56)	(15.21)
Scandinavian	4.174***	3.350***	4.805***
	(13.17)	(10.35)	(13.24)
Socialist	4.713***	5.554***	6.256***
	(16.82)	(19.39)	(19.51)
Test for equality of coefficients			
French=German	50.09***	28.83***	122.0***
French=Scandinavian	103.8***	63.80***	96.61***
French=Socialist	240.5***	376.7***	314.1***
German=Scandinavian	90.50***	55.13***	131.2***
German=Socialist	142.8***	215.2***	196.2***
Scandinavian=Socialist	141.8***	209.8***	192.8***

NOTES: Coefficients can be interpreted as percentage changes in dependent variables. Each specification includes industry and year fixed effects. Excluded category is English legal origin. English legal origin: United Kingdom, Ireland. French legal origin: Belgium, France, Greece, Italy, Netherlands, Portugal, Spain. German legal origin: Austria, Germany, Switzerland. Scandinavian legal origin: Denmark, Finland, Norway, Sweden. Socialist legal origin: Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Russia, Slovenia, Slovakia, Ukraine. t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Results in Table A.3 indeed confirm that state ownership is significantly less prevalent in countries with an English legal tradition than in countries with any other legal tradition. We find the highest prevalence of state firms in Socialist countries, followed by countries with Scandinavian, German, and French legal origins, except for the share of SOEs in domestic total assets, for which the highest estimate is found for Germanic countries (with the same ranking thereafter). All coefficients signif-

icantly differ from one another.

We further validate our firm data by presenting correlations of the presence of state ownership, measured as before, and other time-varying country characteristics. We consider several indicators reflecting i) financial development, ii) economic development, and iii) institutional characteristics. While disparities in characteristics are somewhat less pronounced within Europe than on a global scale, the European countries in our datasets still present considerable variation in many characteristics. The United Kingdom, for example, has a more developed stock market than Romania. Some economies are more dependent on manufacturing, others more on the service industry. We define 'prevalence', as before, as the share of SOEs in the total turnover, number of employees, and total assets of all firms in industry j in country c (cf. (2)). These measures are subsequently regressed on the different characteristics while controlling for a country's legal tradition. We standardize country characteristics to allow for easier comparison across specifications. Standard errors are clustered at the country-year level.

$$SOEpresence_{jct} = \beta_0 + \beta_1 * std\_CountryCharacteritistic_{ct} + \beta_2 * LegalTrad_c + \gamma_j + \gamma_t + \epsilon_{jct} \quad (7)$$

We hypothesize that higher levels of financial development (panel A) allow for private initiatives to obtain the necessary funding, through capital or credit markets, to establish themselves and/or to grow. Therefore, given that POEs face lower budget constraints with a more developed financial sector, the role of SOEs to undertake initiative when the private sector is financially too constrained to do so, becomes smaller. Furthermore, we also expect lower shares of SOEs in the national economies of countries characterized by greater economic development (panel B), partly because such countries typically have better institutional quality (which we discuss separately in panels A and panel C), but also because more advanced economies typically produce highly specialized products and services, which may be more difficult for bureaucratic, government-run firms. Finally, better legal, political, and business-related institutions (panel C) make it easier for private businesses to perform their activities, with fewer administrative hurdles, and free from unwanted interference to the benefit of government officials. Also, collectivist (Hofstede, 1980) societies hold a stronger belief in common, societal objectives, for which government intervention is a necessity. We hence expect lower SOE shares in countries with such institutional quality.

Table A.4 presents results. Each entry in the Table is a β_1-coefficient obtained from running (7) with the dependent variable indicated in the column heading and the country characteristic in the row heading. The findings reveal significant correlations for almost all table entries. The estimated coefficients imply that a one standard deviation change in the country characteristic is typically associated with a change in the prevalence of SOEs of 1 to 2 percentage points. For our indicators of financial (credit offered by banks, stock market capitalization, stocks traded as % of GDP) and economic development (per capita GDP, the share of agriculture and the share of services in GDP, the share of high-tech goods in exports, the number of R&D technicians) all correlations are significant at the 1%-level and point to a negative correlation of state ownership and financial and economic development. Panel C of Table A.4 shifts the focus to institutional development. We find further validation of our data in correlation with the expected signs that are almost always significant at

Table A.4: Share of SOEs in the economy by different institutional environments

	(1)	(2)	(3)
		SOE share in	
	Operating revenue	Employees	Total assets
A - Financial development			
Credit by domestic banks to firms (% GDP)	-1.414***	-1.949***	-1.859***
	(-18.25)	(-24.75)	(-20.73)
Stock market capitalization (% GDP)	-1.163***	-1.693***	-1.482***
	(-11.72)	(-17.28)	(-11.55)
Value of traded stocks (% GDP)	-0.696***	-1.177***	-0.731***
	(-7.63)	(-12.76)	(-6.71)
B - Economic development			
log GDP per capita	-1.564***	-2.550***	-2.125***
	(-20.53)	(-32.99)	(-24.10)
Agriculture share (% value added)	1.536***	2.403***	2.024***
	(21.31)	(33.00)	(24.34)
Service share (% value added)	-1.576***	-2.098***	-1.978***
	(-21.60)	(-28.33)	(-23.37)
High tech exports (% total exports)	-1.036***	-1.439***	-1.508***
	(-11.36)	(-16.19)	(-14.29)
R&D technicians (per mln. inhabitants)	-0.703***	-1.211***	-1.079***
	(-7.74)	(-12.92)	(-10.12)
C - Institutional development			
Quality of government	-1.084***	-1.877***	-1.570***
	(-15.27)	(-25.89)	(-19.18)
High Court independence	-1.613***	-2.247***	-2.083***
	(-23.03)	(-30.90)	(-25.75)
Corruption (0=corrupt; 100=clean)	-1.121***	-1.963***	-1.605***
	(-15.33)	(-26.39)	(-19.00)
Intellectual property rights	-1.086***	-1.979***	-1.580***
	(-12.04)	(-22.48)	(-15.11)
Collectivist country	0.886***	1.415***	1.339***
	(12.31)	(19.37)	(16.17)
Product market regulation	1.461***	1.816***	1.945***
	(14.50)	(18.16)	(17.01)
Days required to register property	0.227**	0.330***	0.187*
	(2.46)	(3.53)	(1.76)
Number of procedures to start business	0.106	0.581***	0.390***
	(1.25)	(6.77)	(4.00)

NOTES: Independent variables are standardized. Coefficients can be interpreted as percentage point changes. Each coefficient is obtained from a separate regression in which SOE shares in country-industry-year totals of the metric indicated in the column headings are regressed on the institutional characteristics (varying at country-year level) indicated in the row headings. All regressions include industry and year fixed effects and an indiactor of the legal tradition. t statistics (clustered at country-year) in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the one percent level. A higher quality of government, more judicial independence, lower levels of corruption, and stronger protection of intellectual property rights are all negatively correlated with the share of SOEs in turnover, employees, and total assets. More collectivist countries, as well as countries characterized by more regulatory restrictions in product markets, are associated with higher levels of state ownership. The latter is echoed by the correlations with the number of days needed to register property and the number of procedures to start a business, although the statistical significance is a bit weaker. Overall, these results indicate that countries with more developed economies typically show lower levels of state ownership.

A.4 Balancing property test for matched sample

After obtaining a matched sample, we are able to compare whether the matching procedure created two groups that are balanced regarding the observable characteristics on which we matched. To test this balancing property, we compare means between the treated and untreated groups in both our original and matched samples. Upon successful matching, there should be no significant difference between treatment and control means. Results are shown in Table A.5. While we can indeed identify a clear reduction in bias when moving from the original to our matched sample with respect to all variables, there still exist significant differences between treatment and control group means in the matched sample. A potential explanation for this is that observations are matched within relatively narrowly defined groups, in which suitable matches do not always exist. Nevertheless, we believe the substantial bias reduction between the two samples proves the usefulness of estimations utilizing the matched sample.

Table A.5: Balancing property test

| | Original sample | | | Matched sample | | |
| | Mean | | t-stat | Mean | | t-stat |
	Treated	Control		Treated	Control	
Log of total assets	14.3673	11.8046	-858.0593	14.4040	14.0274	-80.3836
Log of age	2.5434	2.2291	-378.1556	2.5753	2.6705	82.0848
Listed firm (dummy variable)	0.0065	0.0006	-258.2017	0.0067	0.0072	4.8776
Foreign ownership (dummy variable)	0.1697	0.0929	-223.9725	0.1681	0.1731	7.5175

NOTES: Matching based on propensity score, estimated within country-industry groups as probit regressions of state on lagged log(total assets), lagged log(age), and lagged foreign ownership and listing dummies. We subsequently match SOEs in their first year of government ownership with firms never in government ownership, and retain these matched firms for the entire time span of our dataset. Matches are found within country-industry-year groups based on this propensity score and using nearest-neighbor matching with replacement. Presented in this table are means within these two groups (never state-owned and state-owned in at least one year).

Table A.6: State-ownership and performance: tight majority and wholly-owned

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
	Minority/tight majority/wholly-owned state share								
SOE-minority	-0.0196	-0.0210***	-0.144***	-0.0231***	-0.150***	-0.00882***	-0.00644	-0.210***	-0.978**
	(-1.27)	(-2.84)	(-13.43)	(-12.40)	(-10.89)	(-3.47)	(-0.72)	(-5.50)	(-2.39)
SOE-tightmaj.	0.0850***	0.0395***	0.00734	-0.0181***	-0.108***	-0.0339***	-0.111***	-0.413***	-0.765***
	(5.90)	(7.67)	(0.88)	(-12.91)	(-14.37)	(-17.48)	(-17.75)	(-20.54)	(-2.99)
SOE-wholly	0.307***	0.0332***	-0.259***	-0.0353***	-0.110***	-0.0286***	-0.0571***	-0.605***	0.222
	(19.06)	(4.81)	(-25.00)	(-23.04)	(-13.81)	(-10.10)	(-5.99)	(-20.25)	(0.71)
N	649482	383958	261590	705339	464142	702689	414443	457942	430333
Adj. R^2	0.593	0.703	0.709	0.038	0.100	0.173	0.339	0.140	0.051
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as net income over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities, multiplied by 100; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes, multiplied by 100. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. Panel C distinguishes SOEs with government stakes between 10% and 50%, between 50 and 55% (tight majority), and 100% (wholly-owned), with privately-owned firms as reference category. Panel D is estimated on a 2013-2018 sample. *t*-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A.5 Wholly-owned and tight majority state shares

Table A.6 contains results separating majority state ownership in tight majorities and wholly-owned SOEs. From Figure 1 we know that majority-owned SOEs with government ownership stakes of 50 to 55% (tight majority) and those with 100% government stakes (wholly-owned) are the dominant forms of ownership. Together these two categories account for about 75% of the SOEs we identify with the wholly-owned category being slightly larger.

Table A.6 shows that wholly-owned SOEs are significantly associated with higher employment levels, lower productivity, lower profitability (RoA), and lower implicit interest rate differences. In contrast, 'tight majority'-SOEs experience lower levels of leverage, financial constraints, and effective tax rate differences. Overall, these findings suggest that wholly-owned SOEs are most strongly linked to lower real and financial performance. Meanwhile, SOEs with a tight government majority might benefit from partial state ownership through reduced financial constraints and lower effective tax rates, while showing little to no significant negative impact on productivity and profitability.

A.6 SOE versus POE performance: robustness checks

This appendix contains various robustness checks regarding the estimation of the relative performance of state-owned enterprises versus privately-owned enterprises.

Constructing alternative matched samples   Table A.7 contains results based on samples generated by alternative matching procedures, as well as by using an entropy-balanced sample. In panel A, we exclude distant matches (with distances above the 90th percentile) from the original matched sample. In panel B, we adopt a different matching procedure, in which SOEs and POEs are matched in each year individually. Matches are thus no longer retained for the entire time span. Panel C reweights the full sample using entropy balancing methodology Results are qualitatively similar to the baseline results, with sign and significance preserved for all but one coefficients. Whereas coefficient sizes vary, we mostly find larger estimates.

Table A.7: State-ownership and performance: matching sensitivity

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
	A - Matched sample excluding propensity score distances above the 90th percentile								
SOE	0.157***	0.0373***	-0.108***	-0.0294***	-0.127***	-0.0266***	-0.0711***	-0.429***	-0.747***
	(13.81)	(7.91)	(-16.54)	(-24.48)	(-20.32)	(-12.84)	(-11.84)	(-23.53)	(-3.49)
N	566423	321782	213703	619167	387194	621428	351299	393056	358499
Adj. R^2	0.588	0.676	0.687	0.036	0.093	0.175	0.358	0.136	0.041
	B - Year-by-year matching								
SOE	0.341***	0.00773	-0.324***	-0.0290***	-0.146***	-0.0432***	-0.101***	-0.643***	-0.516*
	(18.59)	(1.03)	(-19.35)	(-17.87)	(-17.20)	(-16.50)	(-11.23)	(-19.50)	(-1.76)
N	232985	133718	92986	243127	172035	257692	154967	160305	157497
Adj. R^2	0.515	0.657	0.630	0.045	0.072	0.211	0.337	0.141	0.039
	C - Entropy balancing								
SOE	0.200***	0.0980***	-0.0655***	-0.0335***	-0.203***	-0.0295***	-0.123***	-0.484***	-1.290***
	(16.52)	(17.60)	(-8.93)	(-29.31)	(-24.40)	(-17.00)	(-22.48)	(-24.14)	(-5.31)
N	14170402	8466011	6026174	14519373	10513505	15366925	8258250	8618283	9677423
Adj. R^2	0.622	0.656	0.711	0.086	0.161	0.239	0.386	0.181	0.088
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as net income over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. In panel A, we exclude observations for which the distance between the propensity scores of treated and control observations is above the 90th percentile. In panel B, we adopt a different matching procedure, in which SOEs and POEs are matched in each year individually. Matches are thus no longer retained for the entire time span. Panel C reweights the full sample using entropy balancing methodology. We obtain a sample with equal number of SOEs and POEs. *t*-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Balanced and stable sample Table A.8 presents the results of regression analyses performed on a balanced sample of firms to evaluate the impact of state-owned enterprises (SOEs) on various firm-level outcomes. Two sets of regressions are shown: Panel A, which uses a stable sample size with unmatched data, and Panel B, which employs both a stable sample size and a balanced sample with matched data. Stable sample size refers to the full availability of the (in)dependent variables, such that estimations for each dependent variable are based on the same sample. Balanced sample refers to having the same time span for treated and control firms, i.e. from the year of matching until 2018. Confirming baseline results, the findings across both panels indicate that SOEs positively influence employment and wages while negatively affecting total factor productivity (TFP), return on assets (RoA), profitability, leverage, financial constraints, interest rates, and tax rates.

Table A.8: Balanced sample, stable sample size

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
	A - stable sample size, unmatched data								
SOE	0.188***	0.0436***	-0.145***	-0.0234***	-0.0300***	-0.00659**	-0.182***	-0.463***	-2.424***
	(15.82)	(8.73)	(-16.92)	(-14.18)	(-6.02)	(-2.47)	(-16.68)	(-19.37)	(-6.52)
N	1441692	1441692	1441692	1441692	1441692	1441692	1441692	1441692	1441692
Adj. R^2	0.784	0.761	0.715	0.053	0.038	0.141	0.264	0.117	0.052
	B - stable sample size and balanced sample, matched data								
SOE	0.301***	0.0577***	-0.152***	-0.00500**	-0.0259***	0.00980**	0.00975	-0.00399***	0.0210***
	(9.26)	(3.18)	(-7.37)	(-2.18)	(-3.27)	(2.23)	(0.64)	(-9.36)	(2.83)
N	22170	22170	22170	22170	22170	22170	22170	22170	22170
Adj. R^2	0.732	0.729	0.723	0.086	0.110	0.224	0.289	0.215	0.068
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Stable sample size refers to the full availability of the (in)dependent variables, such that estimations for each dependent variable are based on the same sample. Balanced sample refers to having the same time span for treated and control firms, i.e. from the year of matching until 2018. Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as P/L over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. *t*-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

3 layers of SOE identification This appendix contains results separating the three distinct sources of the combined SOE indicator: SOEs identified by Global Ultimate Owner (GUO) information, SOEs identified by shareholder information, and SOEs identified through the firm's legal form. Estimations are based on the full, unmatched sample. Results are remarkably similar over these subcomponents of SOE identification and compared to panel A in Table A.10, though with substantially larger coefficients for TFP and financial outcomes among SOEs identified through the firm's legal form.

Table A.9: State-ownership and performance: 3 layers of SOE identification

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
				A - Global Ultimate Owner (GUO)					
SOE (GUO)	0.358***	0.0695***	-0.158***	-0.0488***	-0.158***	-0.0435***	-0.251***	-0.412***	-1.240***
	(21.74)	(11.44)	(-15.14)	(-30.88)	(-23.52)	(-14.53)	(-27.58)	(-18.54)	(-5.62)
N	8968189	5348626	3874446	9056185	6692952	9569429	5032547	5349067	6127892
Adj. R^2	0.620	0.702	0.689	0.042	0.053	0.199	0.463	0.141	0.078
				B - Shareholders					
SOE (SHH)	0.355***	0.0916***	-0.265***	-0.0563***	-0.165***	-0.0204***	-0.187***	-0.465***	-0.995***
	(22.75)	(15.01)	(-27.77)	(-37.45)	(-24.84)	(-7.18)	(-21.15)	(-19.16)	(-3.97)
N	13988799	8301315	5998730	14396755	10378044	15274911	8172816	8511987	9550247
Adj. R^2	0.600	0.687	0.685	0.040	0.054	0.194	0.455	0.168	0.074
				C - Legal form					
SOE (legal)	0.323***	0.0748***	-0.859***	-0.0613***	-0.242***	-0.0634***	-0.273***	-1.280***	1.286
	(7.95)	(3.25)	(-14.38)	(-11.62)	(-7.08)	(-12.16)	(-7.60)	(-11.54)	(1.28)
N	12189488	7454360	5361939	12887037	9396303	13442178	7327487	7628407	8714920
Adj. R^2	0.606	0.685	0.683	0.039	0.053	0.202	0.458	0.175	0.079
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Estimations on complete (unmatched) sample. Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as net income over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes. *RoA, Profit, Leverage, FinCon, IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. t-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Estimations on the original, unmatched sample One has to be careful to interpret findings solely based on the matched sample, as the matching procedure adopted discards a magnitude of information, including potential outliers nevertheless containing valid information. We hence re-estimate the baseline specification using the full, unmatched dataset. Results are presented in panel A of Table A.10. It is important to note foremost that our results do not differ in terms of sign and significance from those obtained in the unmatched regressions, with all coefficients retaining (or increasing) significance. Regarding the size of the estimated effects, for all dependent variables, the estimated relationship is substantially larger than that based on the matched sample, indicating that matching is indeed successful in reducing the bias stemming from the overall different character of SOEs.

Additionally, as results may be distorted by the presence of smaller firms, we also weight firms by their respective sizes as defined by total assets. Results, available upon request, remain remarkably stable.

Filling gaps and missing values in ownership data We re-estimate the baseline specification by adopting a different definition of state ownership. In sections 4, we utilized a definition of

Table A.10: State-ownership and performance: robustness checks

	(1) Empl	(2) Wage	(3) TFP	(4) RoA	(5) Profit	(6) Leverage	(7) FinCon	(8) IntRate	(9) TaxRate
0 - Baseline result for comparison									
SOE	0.174***	0.0282***	-0.129***	-0.0275***	-0.118***	-0.0244***	-0.0645***	-0.450***	-0.404**
	(15.77)	(6.12)	(-18.95)	(-24.94)	(-21.00)	(-12.70)	(-11.32)	(-23.76)	(-2.05)
N	664639	395312	269390	720869	477714	719135	426417	469766	442787
Adj. R^2	0.593	0.701	0.707	0.038	0.100	0.176	0.341	0.140	0.050
A - Unmatched sample									
SOE	0.354***	0.0481***	-0.183***	-0.0495***	-0.155***	-0.0368***	-0.249***	-0.436***	-1.474***
	(24.56)	(9.47)	(-22.63)	(-39.13)	(-27.77)	(-13.37)	(-31.49)	(-22.65)	(-7.96)
N	14337638	8576142	6098754	14710133	10640001	15548767	8374777	8747221	9795013
Adj. R^2	0.604	0.689	0.689	0.041	0.057	0.192	0.450	0.166	0.071
B - Gaps filled									
SOE	0.173***	0.0300***	-0.133***	-0.0281***	-0.117***	-0.0257***	-0.0664***	-0.453***	-0.561***
	(16.42)	(6.80)	(-17.94)	(-24.43)	(-20.98)	(-13.75)	(-12.31)	(-23.34)	(-2.92)
N	651112	389072	265228	713714	472721	710317	419672	459063	438557
Adj. R^2	0.593	0.703	0.712	0.037	0.099	0.175	0.344	0.143	0.050
C - Sample excluding Russia and Ukraine									
SOE	0.175***	0.0281***	-0.119***	-0.0222***	-0.115***	-0.0157***	-0.0596***	-0.403***	-0.429**
	(14.20)	(6.04)	(-17.27)	(-22.00)	(-20.22)	(-8.39)	(-10.23)	(-21.37)	(-2.13)
N	513480	390050	264650	567697	462107	565760	410885	425631	427414
Adj. R^2	0.593	0.689	0.702	0.045	0.099	0.186	0.330	0.150	0.043
D - Pre-crisis sample									
SOE	0.144***	0.00974	-0.172***	-0.0293***	-0.119***	-0.00766***	-0.0664***	-0.362***	-1.683***
	(7.06)	(1.35)	(-16.18)	(-18.25)	(-12.19)	(-2.48)	(-7.70)	(-10.11)	(-4.16)
N	190530	136791	94382	206042	151891	202069	134045	149113	149957
Adj. R^2	0.539	0.745	0.725	0.037	0.103	0.192	0.318	0.208	0.061
E - Manufacturing sample									
SOE	0.0302*	0.0265***	-0.0714***	-0.0342***	-0.111***	-0.0164***	-0.144***	-0.262***	-1.474***
	(1.81)	(3.91)	(-6.63)	(-12.92)	(-8.21)	(-6.65)	(-12.65)	(-6.76)	(-2.67)
N	82523	55344	44261	82439	59269	80138	51572	59729	55715
Adj. R^2	0.569	0.867	0.820	0.035	0.129	0.105	0.295	0.141	0.066
F - Lagged state-ownership									
SOE $(t-1)$	0.168***	0.0251***	-0.125***	-0.0259***	-0.0977***	-0.0238***	-0.0621***	-0.417***	-0.361*
	(14.88)	(5.40)	(-17.57)	(-23.02)	(-17.73)	(-12.42)	(-10.69)	(-21.10)	(-1.79)
N	633370	378562	257170	683950	456275	684750	410967	448668	423082
Adj. R^2	0.592	0.708	0.712	0.038	0.101	0.178	0.335	0.141	0.048
G - Firm and year FE									
SOE	0.123***	-0.0106**	0.00304	-0.00312*	-0.0501***	-0.00157	-0.0141*	-0.144***	0.0778
	(8.34)	(-3.21)	(0.46)	(-2.05)	(-8.87)	(-1.39)	(-2.50)	(-6.87)	(0.28)
N	13623283	8136707	5768870	13950872	10120368	14785661	7966302	8224681	9285268
Adj. R^2	0.815	0.880	0.853	0.323	0.383	0.599	0.763	0.502	0.207
H - Heckman selection models									
SOE	0.234***	0.0436***	-0.164***	-0.0335***	-0.137***	-0.0127***	-0.236***	-0.355***	-1.850***
	(13.83)	(7.66)	(-19.74)	(-31.85)	(-23.02)	(-5.48)	(-29.74)	(-18.70)	(-8.54)
N	7454464	6162147	4550420	9143590	7505407	8989943	7104059	6357043	6947031
Adj. R^2	0.621	0.678	0.696	0.165	0.082	0.178	0.477	0.194	0.072
C-I-Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: Column headings indicate dependent variables. *Empl* is the log number of employees; *Wage* is the log of real wage costs per employee; *TFP* is the log of total factor productivity estimated by WLP-methodology; *RoA* is return on assets calculated as P/L over total assets; *Profit* is the operating profit margin calculated as operating P/L over sales; *Leverage* is calculated as long-term debt over total assets; *FinCon* is an indicator of financial constraints from Mulier et al. (2016); *IntRate* is the implicit interest rate calculated as interest expenses over liabilities; *TaxRate* is the effective tax rate calculated as tax expenses over P/L before taxes. *RoA*, *Profit*, *Leverage*, *FinCon*, *IntRate*, and *TaxRate* variables are winsorized at the 1 and 99 percentiles within groups of state and non-state-owned firms. Control variables are $ln(age)_{i,t}$, $ln(totalassets)_{i,t-1}$, $ln(turnover)_{i,t-1}$, a foreign ownership dummy, and a dummy indicating whether a firm is listed. In column 9, we additionally control for $profitmargin_{i,t}$. *t*-statistics based on standard errors clustered at country-industry-year in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

state ownership by strictly limiting ourselves to information available for a given firm in a given year. However, the data is characterized by major gaps and missing information, especially in earlier years of the sample period. Therefore, we present a series of estimations where such gaps and missing information are filled in by first utilizing, for each firm, information from the first previous year for which non-missing information was found. The state ownership indicator from this year is then adopted for the subsequent years with missing ownership data. Likewise, we also fill in information backward until the year the firm was established, or the first year in our data (i.e. 2002), whichever comes first, by using information from the next first year with non-missing data. As an example, if a firm is identified as being privately-owned between 2005 and 2010, and as being state-owned between 2012 and 2015, in our alternative definition of state ownership, we will assume a firm is privately-owned from 2002 to 2011 onward, and state-owned between 2012 and 2018.

We perform the estimations from sections 4, i.e. on a matched sample dataset[18] in panel B of Table A.10. Results from the full dataset are available upon request. Note foremost that our sample size increases by around 30% to 50%, depending on the specification. Nevertheless, we find remarkably similar results, with both the sign and significance of the estimated effect remaining constant for all specifications. Results are also not one-directionally over- or underestimated.

Excluding Russia and Ukraine Given the substantially different historical backgrounds and the governance structures of Russia and Ukraine, previous results may be partly driven by the presence of these countries in our dataset. This is especially probable given that countries with a Socialist legal tradition are characterized by a much larger proportion of state firms than the rest of Europe, as is shown in section 6. Also, Russia contains a relatively large number of firms overall.
Results are presented in panel C of Table A.10. We continue to find a significant impact of state ownership on the performance and productivity of firms for all real and financial indicators. Effects are running in the same direction as before, but are typically smaller in size compared to those obtained based on the full, matched sample. This implies our results were indeed partly driven by the presence of Russian and Ukrainian firms, but not to the extent that the exclusion of these countries invalidates the previous results.

Pre-crisis results The global financial crisis starting in 2008 greatly affected the financial environment faced by firms, which likely impacted their performance. During these years, governments also provided a wide range of support, mainly to failing financial institutions. However, governments also supported non-financial state firms, implying that the relationship between government ownership and performance during the crisis may have been confounded by crisis-related financial support. We therefore re-estimate the baseline specification (1) on the matched data, only including pre-crisis years 2002 to 2007.[19]. Results are presented in panel D of Table A.10. Comparing these results with the baseline results in section 4, one can observe that the pre-crisis estimates are smaller. This is especially true for the relationship between state ownership and employment (14.4%), wage cost per employee (0.97%), as well as leverage (-0.77%-points).

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[18]Note that, given the larger number of firm-year observations for which ownership types are identified, we construct a new matched sample.
[19]Note that results based on post-crisis years can be found in Table 1

Manufacturing industry subsample   We restrict our sample to only include firms in the manufacturing industry. For these firms, accounting data is often assumed to be more reliable, especially for capital and material inputs, which are used to estimate productivity. Manufacturing firms are also better comparable between countries as their activities are typically more standardized. Results of our manufacturing subsample estimation are shown in panel E of Table A.10. Real performance estimates (employment, wage cost, TFP) are comparatively smaller than when estimated using the full matched sample. Regarding financial performance estimates, we find comparatively larger results for ROA, financial constraints, and effective tax rates. Estimates with respect to other financial performance indicators remain significant, but are somewhat smaller.

Lagged state ownership   Previous specifications may suffer from a simultaneity bias if one asserts that performance impacts the presence of state ownership. It could be, for example, that governments decide to nationalize poorly-performing firms, which would bias the effect of interest: the influence of state ownership on performance. While this paper does not have the ambition to establish true causal relationships, replacing the state ownership dummy in specification 1 by its one period lag, may alleviate the before-mentioned reverse causality concerns, as performance in year t is unlikely to directly affect state ownership in year $t-1$. Results are presented in panel F of Table A.10, and are similar in sign, size, and significance to the baseline results.

Firm fixed effects   Panel G utilizes firm fixed effects to control for time-invariant unobserved heterogeneity across firms. This approach isolates the impact of changes in state ownership (SOE) on changes in firm-level outcomes over time. Overall, when significant, earlier findings continue to hold using this more restrictive set fixed effects. More specifically, the results indicate that state ownership is associated with a significant increase in employment (12.3%). Conversely, significant decreases are observed for wage, ROA, operating profit margins, financial constraints, and implicit interest rates, suggesting that state ownership tends to reduce these variables.

Heckman   In panel H we employ Heckman selection models as an alternative approach to address potential selection effects in government ownership. This two-step method first models the likelihood of a firm being state-owned using a Probit model with the following predictors: election year, government ideology, firm age, lagged RoA, leverage, total assets, turnover, foreign ownership, and listing status. In the second step, the method corrects for potential selection bias in the outcome equations based on the first stage. The results indicate that when correcting for selection bias, state ownership is still significantly positively related to employment and wages, and negatively to TFP, RoA, profit margin, leverage, financial constraints, implicit interest rates, and effective tax rates. This again confirms our earlier results.

A.7 Dynamic effects of privatisation: full results

This appendix contains event study-like figures showing the effects of privatizations for the variables not included in Figure 3 in the main text.

Figure A.1: Dynamic effects of privatizations: Full results

(a) wages

(b) RoA

(c) profit margin

(d) leverage

(e) financial constraints

(f) intrest rate
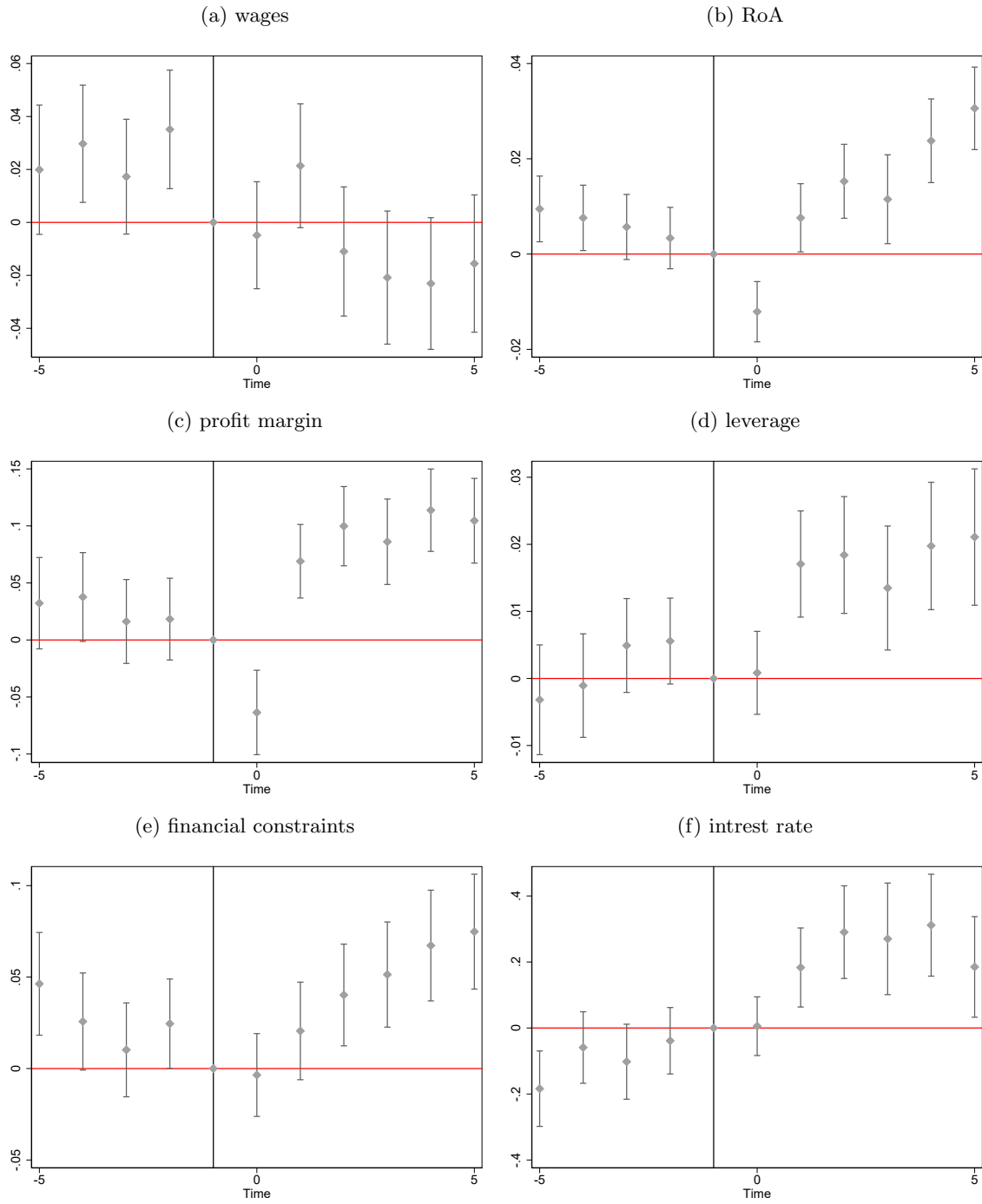
A.8 Ownership stakes over time

This appendix contains a comparison of SOE ownership stakes between 2007 and 2017. Note that panel b matches panel b of Figure 1 in the main text.

Figure A.2: Distribution of state ownership stakes

(a) 2007 (b) 2017
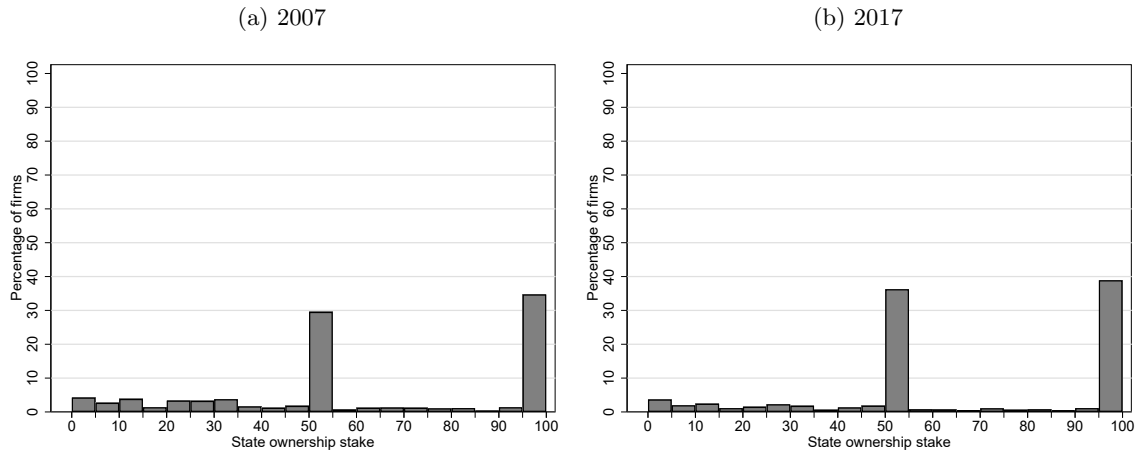
NOTES: Histograms plotting percentage of firms within 5% (non-zero) state ownership stake brackets.

A.9 Data sources institutional variables

This appendix contains information on the data sources for institutional variables used in this paper (main text and Appendix).

Table A.11: Data sources for institutional variables

Variable	Database	Reference
Collectivist country		Hofstede (1980)
Legal origin (e.g. socialist country)		La Porta and López-de Silanes (1999)
Level of property rights	V-Dem	V-Dem (2019)
Control of corruption	Worldwide Governance Indicators	World Bank (2021)
Ease of enforcing contracts	Doing Business	World Bank (2020a)
Rule of law	Worldwide Governance Indicators	World Bank (2021)
Level of democracy	Polity5	Center for Systemic Peace (2018)
Credit by domestic banks to firms (% GDP)	World Development Indicators	World Bank (2020b)
Stock market capitalization (% GDP)	World Development Indicators	World Bank (2020b)
Value of traded stocks (% GDP)	World Development Indicators	World Bank (2020b)
log GDP per capita	World Development Indicators	World Bank (2020b)
Agriculture share (% value added)	World Development Indicators	World Bank (2020b)
Service share (% value added)	World Development Indicators	World Bank (2020b)
High tech exports (% total exports)	World Development Indicators	World Bank (2020b)
R&D technicians (per mln. inhabitants)	World Development Indicators	World Bank (2020b)
Quality of government	Quality of Government Index	Unversity of Gothenburg (2020)
High Court independence	V-Dem	V-Dem (2019)
Days required to register property	World Development Indicators	World Bank (2020b)
Corruption (0=corrupt; 100=clean)	Corruption Perceptions Index	Transparency International (2020)
Intellectual property rights	Property Rights Index	Property Rights Alliance (2018)
Number of procedures to start business	World Development Indicators	World Bank (2020b)
Product market regulation	Product Market Indicators	OECD (2016)