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State Ownership and Corporate Leverage Around the World*

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Abstract

Does state ownership hinder or help firms access credit? We use data on almost 4 million firms in 89 countries to study the relationship between state ownership and corporate leverage. Controlling for country-sector-year fixed effects and conventional firm-level determinants of leverage, we show that state ownership is robustly and negatively related to corporate leverage. This relationship holds across most of the firm-size distribution—with the important exception of the largest companies—and is stronger in countries with weak political and legal institutions. A panel data analysis of privatized firms and a comparison of privatized with matched control firms yield similar qualitative and quantitative effects of state ownership on leverage.

JEL codes: D22; F36; G32; G38; H11; H81; L33

Keywords: State ownership, privatization, corporate debt, state banks

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1 Introduction

Corporate indebtedness has risen sharply in the wake of the global financial crisis as low interest rates enticed many firms to issue bonds and borrow from banks. This debt surge occurred in Western countries and emerging markets alike (Abraham, Cortina, and Schmukler, 2021). As a result, the total debt of non-financial companies increased from 84 percent of global GDP in 2009 to 92 percent in 2019 (IIF, 2020). The recent Covid-19 pandemic has pushed up debt levels even further, creating fears of a corporate debt bubble that could threaten the health of the global economy (IMF, 2019; Boone et al., 2022).

The past decade has also been characterized by a steady rise in state ownership of corporate equity. Many governments not only nationalized banks during the global financial crisis, but also took stakes in non-financial corporations. The increasing popularity of Chinese-style state capitalism further contributed to this resurgence in state ownership (Megginson, 2018) as did the Covid-19 pandemic, which led many governments to take equity stakes in financially distressed companies (EBRD, 2020).

The parallel increase in state ownership and corporate leverage around the world raises the question: to what extent can the latter increase be explained by the former? The existing literature identifies two countervailing forces (Borisova, Fotak, Holland, and Megginson, 2015). On the one hand, state ownership can benefit firms because it implicitly guarantees that debt will be repaid (Faccio, Masulis, and McConnell, 2006; Iannotta, Nocera, and Sironi, 2013). This lowers borrowing costs and may therefore increase leverage. On the other hand, state ownership may increase the cost of debt if the state's non-financial objectives clash with those of for-profit lenders.[1] This would give rise to a negative relationship between state ownership and corporate leverage.

In order to study which of these effects dominates, we use an exhaustive firm-level data set. We start by splicing multiple historical editions of Bureau van Dijk's Orbis database. This allows us to carefully track the ownership structure of individual companies over time, and to identify the shares of all shareholders classified as public authorities or the state. We then create continuous measures of state ownership as well as dummy variables that indicate

[1] For example, state ownership can entail outright political interference (Shleifer and Vishny, 1994; Ben-Nasr, Boubakri, and Cosset, 2012); increased risk taking (Gropp, Gruendl, and Guettler, 2004); or weaker financial discipline (Qiu and Yu, 2019). Note that a negative relationship between state ownership and leverage emerges only if political distortions harm creditors relatively more than shareholders.

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whether the state owns more than 20, 50 or 99 percent of a firm's equity, either directly or indirectly. Our final data set spans 89 countries over 20 years (2000–2019) and contains 20 million annual observations on almost 4 million firms. The comprehensive nature of our data allows us to explore heterogeneity in the relationship between state ownership and corporate leverage across several important firm- and country-specific dimensions.

We first conduct a cross-sectional analysis to uncover key patterns and stylized facts about state ownership and firm leverage. Throughout this analysis we control for standard (time-varying) determinants of firm leverage as suggested by corporate finance theory: firm size; profitability; asset tangibility; and the size of the non-debt tax shield. Importantly, we also control for country-sector-year fixed effects in all regressions, thus comparing firms with different levels of state ownership in the same country, sector *and* year.

The first key result is that state ownership, both at the extensive and the intensive margin, is robustly and *negatively* related to firm leverage, defined as total debt normalized by total assets. This implies that, on average, the negative impact of state ownership more than offsets any benefits firms may derive (in terms of borrowing capacity) from the state as a shareholder. The magnitude of the effect is substantial: within the same country-sector-year, firms with any state ownership on average have a 5 percentage point lower debt/assets ratio. This is about one-quarter of the median leverage of 18.6 percent in our global sample.

Our second main result is that the negative relationship between state ownership and corporate leverage holds across most of the firm-size distribution—with the important exception of the very largest firms. We find that only in the top percentiles of the firm-size distribution—that is, firms owning more than approximately USD 3 billion of assets—state ownership is associated with *higher* corporate leverage. In other words, only the largest firms in a country benefit from (partial) state ownership through implicit bailout guarantees and cheaper credit. This finding is corroborated by analogous results for corporate borrowing costs: for smaller firms, state ownership is associated with more expensive debt while, for larger ones, the relationship has the opposite sign.

Third, we find that the negative relationship between state ownership and corporate leverage is considerably weaker in richer countries with a stronger rule of law; better control of corruption; stronger insolvency rights; and better investor protection. This indicates that, in better institutional environments, private creditors worry less about distortions due to state interference so that the negative impact of state ownership on firm leverage is smaller.

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We also show that the relationship between state ownership and corporate leverage depends critically on the structure of the banking system, in particular the presence of foreign and state banks (relative to domestic private banks). We find that (smaller) state-owned firms are (even) less levered, relative to privately owned ones, in countries where foreign banks play a bigger role. This indicates that foreign bank ownership imposes financial discipline and reduces the likelihood of the state channeling credit to state-owned enterprises. In line with this interpretation, we find that state-owned firms, especially smaller ones, pay higher interest rates relative to equivalent privately owned firms in countries where foreign banks play a bigger role. Our results on state banks are more nuanced. While, on average, a larger presence of state banks is associated with a stronger negative relationship between state ownership and firm leverage, this effect is reversed for larger companies. This suggests that countries use state banks to allocate credit to favored "national champions" (though we do not find that they do so at subsidized interest rates).

Finally, we complement our cross-firm results with a within-firm analysis based on panel data on privatized firms, as well as with results based on a matching estimator that systematically compares privatized firms with observationally similar (non-privatized) state-owned enterprises. Both of these exercises yield empirical results that are very similar to those from the cross-firm analysis, both qualitatively and quantitatively. We find that firms typically increase their leverage by about 5 percentage points (27 percent of the sample mean) in the five years after privatization and relative to comparable (matched) non-privatized firms.

The comprehensive nature of our data set—in terms of its coverage of firms of very different sizes and of countries with very different institutional environments—allows us to bring four new insights to the literature. First and foremost, we shed light on how the relationship between state ownership and firm leverage varies across the firm-size distribution. Previous papers relied on relatively small samples of large (or very large) listed companies. For example, Dewenter and Malatesta (2001) analyze state-owned enterprises among the 500 largest non-US firms in 1975, 1985 and 1995. They show that—after controlling for business cycles, firm size, location and industry—state-owned enterprises are leveraged more and perform less well than comparable private firms. They also show that leverage falls after privatization events. Borisova, Fotak, Holland, and Megginson (2015) use bond credit spreads from 226 large, publicly traded companies from 43 countries. For these large firms they find that, while in normal times government ownership is associated with a higher cost of debt, the credit

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spreads of state firms were lower during the global financial crisis (when implicit bailout guarantees were particularly important). Borisova and Megginson (2011) use a sample of publicly traded bonds by 60 large European companies to show how credit spreads initially increase during privatization while fully privatized firms experience a drop in their cost of debt. In a similar vein, Boubakri and Cosset (1998; 79 large companies); D'Souza and Megginson (1999; 85 large companies) and Megginson, Nash, and Van Randenborgh (1994; 61 large companies) also find that, after privatization, companies reduce their debt ratios. Interestingly, Boubakri and Saffar (2019; 453 large companies) find that newly privatized firms may continue to benefit from government support after (partial) privatization as residual state ownership correlates positively with bank borrowing.

Our contribution is to show how the impact of state ownership on the cost of borrowing, and therefore on corporate indebtedness, depends crucially on firm size. For the bulk of firms, state ownership and the associated inefficiencies entail higher average borrowing costs.[2] This effect of state ownership changes sign for the largest enterprises. For such "national champions"—large firms of national strategic importance—we find that the downsides of state ownership are typically more than compensated for by the implicit (and sometimes explicit) bailout guarantees of the state. By analyzing the full spectrum of state firms—we use data on 46,039 firms with at least a 20 percent government stake—we thus uncover important heterogeneity that helps to put earlier empirical findings into a broader perspective.

Second, the granular and time-varying nature of our data allows us to explore the intensive and extensive margins of the effect of state ownership. This is important because, over the past two decades, many governments have expanded their minority stakes in a broad variety of enterprises (Faccio and Lang, 2002). As yet, little is known about the impact of such stakes on the financial policies and borrowing behaviors of such enterprises. Our data show clearly that the negative effect of state ownership on firm leverage already occurs when the state takes minority stakes of as little as 1 percent, suggesting that even small equity stakes can carry considerable power (such as when the state holds a golden share). An analysis estimating the marginal effect of state ownership at various firm sizes reveals clearly how the impact of state ownership on firm leverage increases monotonically as the state owns

[2]This is in line with recent work showing that losses are especially common among small state firms (Musacchio and Pineda Ayerbe, 2019) and the observation that in China many small (but only very few large) state-owned enterprises have gone bankrupt during recent times.

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progressively larger equity stakes.

Third, we shed new light on the importance of the structure of the banking system, by distinguishing between countries with different levels of foreign and state ownership in their banking sectors. Earlier work shows that lending by state banks is often driven by political motivations, electoral cycles in particular.[3] Such lending can distort the allocation of capital throughout the economy, for example, when state banks prefer to lend to state-owned enterprises, crowding out loans to the private sector (Gordon and Li, 2003; Allen et al., 2005; Li et al., 2009; Molnar and Lu, 2019).[4] Panizza (2021) uses a global data set of state banks to show that both state-owned firms and (large) firms that are part of a conglomerate are more likely to borrow from state banks.

Our contribution is to demonstrate how state banks limit access to credit for smaller state firms, but ease the borrowing constraints of larger state-owned companies. This suggests that state banks help to redistribute financial resources from smaller firms to larger, strategically more important ones. Moreover, we show that foreign banks impose financial discipline by reducing the leverage of (smaller) state-owned firms compared to similar privately owned ones. This is in line with foreign banks relying on arm's-length techniques when lending to distant borrowers, thus reducing credit access to relatively opaque clients in destination countries (Mian, 2006; Detragiache, Tressel, and Gupta, 2008). Our results imply that such distance constraints bind in particular for firms in which the state holds an ownership stake and can exert influence.

Fourth, we contribute to the rich literature on state ownership of productive assets and the firm-level impacts of privatization. Various papers show that full or partial privatization can boost firms' efficiency and performance provided the right institutional and regulatory preconditions are in place (D'Souza, Megginson, and Nash, 2005).[5] Megginson, Nash, and Van Randenborgh (1994) compare the pre- and post-privatization performance of 61 large companies and find that a majority of these large firms decrease their leverage ratios after privatization. They argue that this reflects the combined effect of the state's withdrawal

[3]See, for example, Shleifer and Vishny (1994); Shleifer (1998); La Porta et al. (2002); Sapienza (2004); Dinç (2005); Khwaja and Mian (2005); Carvalho (2014) and Bircan and Saka (2021).

[4]On the other hand, state banks may overcome market failures by financing socially desirable investments that the private sector is unwilling or unable to fund (Jiménez, Peydró, Repullo, and Saurina, 2019).

[5]For example, La Porta and López de Silanes (1999); Megginson and Netter (2001); Megginson (2005); Bortolotti, Fantini, and Siniscalco (2004); and Estrin et al. (2009). Even partial privatization, where the government remains in control of management, can benefit productivity and profitability (Gupta, 2005).

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of debt guarantees and the firm's improved access to public equity. Our contribution is to demonstrate how the effect of privatization differs markedly for smaller firms. For these firms, the main financial impact of privatization is improved access to debt as lenders worry less about political interference (these small firms never benefited from implicit bailout guarantees in the first place). Only for larger firms is this effect reversed, as these firms can access global equity markets and may experience an uptick in the cost of debt once implicit government guarantees disappear.

The remainder of this paper is structured as follows. In Section 2, we briefly review the corporate finance literature on optimal capital structures and outline the main mechanisms through which government ownership can affect firm leverage. Sections 3 and 4 then describe our data and empirical approach, respectively. We present our results in Section 5, and conclude in Section 6.

2 The Drivers of Firm Leverage

2.1 Theories of optimal capital structure

The corporate finance literature offers three models to explain firms' capital structures. The first, trade-off theory, describes the trade-off between the advantageous and adverse effects of debt financing on firm value. Modigliani and Miller (1958) have shown that, in the absence of transaction costs, a firm's value is independent of its financial structure. This changes in the presence of bankruptcy costs or taxes that are not neutral to leverage. On the one hand, higher leverage then means firms benefit more from debt tax shields. On the other, higher leverage also leads to higher (expected) costs of financial distress (such as the administrative costs of liquidation). Firms then choose an optimal capital structure that resolves this trade-off.

The second model is the pecking-order hypothesis. It argues that firms prefer internal over external financing due to asymmetric information between managers and investors. Moreover, if the firm relies on external funds, as in Myers and Majluf (1984), then it prefers debt to equity due to the lesser impact of information asymmetries (Donaldson, 1961; Myers, 1984). Trade-off behavior and pecking-order considerations need not be mutually exclusive. For example, firms may have a target leverage ratio but follow the pecking order to reach it.

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Moreover, while trade-off considerations can be important in the longer term, pecking-order behavior may matter (more) in the short term (Mayer and Sussman, 2004).

The third theoretical framework comprises agency theory (Jensen and Meckling, 1976). It focuses on conflicts that can occur between shareholders and managers, as well as between shareholders and debt holders. These conflicts determine an optimal capital structure that trades off agency costs with other financing costs. For example, debt may commit a firm to larger cash payments so less cash remains available for self-interested managers to waste (Jensen, 1986).

2.2 Determinants of firms' capital structure

The aforementioned capital structure theories generate the following predictions about the relationship between leverage and firm characteristics such as size, tangibility of assets and cash flows. First, as larger firms tend to be more diversified, have stable cash flows (Rajan and Zingales, 1995; Fama and French, 2002) and are therefore less likely to go bankrupt, trade-off theory predicts a positive association between firm size and leverage. In contrast, pecking-order theory highlights that larger firms are more transparent and less subject to information asymmetries, which leads them to prefer equity over debt.

Second, trade-off theory predicts a positive relationship between asset tangibility and leverage because outsiders can easily value tangible assets. This will lower expected distress costs (Frank and Goyal, 2009). That is, when assets are tangible and can serve as collateral, a firm's leverage will be higher, all else equal (Rajan and Zingales, 1995). In contrast, pecking-order theory predicts an inverse relationship between tangibility and leverage because tangibility lowers information asymmetries. This increases the attractiveness of equity relative to debt.

Third, according to trade-off theory, profitable firms have more income to shield from taxation and will therefore have higher leverage. Agency theory predicts that profitable firms are more likely to encounter free cash-flow problems and may therefore use leverage to control their managers (Jensen, 1986). In contrast, pecking-order theory implies profitable firms will be less leveraged: these firms will prefer to use their internal funds (retained earnings) over external debt and equity financing (Myers and Majluf, 1984).

Fourth, higher non-debt tax shields, such as depreciation, reduce the tax advantage of

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debt financing. Therefore, trade-off theory implies a negative association between non-debt tax shields and leverage (DeAngelo and Masulis, 1980). Yet, Bradley, Jarrell, and Kim (1984) find a positive correlation between firms' non-debt tax shields and leverage, and suggest this may reflect that high non-debt tax shields also proxy for asset tangibility.

A large empirical literature assesses the empirical relevance of these theoretical predictions regarding the determinants of corporate leverage.[6] Across the board, this body of work concludes that leverage is positively related to the size of the firm; the tangibility of its fixed assets; its non-debt tax shields; and its growth opportunities. In contrast, leverage tends to be negatively correlated with firm-level income volatility and profitability.[7]

2.3 State ownership and firm leverage

How can a firm's ownership—and, in particular, ownership by the state—impact its capital structure? The main effect of state ownership is that it dramatically changes the trade-off between the benefits and risks of taking on debt. On the one hand, the implicit or explicit bailout guarantees that accompany state ownership can reduce the cost of debt because banks and other lenders worry less that a firm will default on its obligations (Faccio, Masulis, and McConnell, 2006; Iannotta, Nocera, and Sironi, 2013). This may particularly apply to large firms that are politically and socially important, and to which the government cannot credibly deny funding (Kornai, 1979). Such soft budget constraints may be particularly common in countries where a large part of the domestic banking system is in state hands (Cull and Xu, 2005; Megginson et al., 2014).

On the other hand, state ownership can increase the cost of debt if the state's non-financial objectives (such as ensuring high levels of employment) clash with those of for-profit lenders. Governments can also extract rents from state firms by paying below-market prices for outputs (Ahroni, 1986) or by implementing price controls to cater to voters. Not only large strategic state firms, but also smaller state-owned enterprises that receive less attention engage in such distorting activities (Musacchio and Pineda Ayerbe, 2019). Finally, state ownership can also make borrowing more expensive because the managers of state

[6] See Harris and Raviv (1991) for an early review.

[7] For example, Rajan and Zingales (1995) provide an empirical assessment of the key correlates of firm leverage in G7 countries, while Booth, Aivazian, Demirgüç-Kunt and Maksimovic (2001) asses the drivers of corporate leverage in ten developing countries.

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firms are not adequately incentivized or monitored (Shleifer, 1998; Megginson, 2005 and Firth, Fung, and Rui, 2006).

Importantly, the conflict between governments' political objectives and private investors' profit motives applies both to private lenders and to private equity holders. If state ownership is expected to undermine private shareholders' payoffs, it should also raise the marginal cost of raising external equity, not just external debt.

3 Data

3.1 Firm-level data

We create a new firm-level data set that splices multiple historical editions of Bureau van Dijk's Orbis database. We focus on firms that report information on total assets and debt structure in any year between 2000 and 2019. As our goal is to identify the relationship between state control and corporate leverage, we exclude companies without reliable ownership information. Our final data set spans 89 countries, the period 2000–2019 and contains about 20 million annual observations on almost 4 million firms. A total of 46,039 (equivalent to about 1 percent) of these firms have at least a 20 percent government stake.

3.1.1 Corporate leverage and covariates

For each firm we have (time-varying) information on their ownership, profit-and-loss statements, and balance sheet—including their leverage, which we define as total debt normalized by total assets. Panel A of Table 1 shows there is wide variation across firms in their relative indebtedness: leverage ranges between zero and 200 percent and is, on average, 18.6 percent. Figure 1 shows a small decline in the leverage of non-state owned firms over the past 1.5 decades, whereas (partially or fully) state-owned firms experienced a slow but steady increase in leverage.

We create four firm covariates for which corporate finance theory suggests co-determine leverage (see Section 2.2) and use them as controls throughout our analysis. These are firm size (log total assets); profitability (earnings before interest, taxes, depreciation and amortization (EBITDA)/total assets); asset tangibility; and the non-debt tax shield. We follow Berkowitz, Lin, and Ma (2015) and Liu, Liu, Megginson and Wei (2019) and use fixed assets

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over total assets as a measure of asset tangibility. A firm's non-debt tax shield is proxied by total depreciation and amortization over total assets. For about half of all observations, we can also create a proxy for the firm's cost of debt by calculating the ratio between total interest expenses and total formal debt (trimmed at the 5th and 95th percentiles). The average implied interest rate is 8.7 percent (Table 1).

3.1.2 Firm-size categories

We allocate each firm to one of five predefined and mutually exclusive size buckets: micro, small, medium-sized, large and super-large firms. In line with official EU definitions[8], micro firms own less then EUR 2 million in total assets; small firms less than EUR 10 million; and medium-sized firms less than EUR 43 million. Large firms are all other firms with the exception of super-large ones, which own more than EUR 1 billion in assets.

Figure 2 presents the share of all enterprises that are state owned, for various firm size categories. The dark gray bars indicate state-owned enterprises' share of total assets owned by all firms in a particular size category. The light gray bars indicate the share of state firms in the total number of firms in each category. The figure shows that state ownership is concentrated among larger firms. For example, among super-large firms, state-owned enterprises account for about 12 percent of total assets and 9 percent of the total number of firms. These numbers are much lower, at 2 percent and 0.4 percent among micro firms.

Figure 3 shows a bin scatter plot in which we group all firms with any state ownership into 20 equal bins: 1–5 percent state ownership; 6–10 percent state ownership; etc. Firms with 100 percent state ownership are assigned to a separate bin. The fitted curve shows a clear negative relationship between the intensity of state ownership and firm size. Governments tend to hold minority stakes in (very) large firms and often hold large majority stakes in smaller firms.

3.1.3 State ownership

The Orbis database contains subsidiary-shareholder pair information on direct and total ownership in each year.[9] By splicing various historical editions of Orbis, we carefully track the

[8] https://ec.europa.eu/growth/smes/sme-definition_en.

[9] Orbis provides information on voting shares for those firms whose shares are split into voting versus non-voting shares. This makes the database particularly well-suited to identify control (Kalemli-Özcan et

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ownership structure of companies over time and then summarize the shares of all shareholders classified as public authorities, the state or the government. This includes minority stakes by state-owned investment funds and sovereign wealth funds, an increasingly important form of state ownership (Megginson, 2018).

It is important to account not only for direct but also indirect state ownership. Once we have identified all firms where state agencies directly own more than 20 percent of all shares, we next identify the firms in which these directly state-owned firms cumulatively own more than 20 percent. These indirectly state-owned firms are then added to the list of state firms. We proceed with this iteration until we have identified all firms that are linked to state agencies in a way that, at each point in the ownership chain, the state controls at least 20 percent.

Last, we also create a continuous measure of state ownership that ranges between 0 and 100. The average government stake in firms' equity is very small: 0.8 percent (Table 1, Panel A). The median firm has no state ownership. We then define dummy variables that indicate whether the state owns more than 1, 20, 50 or 99 percent of a firm's equity. Only about 1 percent of all firms is at least 20 percent state-owned. Moreover, we create dummies for whether a company falls within one of the following state-ownership intervals: [1%; 20%), [20%; 50%), [50%; 99%) and [99%; 100%].

3.2 Industry-level data

We explore the role of cross-industry variation in firms' dependence on external finance, their liquidity needs and their access to tangible (and therefore pledgable) assets.[10] Data on external finance dependence come from Rajan and Zingales (1998) and Duygan-Bump et al. (2015). Both measure firms' dependence on external finance as the proportion of capital expenditures not financed with cash flow from operations. Positive values indicate that firms tend to issue debt or equity to finance investments, while negative values mean that firms

al., 2015 and Aminadav and Papaioannou, 2020).

[10] As our firm-level data use a four-digit NACE 2 sector classification, we first establish concordance between manufacturing industries in ISIC rev. 2 and NACE 2 using concordance tables from UN Stats (see https://unstats.un.org/unsd/classifications/Econ/isic). If one NACE 2 sector matches multiple ISIC rev. 2 sectors, then we use a simple mean of the corresponding ISIC rev. 2 sectors.

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in a particular industry typically have cash flows that exceed their investments.[11]

Our second industry-level characteristic is liquidity needs. Firms in industries that require more working capital will typically need more liquid funds to operate. We use the primary measure of sector-level liquidity needs by Raddatz (2006): the median ratio of inventories over sales for US public companies during 1980–1989.

Third, we measure asset tangibility as the median value of tangible fixed assets over total assets in an industry. In the vein of Rajan and Zingales (1998), we take all US firms for which we have data on tangible fixed assets in any year between 2000 and 2019. For each of these firms, we then calculate their median asset tangibility over this period.

Last, we compute the median asset tangibility for each four-digit sector. In line with the literature, we expect higher asset tangibility to support firm borrowing and thus to increase leverage, all else equal (Harris and Raviv, 1991; Almeida and Campello, 2007). This implies that any negative effect of state ownership on firm leverage should be attenuated in sectors where firms own relatively more tangible assets.

3.3 Country-level data

We explore country-level heterogeneity in the relationship between state ownership and firm leverage across several key dimensions. We first assess the role of the ownership composition of national banking systems. To do so, we collect information on the share of domestic banking assets held by the government and by foreign investors. We source data on state banks' assets from the World Bank's *Bank Regulation and Supervision Survey* and data on assets held by foreign banks from the Global Financial Development Database, also from the World Bank. State (foreign) banks are defined as institutions where the government (foreign investors) holds at least 50 percent of all equity. Across our country sample, on average, 15 percent (34 percent) of all banking assets are in the hands of state (foreign) banks (Table 1, Panel B).

We also explore variation in domestic income levels and institutional quality. National income levels are measured as log GDP per capita, converted to constant 2017 dollars using

[11] Both measures are based on US data from the 1980s to the early 1990s. However, Duygan-Bump et al (2015) extend the analysis to services whereas Rajan and Zingales (1998) cover only manufacturing sectors. For this reason, the classification by Duygan-Bump et al. (2015) is our preferred measure, while we use the estimates by Rajan and Zingales (1998) for robustness checks.

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purchasing power parity rates. Our main institutional quality measures are the *Rule of law* and *Control of corruption* indices from the World Governance Indicators database; and the *Resolving insolvency* and *Protecting minority investors* scores from the World Bank's *Doing Business* report. Appendix Table A.1 contains all variable definitions.

4 Empirical Methodology

4.1 Cross-sectional analysis

We start our analysis by running cross-sectional regressions in which we explain the leverage (L) of firm i in sector s in country c and year t by one or several time-varying measures of state ownership (S). In all specifications, we control for a matrix Z of standard time-varying determinants of firm leverage as suggested by corporate finance theory: firm size; profitability; asset tangibility; and the size of the non-debt tax shield. Importantly, we saturate all specifications with highly granular sector-country-year fixed effects, ϕ_{sct}, thus comparing firms with different levels of state ownership in the same sector, country and year. Because we systematically compare state-owned enterprises and private firms within the same sector, we exclude by construction any sectors in which state firms have a natural monopoly. We cluster standard errors at the firm level. Our baseline OLS specification is:

$$L_{isct} = \beta_0 + \beta_1 S_{it} + \gamma' Z_{it} + \phi_{sct} + \epsilon_i \tag{1}$$

In some specifications, we replace the dependent variable L_{isct} by I_{isct}: the firm-specific cost of debt. Moreover, to explore cross-country heterogeneity, we also estimate interaction regressions following Equation 2:

$$L_{isct} = \beta_0 + \beta_1 S_{it} + \beta_2 S_{it} \times M_{ct} + \gamma' Z_{it} + \phi_{sct} + \epsilon_i \tag{2}$$

where M_{ct} indicates time-varying country-level measures of the ownership structure in the banking sector or proxies for the quality of the institutional environment. In some specifications, we replace M_{ct} with M_{st}: time-varying sector characteristics such as industries' external finance dependence, liquidity needs or asset tangibility. In either case, the effect of M_{ct} or M_{st} itself is absorbed by our fixed effects ϕ_{sct}.

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4.2 Analysis of privatization events

4.2.1 Panel data analysis of privatized firms

For a deeper insight into the relationship between state ownership and firm leverage, we study changes in corporate indebtedness for firms that underwent a privatization process. To do so, we create a comprehensive global data set of privatization events by extracting all privatizations flagged by Bureau van Dijk's Zephyr database and that are of the "Acquisition" deal type. Privatizations are deals where "a government, council or other state-owned entity disposes of a company or stake in a company that it owns", and acquisitions are those deals "where the acquirer ends up with 50 percent or more of the equity of the target".

Our dataset includes detailed information on 2,714 firms privatized during 2000–2019. Most privatizations took place in Russia (1,098 cases), Serbia (267), Poland (192), Ukraine (140) and Bulgaria (118). Our analysis considers firms' debt levels within five-year periods directly before and after privatization. To ensure our results are not biased by firms disclosing financial information only in one period, we focus on firms for which we have at least three years of data before and after privatization. This reduces the sample to 946 companies. We run regressions following Equation 3 and cluster standard errors at the firm level:

$$L_{isct} = \beta_0 + \beta_1 PP_{it} + \gamma^{'} Z_{it} + \psi_i + \theta_{ct} + \mu_{st} + \epsilon_i \tag{3}$$

The variable of interest is a firm-specific pre-privatization dummy (PP_{it}) that takes the value '1' in the years before privatization and '0' in the years afterwards (the privatization year itself is excluded from the analysis). If privatization leads to an increase in firm leverage, we would therefore expect β_1 to be negative. Importantly, this setup allows us to include firm fixed effects (ψ_i) that absorb all observable and unobservable time-invariant firm characteristics that might otherwise confound estimates of the impact of state ownership on leverage. We thus obtain a clean within-firm estimate of the privatization impact. We also control for country-year (θ_{ct}) and sector-year (μ_{st}) fixed effects. These absorb time trends that affect specific countries (such as their business cycle) and specific sectors (such as industry-level technological change), respectively.

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4.2.2 Matching estimator of average treatment effects on privatized firms

To further identify the causal effect of privatization on the debt structure of (previously) state-owned firms, we use a matching estimator (Abadie and Imbens, 2006) to systematically compare privatized firms with similar peers that remained for at least 20 percent state-controlled throughout the observed period. We estimate the average treatment effect on the treated (ATT) with treatment being the privatization event.[12]

We condition on several key pre-treatment variables by matching exactly on country, two-digit NACE rev. 2 sector and year. In addition, we match on firm size, tangibility (ratio of fixed assets to total assets), productivity (ratio of operating revenue to total assets), leverage (the outcome variable) and the ratio of total informal debt to total assets. As privatization expectations and preparations may affect these covariates, we use the mean of the years *T-3*, *T-4*, and *T-5* as the reference period for matching (where T is the year of privatization). In order to find the optimal covariate balance, we use a genetic search algorithm as proposed by Diamond and Sekhon (2005) and Sekhon and Grieve (2011).[13] A privatized firm s is matched to a firm z that stayed state-owned throughout the observed period in such a way that the extended Mahalanobis distance m_{sz} is minimized:

$$m_{sz}\left(\mathrm{x}_{is}, \mathrm{x}_{iz}\right) = \left(\mathrm{x}_{is} - \mathrm{x}_{iz}\right)^{\mathrm{T}} \Sigma^{-\frac{1}{2}} \mathrm{W} \Sigma^{-\frac{1}{2}} \left(\mathrm{x}_{is} - \mathrm{x}_{iz}\right)$$

where x_{ic} is a vector of K observable covariates for firm i of type $c = s, z$; $\Sigma^{-\frac{1}{2}}$ is the inverted Cholesky decomposition of the empirical variance-covariance matrix of the covariates, Σ, while W is a matrix of weights obtained via a genetic algorithm that optimizes the covariate balance. Matching is performed with replacement, so a control firm can be linked to multiple treated firms. We match privatized firms s to control firms z one-to-one, conservatively accepting a higher variance for our estimates in exchange for a lower bias.

Our outcome variable is firm leverage at *T-5* to *T+5*: from five years before privatization to five years after. Because Orbis does not always contain data for all years, we run separate

[12] See Campello and Giambona (2013); Kahle and Stulz (2013); and Gropp, Mosk, Wix and Ongena (2019) for recent applications of this matching estimator in the corporate finance literature. Estimating consecutive cross-sectional ATT's is equivalent to applying a difference-in-differences approach to matched treated and control firms, as long as matching takes into account pre-treatment outcome levels (as we do). See also Athey and Imbens (2006).

[13] We implement this algorithm in R using the *Matching* package of Sekhon (2011).

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analyses for each year. The analysis of the privatization effect in years *T+1* and *T+2* can therefore be based on slightly different treated and control sub-samples because some firms only report outcomes in year *T+1* and others only in year *T+2*. For each year, we estimate the ATT with and without a correction for multiple covariates bias and perform statistical inference by calculating standard errors based on conventional formulas (Abadie and Imbens, 2006). Out of all treated firms selected for this exercise, 656 were matched exactly on country, year and two-digit sector to one or more control firms.[14]

5 Results

5.1 Baseline results

Table 2 presents our baseline results for the full sample. Controlling for country-sector-year fixed effects and for conventional determinants of leverage, we find that state ownership is negatively and significantly correlated with corporate indebtedness. Column (1) shows that even when using a very low minimum ownership threshold of just 1 percent, we find that state ownership decreases leverage by about 5 percentage points. This magnitude is substantial as the mean leverage in our data is 18.6 percent.

The effect is larger when we use higher thresholds for state ownership. In columns (2), (3) and (4), we present the results for the 20, 50 and 99 percent thresholds, respectively. In column (5), we include dummies for a comprehensive set of ranges of state ownership and find the effect monotonically increases from about 3 percentage points for state ownership below 20 percent to about 7 percentage points for state ownership above 99 percent. In all of the following regressions, we will use the dummy for the state's stake being above 20 percent as our main measure of state ownership. All our results are robust to using alternative thresholds.[15]

Throughout Table 2, we control for firm-level profitability, effectively shutting down the possibility that state ownership not only impacts leverage directly but also indirectly through

[14]The number of matched firms is lower in our year-by-year ATT estimates because data for the outcome variable may be missing for specific years (either for the treatment firm or for all control firms in the relevant country-sector-year cell) or because none of the available control firms are similar to the treated firms in terms of the matching covariates.

[15]Appendix Figure A.1 shows that these results are also robust to excluding one industry, region or year at a time.

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profitability. For example, state ownership may deter firm entry in the same sector and/or locality (Brandt, Kambourov and Storesletten, 2020). Such a protected position may then allow state firms to charge higher markups and become more profitable (Berkowitz and Nishioka, 2022) which in turn may translate in either higher leverage (in line with trade-off and agency theories) or lower leverage (as pecking-order theory would predict). Yet, when we exclude the profitability measure from our baseline regressions in Table 2, the estimated coefficients for the state-ownership variables turn out to be very stable. This suggests that, on average in our global sample, profitability is not an important mediator in the relationship between state ownership and leverage.

In Table 3, we explore the heterogeneity of the effect with respect to firm size. We consider our sub-samples of micro, small, medium-sized, large and super-large firms, as defined in Section 3.1.2. We find that the average negative effect in the full sample is driven by all but the largest firms. The effect is greatest for micro and small firms, lesser for medium-sized firms, even less for large firms and negligible for super-large firms. As we have only around 75,000 super-large firms in our sample (compared to 3.5 million micro and small firms), the average effect is similar in magnitude to that for micro and small firms. In columns (7) and (8), we rerun regressions for the full sample weighting the observations by size. In column (7), where the weights are proportional to log total assets, the coefficient on state ownership remains significantly negative. In column (8), where we weight observations by linear total assets, the average effect is driven by super-large firms and is essentially zero.

Figure 4 presents the estimated marginal effects of state ownership on leverage at different points of the firm-size distribution (the horizontal axis is logarithmic). These estimates are based on a regression for the full sample where the state ownership dummy is interacted with the log of total assets and with the squared log of total assets. The effect is clearly negative and statistically significant for firms with assets below EUR 1 billion, becomes zero or insignificant among firms with assets from EUR 1 to 10 billion, and is positive for firms with assets of EUR 10 billion or more. The positive effect for the largest firms is in line with previous studies, which mostly focus on listed firms that are usually very large.[16] Importantly, Figure 4 reveals that such findings based on only a subset of the very largest

[16]In Appendix Table A.2, we focus on a global sample of the 100, 300 or 500 largest listed firms. For this select sample, we also find a positive relationship between state ownership (of at least 20 percent) and leverage, although the coefficient is only precisely estimated for the 100 largest listed firms in the years before the global financial crisis.

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firms cannot be extrapolated to the vast majority of smaller companies. For these firms, the effect of state ownership is actually *negative*, statistically significant, and large in magnitude.

In Appendix Table A.4, we run similar regressions while interacting the state-owned dummy variable with one of three sectoral characteristics: the sector's external finance dependence (EFD), its liquidity needs and the sector's average asset tangibility. The results confirm the strong and robust negative relationship between state ownership and firm leverage. They also show, however, that—in sectors with a high external finance dependence (column 1) or with higher asset tangibility (column 3)—this negative effect is attenuated.

5.2 Cross-country heterogeneity

5.2.1 Institutional quality

In Table 4, we explore cross-country heterogeneity in the quality of political and legal institutions. Each column includes our main independent variable (state ownership) and its interaction with a country-level measure of institutional quality. In all specifications, the coefficient on state ownership remains negative and statistically significant, while the coefficient on the interaction term is positive and significant. The results indicate that the negative effect of state ownership on leverage is substantially stronger in economically less developed countries (column 1) and in countries with a weaker rule of law (column 2), more corruption (column 3), weaker insolvency regimes (column 4) and less investor protection (column 5).

The magnitudes are also large: if one country is 2.7 times as poor as another country, then the effect of state ownership on leverage is stronger by an additional 5 percentage points (similar to our average effect in the full sample). Likewise, reducing a country's corruption or strengthening its rule of law by one global standard deviation reduces the effect of state ownership on leverage by almost 3 percent (about half of the average effect). The magnitudes are similar for the indicators of insolvency resolution and the protection of minority investors. Together these results reveal how underdeveloped institutional frameworks exacerbate credit-market frictions related to state ownership.

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5.2.2 Ownership structure of the banking sector

In Table 5, we explore the role of the ownership structure of countries' banking systems. In addition to the state ownership dummy, we include its interactions with the share of state banks and the share of foreign banks in a country's banking system. Column (1) presents the results for the full sample. The coefficient on state ownership remains negative and statistically significant, and so are the coefficients on the interaction terms.

First, we find that the higher the share of state banks in the economy, the stronger the negative effect of state ownership on firm leverage. This result is clearly at odds with the conventional wisdom that state banks are more likely to lend to (all) state-owned firms. To investigate this further, columns (2)–(6) break the sample down into different size categories. We find the effect for the full sample is driven by micro, small and medium-sized firms. That is, a larger presence of state banks further reduces the leverage of small and medium-sized state enterprises. At the same time, the coefficient on the interaction term for larger firms is positive and significant (in the case of large firms) or insignificant (in the case of super-large firms). This suggests that countries may use state banks to channel credit towards larger state-owned "national champions" and away from smaller state-owned firms.

Second, we find that, in countries with a higher share of foreign banks, the negative effect of state ownership on leverage is also stronger.[17] This indicates that foreign banks provide financial discipline and are more reluctant to lend to state-owned firms than their (private) domestic competitors are. As in the case of state banks, the effect is concentrated in the micro, small and medium-sized firm categories. It is these smaller state-owned enterprises that foreign banks feel less secure lending to, whereas this is not the case for larger (likely more transparent and publicly more supported) state-owned enterprises.

5.3 State ownership and the cost of debt

Table 3 shows that state ownership is associated with significantly lower firm leverage across most of the firm-size distribution. The exceptions are large and super-large firms, where this negative effect is either very small (in the case of large firms) or entirely absent (in the

[17] This is confirmed by the sample-split regressions reported in Appendix Table A.3, which show that the relationship between state ownership and firm leverage is systematically more negative in countries where foreign banks own larger segments of the banking sector.

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case of super-large firms). These baseline results, and the subsequent additional findings, are consistent with the idea that creditors are concerned about the governance-related risks of lending to (smaller) state-owned enterprises. This should make creditors price in these risks by charging higher interest rates to (relatively small) state-owned firms. The results in Table 6 demonstrate precisely this. We find that, in the sample as a whole, state ownership is associated with, on average, a 0.3 percentage point higher implied interest rate. This amounts to 3.5 percent of the median interest rate. Importantly, this positive effect is entirely concentrated among small and medium-sized state firms (column 2). In contrast, large and super-large firms appear to *benefit* from state ownership in the form of lower borrowing costs.

Figure 5 shows the marginal effects of state ownership on borrowing costs along the firm-size distribution (the horizontal axis is again logarithmic). These estimations are based on column (1) of Table 6, with the state ownership dummy interacted with the log of total assets and the squared log of total assets. The figure shows clearly how state ownership makes debt more expensive for smaller state-owned enterprises but cheaper for larger ones. The finding that the largest firms benefit financially from the implicit and explicit bailout guarantees associated with state ownership is in line with the existing literature (Faccio, Masulis, and McConnell, 2006; Iannotta, Nocera, and Sironi, 2013). Our contribution here is to demonstrate that the impact of state ownership on funding costs is in fact the opposite for the vast majority of smaller state-owned enterprises that have, as yet, not been studied in the corporate finance literature.

In Table 7, we investigate whether and how the structure of the banking system moderates the relationship between state ownership and corporate debt costs. Interestingly, the data show that there is no special role for state-owned banks (relative to private domestic banks) in determining the interest rates paid by state-owned firms. This indicates that the bailout guarantees associated with state ownership help to reduce the credit risk as perceived by privately owned and state-owned domestic banks alike. In contrast, we find that a greater presence of *foreign* banks results in a higher cost of borrowing for state firms. Yet, in line with Table 5, this holds mainly for smaller state firms and much less so, or not at all, for large and super-large ones.

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5.4 Privatization and firm leverage

In this section, we study a sub-sample of firms that were privatized. This allows us to estimate the impact of state ownership on leverage by analyzing an ownership change within the same firm. We focus on privatized firms for which we have at least three years of data before and after the privatization year. There are about 900 such firms. Of these, about 700 are micro, small and medium-sized firms, while almost 200 are large and super-large firms. Figure 6 shows the evolution of leverage before and after privatization separately for micro, small and medium-sized firms (solid line) versus large and super-large firms (dashed line). For the latter, there is no change in leverage in the 10-year window around the privatization event. However, for the smaller firms, privatization is accompanied by a major increase in leverage around the year of privatization. Moreover, this increase is sustained for at least five years after the change in ownership.

In Table 8, we report results from panel regressions where we include firm fixed effects, country-year and sector-year fixed effects, and our standard set of time-varying firm-level characteristics. We exclude the year of privatization from the analysis. The results are strikingly similar to our earlier baseline results—in terms of the sign of the effect and its magnitude. In column (1), we present the results for the full sample. Here state ownership (that is, the pre-privatization dummy) has a negative and significant impact on leverage. The magnitude of the effect is 5 percentage points, exactly as in Table 2 where we compared leverage in state-owned and private firms while controlling for country-sector-year fixed effects. Once we split the sample into size categories, we again find that the average effect is driven by the micro, small and medium-sized firms (column 2). For these, the coefficient is negative and significant and the size of the effect is 6 percentage points. This is again very similar to the results in Table 3. For the large and super-large firms in column (3), there is no effect: the coefficient is close to zero.

Next, we use a matching estimator to systematically compare privatized firms with similar firms that remained state-controlled. We condition on several key pre-treatment variables by matching exactly on country, two-digit sector and year. In addition, we match on firm size, tangibility, productivity, leverage (the outcome variable) and the ratio of total informal debt to total assets. We use genetic Mahalanobis distance matching and Appendix Figure A.2. presents the variance-standardized means between the treated and control observations for both the raw and the matched sample. For each year, we then estimate the ATT with

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and without a correction for multiple covariates bias (Abadie and Imbens, 2006).

Table 9 and Figure 7 present these ATT estimates. The results are qualitatively and quantitatively similar to those of the cross-sectional regressions and the panel data analysis. Relative to the matched control group, privatization increases leverage by about 5 percentage points. There is, however, one nuance: while the main increase in leverage takes place in the year of privatization (and the year after), there is also a clear (albeit not as steep) increase in leverage just beforehand. In the two years before privatization, firm leverage already rises by about 2 percentage points. As the preparation of privatization deals usually takes several years, this likely reflects creditors' ex ante expectations of improved governance after privatization.[18]

6 Conclusions

In this paper, we have studied the relationship between state ownership and leverage in 4 million firms around the world. While previous studies focused mostly on large and listed companies, our sample includes many micro, small and medium-sized firms. We show that the relationship between state ownership and leverage is indeed heterogeneous across firm sizes. While there is no robust impact of state ownership on leverage for large firms in our sample, we find a strong negative effect of state ownership on leverage among micro, small and medium-sized firms. Controlling for country-sector-year fixed effects and standard firm-level determinants of leverage, state-owned firms have a 5 percentage points lower debt to assets ratio than their private peers. This is substantial: the average leverage in our data set is 18.6 percent. The effect is increasing in the degree of state ownership, but is significant even if the state only has a small ownership stake. Finally, we find similar effects on firms' costs of debt: while state ownership increases these costs for smaller state firms, it actually reduces external funding costs for large and super-large state-owned enterprises.

In addition to comparing state and private firms within the same countries, sectors and years, we also analyze the effect of state ownership on leverage within the same firms. We study the evolution of leverage in firms that underwent privatization and find that privatiza-

[18] In unreported regressions, we also find a simultaneous decline in privatized firms' average debt costs of 3 percentage points. Because we only have data on the cost of debt for about half of the privatized firms, this sample is too small to perform sub-sample analyses by firm size.

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tion allows firms to lever up. Similar to our findings from the cross-firm analysis, this effect is again driven by micro, small and medium-sized firms. The magnitude of the effect is also very similar: 5 percentage points.

The strong negative relationship between state ownership and corporate leverage likely reflects the corporate governance risks of state ownership. Creditors may fear the state's intervention in firms' operations, and they may therefore be less willing to lend to such firms. Indeed, we find the negative effects of state ownership on leverage are much stronger in countries with a weaker rule of law, control of corruption, protection of investors, and insolvency procedures. These results are consistent with the view that state ownership is especially costly in countries with weaker political and legal institutions.

Our results can also be seen in light of a recent literature that underlines the substantial misallocation of capital and labor across firms—even within narrowly defined industrial sectors and within the same country (Hsieh and Klenow, 2009; Restuccia and Rogerson, 2017). State ownership can be an important source of such allocative inefficiency and the resulting drag on total factor productivity (Nigmatulina, 2022). Our results highlight one mechanism through which state ownership can introduce distortions and resource misallocation: it interferes with the ability of all but the largest firms to access credit.

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Tables and Figures

Table 1: Summary Statistics

Panel A: Firm-level Variables

Variable	Observations	Mean	SD	Median	Min.	Max.
State ownership	19,651,734	0.814	8.384	0	0	100
State-owned $\geq$ 20%	19,651,734	0.010	0.099	0	0	1
State-owned $\geq$ 50%	19,651,734	0.008	0.090	0	0	1
State-owned $\geq$ 99%	19,651,734	0.006	0.076	0	0	1
State-owned [1%; 20%)	19,651,734	0.005	0.067	0	0	1
State-owned [20%; 50%)	19,651,734	0.002	0.042	0	0	1
State-owned [50%; 99%)	19,651,734	0.002	0.048	0	0	1
Firm size	19,651,734	13.925	2.197	13.732	2.197	29.131
Profitability	19,651,734	0.091	0.195	0.074	-2	2
Tangibility	19,651,734	0.274	0.289	0.158	0	1
Non-debt tax shield	19,651,734	0.043	0.056	0.027	0	1
Firm leverage	19,651,734	0.186	0.249	0.072	0	2
Cost of debt	9,847,218	0.087	0.106	0.054	0.006	0.823

Panel B: Country-level Variables

Variable	Countries	Mean	SD	Median	Min.	Max.
State banks	87	0.152	0.196	0.056	0	1
Foreign banks	86	0.341	0.323	0.22	0	1
GDP per capita, PPP, log	87	10.049	0.868	10.224	7.729	11.655
Rule of law	86	0.576	0.931	0.590	-1.823	2.100
Control of corruption	86	0.538	1.023	0.356	-1.431	2.470
Resolving insolvency	84	0.564	0.204	0.552	0	0.939
Protecting minority investors	84	0.600	0.149	0.600	0.200	0.967

Panel C: Industry-level Variables

Variable	Industries	Mean	SD	Median	Min.	Max.
External finance dependence	73	0.036	0.314	0.010	-0.960	0.670
Liquidity needs	107	0.173	0.042	0.174	0.050	0.290
Tangibility	403	0.257	0.188	0.207	0.000	0.855

Notes: This table provides summary statistics for all variables used in the analysis. Panels A, B and C summarize the main characteristics of firm-, country- and industry-level variables, respectively. Appendix Table A.1 contains all variable definitions and data sources.

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Table 2: State Ownership and Firm Leverage

	Firm leverage				
	(1)	(2)	(3)	(4)	(5)
State-owned ≥ 1%	-0.048***				
	(0.001)				
State-owned ≥ 20%		-0.055***			
		(0.001)			
State-owned ≥ 50%			-0.060***		
			(0.001)		
State-owned ≥ 99%				-0.064***	
				(0.002)	
State-owned [1%; 20%)					-0.030***
					(0.001)
State-owned [20%; 50%)					-0.031***
					(0.002)
State-owned [50%; 99%)					-0.047***
					(0.002)
State-owned [99%; 100%]					-0.067***
					(0.002)
Firm size	0.011***	0.011***	0.011***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.125***	-0.126***	-0.125***	-0.125***	-0.125***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	0.184***	0.185***	0.185***	0.184***	0.185***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Non-debt tax shield	0.188***	0.187***	0.187***	0.186***	0.187***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Country × Sector × Year FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.214	0.214	0.214	0.214	0.214
N observations	19,651,734	19,651,734	19,651,734	19,651,734	19,651,734
N firms	3,976,881	3,976,881	3,976,881	3,976,881	3,976,881
N countries	89	89	89	89	89

Notes: This table reports OLS regressions where the dependent variable is firm leverage. Column 5 uses bins where the omitted baseline category is all firms with no or less than 1% state ownership. All regressions include interactive fixed effects (FE) at the country × two-digit NACE 2 sector × year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 3: State Ownership and Firm Leverage: Firm-Size Heterogeneity

	Micro	Small	Medium	MSMEs	Large	Super-large	All firms	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
State-owned $\geq$ 20%	-0.063***	-0.062***	-0.040***	-0.062***	-0.018***	-0.005	-0.052***	-0.007
	(0.002)	(0.003)	(0.003)	(0.001)	(0.003)	(0.009)	(0.001)	(0.008)
Firm characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Sector×Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.220	0.201	0.227	0.213	0.286	0.380	0.214	0.387
N observations	14.0M	3.5M	1.3M	18.8M	737,270	75,625	19.7M	19.7M
N firms	3.1M	582,095	198,609	3.9M	96,179	8,433	4.0M	4.0M
N countries	61	76	85	87	89	68	89	89

Notes: This table reports OLS regressions where the dependent variable is firm leverage. In columns 1-6, the sample includes firms of the specified size category only and observations are not weighted. The firm-size categories are: super-large (total assets above EUR 1 billion, large (total assets between EUR 1 billion and EUR 43 million), medium-sized (total assets between EUR 10 and 43 million), small (total assets between EUR 2 and 10 million) and micro (total assets below EUR 2 million). MSMEs is a combination of micro, small and medium-sized firms. A firm is classified by its size only once: in the year it first enters the data set. In columns 7 and 8, the sample includes all firms. In column 7, observations are weighted by log of total assets and in column 8 by total assets. Firm characteristics include firm size, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country $\times$ two-digit NACE 2 sector $\times$ year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 4: State Ownership, Institutional Quality and Firm Leverage

	Firm leverage				
	(1)	(2)	(3)	(4)	(5)
State-owned $\geq$ 20%	-0.521***	-0.074***	-0.071***	-0.139***	-0.113***
	(0.021)	(0.001)	(0.001)	(0.004)	(0.006)
State-owned $\geq$ 20% $\times$ GDP per capita	0.045***				
	(0.002)				
State-owned $\geq$ 20% $\times$ Rule of law		0.023***			
		(0.001)			
State-owned $\geq$ 20% $\times$ Control of corruption			0.022***		
			(0.001)		
State-owned $\geq$ 20% $\times$ Resolving insolvency				0.120***	
				(0.006)	
State-owned $\geq$ 20% $\times$ Protecting investors					0.097***
					(0.010)
Firm characteristics	Yes	Yes	Yes	Yes	Yes
Country $\times$ Sector $\times$ Year FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.214	0.214	0.214	0.213	0.212
N observations	19.6M	19.5M	19.5M	19.2M	18.5M
N firms	4.0M	3.9M	3.9M	3.8M	3.7M
N countries	87	86	86	84	84

Notes: This table reports OLS regressions where the dependent variable is firm leverage. Firm characteristics include firm size, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country $\times$ two-digit NACE 2 sector $\times$ year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 5: State Ownership, Structure of the Banking Sector and Firm Leverage

	All firms (1)	MSMEs (2)	Large (3)	Super-large (4)
State-owned $\geq$ 20%	-0.030***	-0.032***	-0.029***	0.010
	(0.003)	(0.003)	(0.008)	(0.018)
State-owned $\geq$ 20% $\times$ State banks	-0.022***	-0.088***	0.049***	-0.030
	(0.008)	(0.011)	(0.018)	(0.042)
State-owned $\geq$ 20% $\times$ Foreign banks	-0.087***	-0.084***	0.000	-0.015
	(0.004)	(0.005)	(0.016)	(0.047)
Firm characteristics	Yes	Yes	Yes	Yes
Country $\times$ Sector $\times$ Year FE	Yes	Yes	Yes	Yes
R-squared	0.208	0.207	0.288	0.373
N observations	13.1M	12.6M	517,548	47,825
N firms	3.7M	3.6M	90,533	7,798
N countries	85	84	85	66

Notes: This table reports OLS regressions where the dependent variable is firm leverage. In column 1, the sample includes all firms; in columns 2–4, the sample includes firms of the specified size category. The notes to Table 3 provide the definitions of these size categories. Firm characteristics include firm size, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country $\times$ two-digit NACE 2 sector $\times$ year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 6: State Ownership and the Cost of Debt

	All firms (1)	MSMEs (2)	Large (3)	Super-large (4)
State-owned $\geq$ 20%	0.003***	0.004***	-0.008***	-0.007**
	(0.000)	(0.001)	(0.001)	(0.003)
Firm characteristics	Yes	Yes	Yes	Yes
Country $\times$ Sector $\times$ Year FE	Yes	Yes	Yes	Yes
R-squared	0.089	0.091	0.149	0.31
N observations	9.8M	9.3M	507,440	57,541
N firms	2.4M	2.4M	79,680	7,040
N countries	89	85	89	63

Notes: This table reports OLS regressions where the dependent variable is a firm's cost of debt. In column 1, the sample includes all firms while in columns 2–4, the sample includes firms of the specified size category. The notes to Table 3 provide the definitions of these size categories. Firm characteristics include firm size, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country $\times$ two-digit NACE 2 sector $\times$ year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 7: State Ownership, Structure of the Banking Sector and the Cost of Debt

	All firms (1)	MSMEs (2)	Large (3)	Super-large (4)
State-owned $\geq$ 20%	-0.005***	-0.004***	-0.014***	-0.010
	(0.001)	(0.001)	(0.002)	(0.008)
State-owned $\geq$ 20% $\times$	0.002	0.006	0.007	0.008
State banks	(0.003)	(0.004)	(0.005)	(0.015)
State-owned $\geq$ 20% $\times$	0.022***	0.023***	0.011*	0.009
Foreign banks	(0.002)	(0.003)	(0.006)	(0.013)
Firm characteristics	Yes	Yes	Yes	Yes
Country $\times$ Sector $\times$ Year FE	Yes	Yes	Yes	Yes
R-squared	0.076	0.078	0.129	0.28
N observations	7.0M	6.6M	355,851	35,866
N firms	2.2M	2.1M	73,225	6,454
N countries	85	81	85	61

Notes: This table reports OLS regressions where the dependent variable is a firm's cost of debt. In column 1, the sample includes all firms while in columns 2–4, the sample includes firms of the specified size category. The notes to Table 3 provide the definitions of these size categories. Firm characteristics include firm size, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country $\times$ two-digit NACE 2 sector $\times$ year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 8: Privatization and Firm Leverage

	All firms (1)	MSMEs (2)	(Super)Large (3)
Pre-privatization	-0.050*** (0.010)	-0.061*** (0.011)	-0.006 (0.025)
Firm characteristics	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes
Sector × Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Within R-squared	0.042	0.043	0.010
N observations	7,911	6,129	1,286
N firms	920	727	164
N countries	29	22	21

Notes: This table reports fixed effects panel data regressions where the dependent variable is firm leverage. The sample includes only firms that were privatized and for which we have data for at least three years before and three years after privatization. A privatization is a deal that was classified as "Acquisition" by Bureau van Dijk's Orbis Zephyr database (that is, the acquirer ended up with 50 percent or more of the target's equity). The year of privatization is excluded from the analysis. In column 1, the sample includes all eligible firms. In column 2, the sample includes micro, small and medium-sized firms. In column 3, the sample includes large and super-large firms. The notes to Table 3 provide the definitions of these size categories. The explanatory variable of interest—*Pre-privatization*—is a dummy that takes the value '1' in the years before privatization and '0' in the years afterwards. Firm characteristics include firm size, tangibility and productivity. All regressions include firm fixed effects (FE) as well as interactive FE at the country × year level and the two-digit NACE 2 sector × year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table 9: Privatization and Firm Leverage: Average Treatment Effect on the Treated (ATT)

Year	Treated	Control	Raw Diff.	ATT	ATT b.a.	Γ^*
T-5	373	334	-0.059***	0.001	-0.001	1.00
			(0.006)	(0.002)	(0.001)	
T-4	408	371	-0.051***	0.002	-0.002***	1.00
			(0.005)	(0.002)	(0.001)	
T-3	468	428	-0.051***	0.005***	0.002*	1.00
			(0.005)	(0.002)	(0.001)	
T-2	391	357	-0.046***	0.021***	0.018***	1.00
			(0.005)	(0.002)	(0.002)	
T-1	411	385	-0.042***	0.029***	0.026***	1.00
			(0.005)	(0.003)	(0.003)	
T	508	481	-0.015***	0.040***	0.038***	1.20
			(0.006)	(0.004)	(0.004)	
T+1	483	449	0.015**	0.069***	0.066***	1.60
			(0.006)	(0.005)	(0.005)	
T+2	451	417	0.023***	0.066***	0.064***	1.60
			(0.007)	(0.006)	(0.006)	
T+3	369	337	0.016**	0.076***	0.074***	1.75
			(0.007)	(0.006)	(0.006)	
T+4	316	287	0.023***	0.059***	0.058***	1.40
			(0.008)	(0.005)	(0.005)	
T+5	278	255	0.029***	0.064***	0.067***	1.20
			(0.009)	(0.006)	(0.006)	

Notes: Standard errors are reported in parentheses. A privatization is a deal that was classified as "Acquisition" by Bureau van Dijk's Orbis Zephyr database (that is, the acquirer ended up with 50 percent or more of the equity of the target). Year T denotes the year of privatization. Years T-5 through T-1 denote the years before privatization while years T+1 through T+5 denote the years after privatization. The matched sample is obtained by genetic Mahalanobis distance matching (with one nearest neighbor) on firm size, tangibility, productivity, the ratio of total formal debt to total assets, and the ratio of total informal debt to total assets, averaged over years T-3, T-4, and T-5. We also force exact matching on country, two-digit NACE Rev. 2 industry and year. In the matched sample, *Treated* is the number of matched treated observations; *Control* is the number of matched controls. The dependent variable is firm leverage. *Raw Diff.* are raw differences based on simple dummy variable regressions on the whole sample. *ATT* and *ATT b.a.* are estimates of the average treatment effect on the treated (ATT) excluding and including a bias-adjustment term, respectively (Abadie and Imbens, 2011). In both cases, standard errors are computed following Abadie and Imbens (2006). Γ^* is the minimum value of parameter $\Gamma \geq 1$, selected from a grid spaced by intervals of 0.05 length, such that in a sensitivity analysis à la Rosenbaum (2002) the Wilcoxon signed-rank tests associated with Γ^* do not simultaneously reject the null hypothesis that the outcome variable is not different across the treated and control samples, for tests with $\alpha = .05$ type I error. Appendix Table A.1 contains all variable definitions and data sources.

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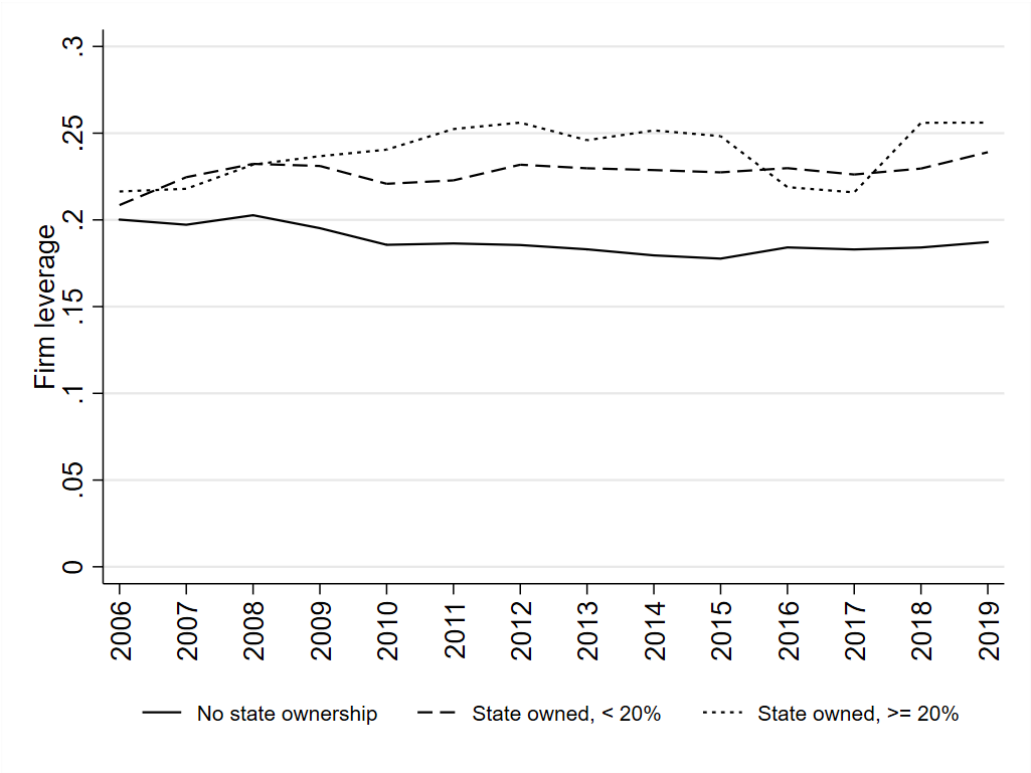
Figure 1: State Ownership and Firm Leverage over Time



Notes: This figure shows the development of average firm leverage in a balanced sample of approximately 19K firms across 70 countries during 2006–2019. The solid line indicates firms without any state ownership. The dashed line indicates firms with strictly positive state ownership below 20 percent. The dotted line indicates firms with state ownership of 20 percent or more. Appendix Table A.1 contains all variable definitions and data sources.

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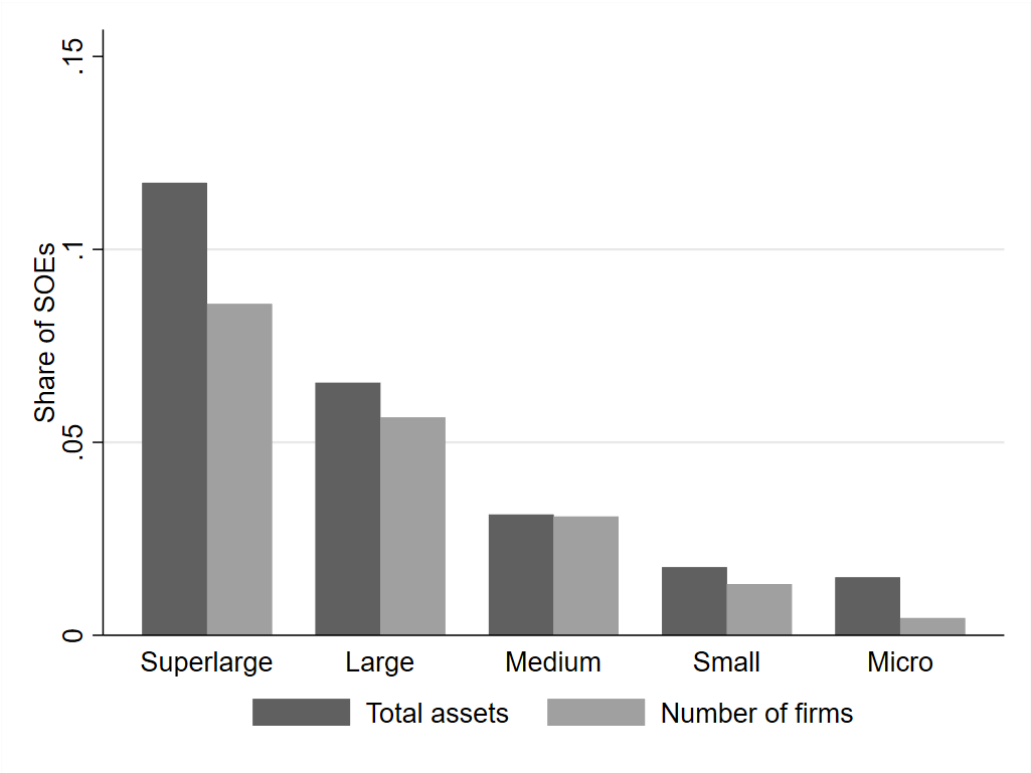
Figure 2: Share of State-Owned Enterprises among All Enterprises, by Firm Size



Notes: This figure reports the share of state-owned enterprises (SOEs) within each of five firm size categories: super-large (total assets above EUR 1 billion), large (total assets between EUR 1 billion and EUR 43 million), medium (total assets between EUR 10 EUR 43 million), small (total assets between EUR 2 and 10 million) and micro (total assets below EUR 2 million). A firm is classified by its size only once: in the year it first enters the dataset. Reported shares are averages over the years 2011–2019. SOEs are defined as firms with at least 20 percent state ownership. Appendix Table A.1 contains all variable definitions and data sources.

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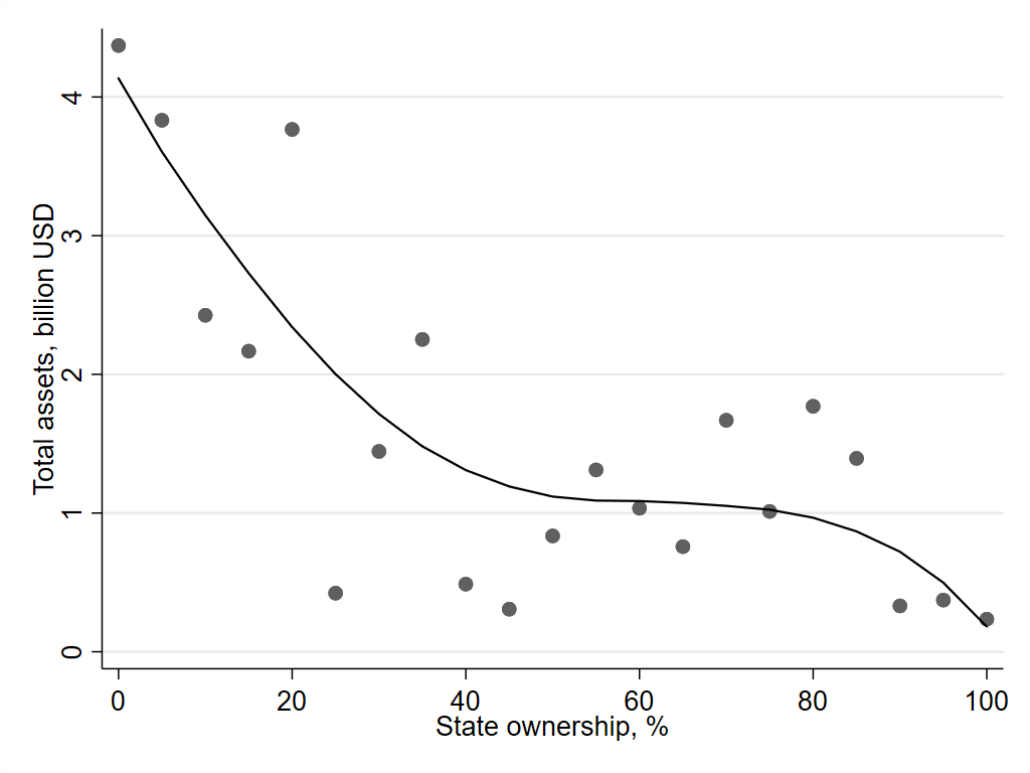
Figure 3: Variation in State Ownership and Firm Size



Notes: This figure reports simple means of total firm assets by the level of state ownership. On the horizontal axis, firms are grouped into bins with a 5 percentage point width (e.g. from 0 to 5 percent, from 5 to 10 percent, etc.) in terms of the share of state ownership. Firms without state ownership are excluded from the sample while firms with 100 percent state ownership are assigned to a separate bin. The line is a LOESS curve with 80 percent bandwidth. Appendix Table A.1 contains all variable definitions and data sources.

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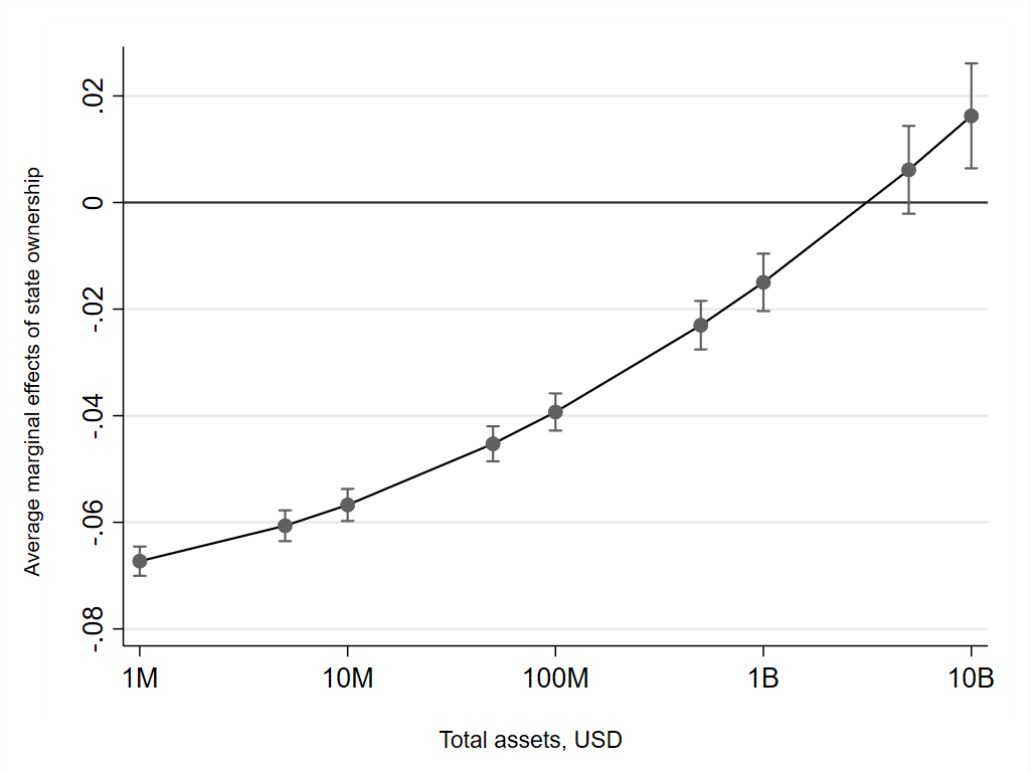
Figure 4: Marginal Effects of State Ownership on Firm Leverage, by Firm Size



Notes: This figure reports average marginal effects of state ownership on firm leverage with 95 percent confidence intervals. The analysis is based on the regressions reported in Table 2, column 2, with the state-owned dummy interacted with the log of total assets and the squared log of total assets. Appendix Table A.1 contains all variable definitions and data sources.

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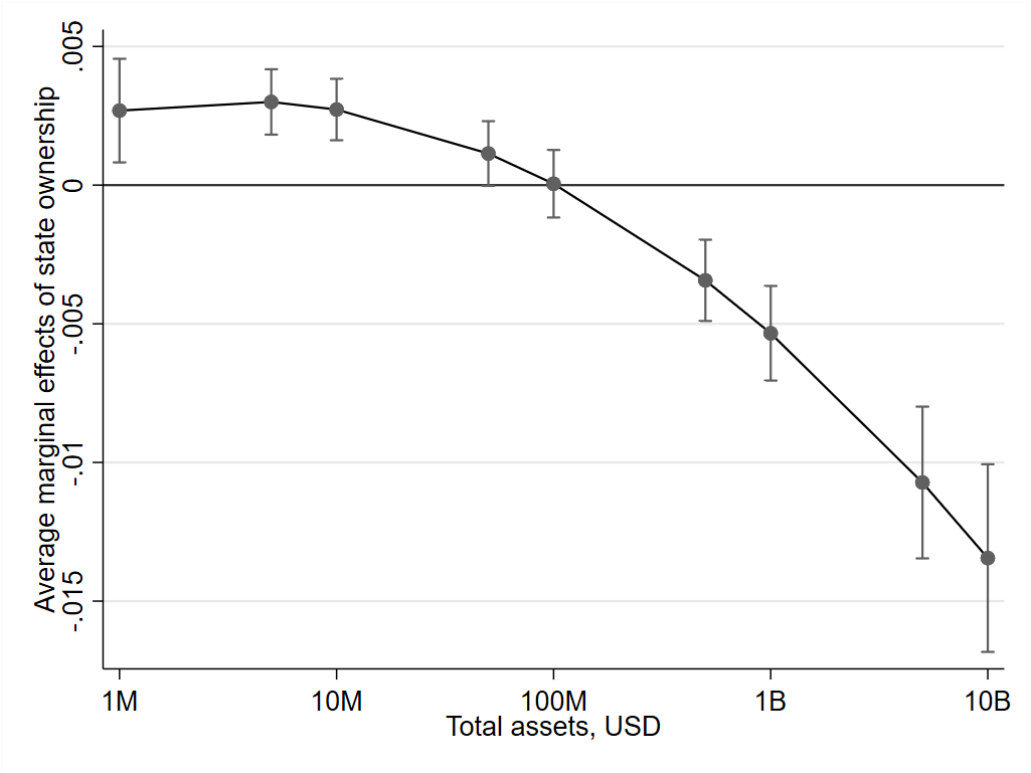
Figure 5: Marginal Effects of State Ownership on the Cost of Debt, by Firm Size



Notes: This figure reports average marginal effects of state ownership on cost of debt with 95 percent confidence intervals. The analysis is based on the regressions reported in column 1 of Table 6 with the state-owned dummy interacted with the log of total assets and the squared log of total assets. Appendix Table A.1 contains all variable definitions and data sources.

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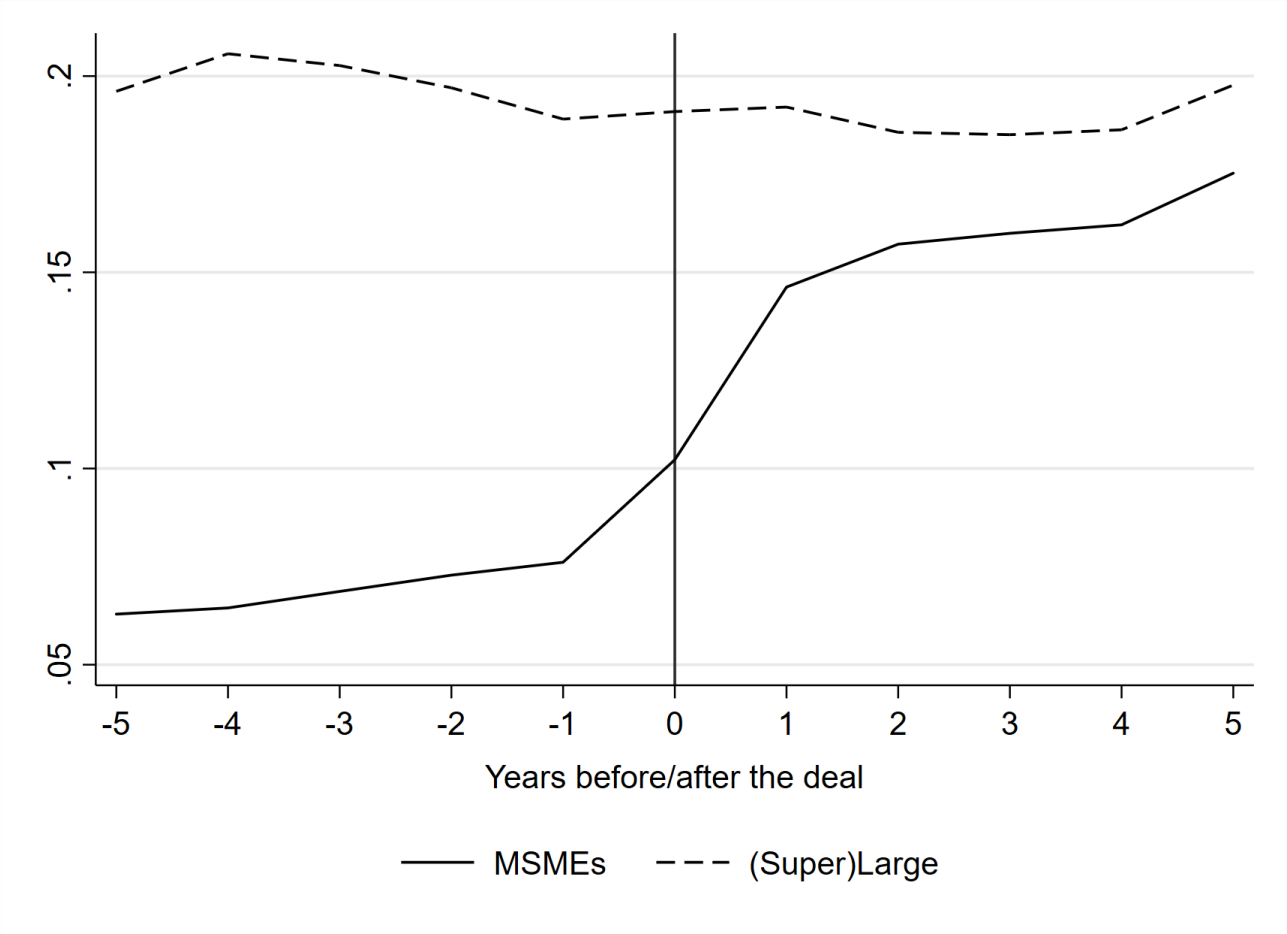
Figure 6: Firm Leverage Before and After Privatization



Notes: This figure reports average firm leverage before and after privatization. The sample includes only firms that were privatized and for which data are available for at least three years before and three years after privatization. A privatization is a deal that was classified as "Acquisition" by Bureau van Dijk's Orbis Zephyr database (that is, the acquirer ended up with 50 percent or more of the target's equity). Year 0 denotes the year of privatization. Years -5 through -1 are the years before privatization while the years 1 through 5 are the years after privatization. The solid line shows average firm leverage for micro, small and medium-sized enterprises (MSMEs), and the dashed line shows average firm leverage for large and super-large enterprises. The notes to Table 3 provide the definitions of these size categories. Appendix Table A.1 contains all variable definitions and data sources.

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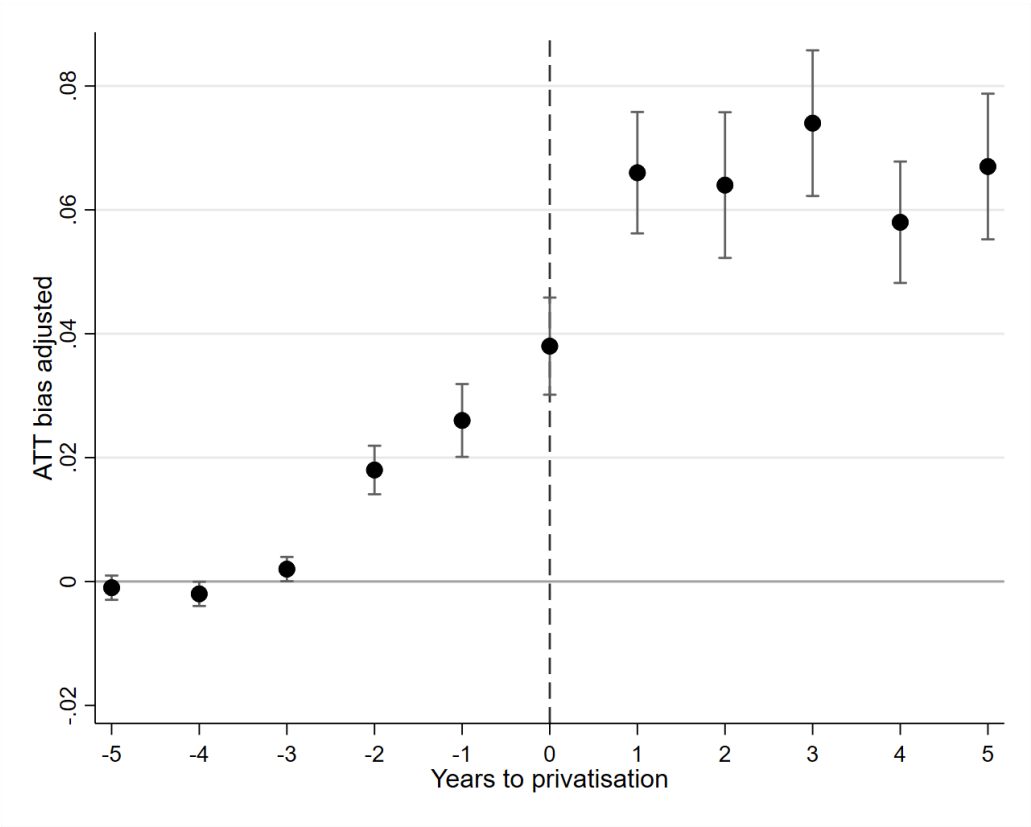
Figure 7: Privatization and Firm leverage: Event Study



Notes: This figure provides a graphic representation of the ATT analysis presented in Table 9. The dots correspond to annual ATT estimates including a bias-adjustment term. The whiskers represent 95 percent confidence intervals.

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Appendices

Table A.1: Variable Definitions and Data Sources

Variable	Definition	Source
State ownership	Cumulative percentage of company voting shares (in)directly controlled by the state, governmental agencies, governmental departments, or local authorities.	BvD Orbis
State-owned $\geq$ X%	Dummy that is 1 if state ownership is above or equal to X%, and 0 otherwise.	*Id.*
State-owned [X%; Y%)	Dummy that is 1 if state ownership is above or equal to X% and below Y%, and 0 otherwise.	*Id.*
Firm size	Total assets (log).	*Id.*
Profitability	Earnings before interest, taxes, depreciation, and amortization (EBITDA) to total assets.	*Id.*
Productivity	Operating revenue to total assets.	*Id.*
Tangibility (firm-level)	Tangible fixed assets to total assets.	*Id.*
Non-debt tax shield	Depreciation and amortization to total assets.	*Id.*
Firm leverage	Total formal debt (loans from banks and outstanding bonds) to total assets.	*Id.*
Cost of debt	Total interest expenses to total formal debt (trimmed at the 5th and 95th percentiles).	*Id.*
State banks	Share of bank assets held by domestic state banks (50 percent or more state-owned).	Bank Regulation and Supervision Survey. Chinese data: Berger et al. (2009)
Foreign banks	Share of bank assets held by foreign banks (50 percent or more foreign-owned).	Global Financial Development Database
GDP per capita	Log of GDP per capita based on purchasing power parity (PPP) and constant 2017 dollars.	World Development Indicators
Rule of law	Index capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police and the courts, as well as the likelihood of crime and violence. The index is expressed in units of a standard normal distribution, with mean zero, standard deviation of one, and runs from approximately -2.5 to 2.5. Higher values indicate a stronger rule of law.	World Governance Indicators

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Control of corruption	Index capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. The index is expressed in units of a standard normal distribution, with mean zero, standard deviation of one, and runs from approximately -2.5 to 2.5. Higher values correspond to better control of corruption (i.e. lower corruption).	*Id.*
Resolving insolvency	Index measuring the gap between an economy's performance and the regulatory best practice on the Resolving Insolvency Indicator components. The score ranges from 0 to 100, where 0 represents the worst regulatory performance and 100 the best.	World Bank Doing Business
Protecting minority investors	Index measuring the gap between an economy's performance and the regulatory best practice on the Protecting Minority Investors Indicator components. The score ranges from 0 to 100, where 0 represents the worst regulatory performance and 100 the best.	*Id.*
External finance dependence	Industry-level median proportion of capital expenditures not financed with cash flow from operations. Positive values mean firms must issue debt or equity to finance investments. Negative values mean firms have cash flow exceeding their investments. Calculated using data from companies in Compustat for at least 10 years between 1980 and 1996. Industry is defined at the two-digit level.	Duygan-Bump et al. (2015)
Liquidity needs	Industry-level median ratio of inventories over annual sales. Calculated based on data from all manufacturing companies in Compustat during 1980–1989. Industry is defined at the four-digit level.	Raddatz (2006)
Tangibility (sector-level)	Industry-level median ratio of tangible fixed assets to total assets. Calculated based on data from all available US companies in Bureau van Dijk's Orbis during 2000–2019. Industry is defined at the four-digit level.	BvD Orbis

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Table A.2: State Ownership and Firm Leverage: Largest Public Firms

	All years: 2000–2019			Pre-GFC: 2000–2008			Post-GFC: 2009–2019		
	Top100	Top300	Top500	Top100	Top300	Top500	Top100	Top300	Top500
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
State-owned, $\geq 20\%$	0.064	0.021	0.011	0.116**	0.043	0.022	0.010	0.016	0.007
	(0.058)	(0.037)	(0.024)	(0.051)	(0.058)	(0.038)	(0.055)	(0.036)	(0.024)
Firm characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Sector×Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.710	0.627	0.599	0.750	0.643	0.589	0.733	0.611	0.599
N observations	889	3,690	6,663	391	1,624	3,019	498	2,066	3,644
N firms	219	843	1,619	180	738	1,403	91	314	575
N countries	15	34	39	13	33	37	10	17	25

Notes: This table reports OLS regressions where the dependent variable is firm leverage. In each column, the sample includes the N largest listed firms within the specified period, where N = {100, 300, 500}. Firm characteristics include firm size, tangibility, profitability and the non-debt tax shield. All regressions include interactive fixed effects (FE) at the country × two-digit NACE 2 sector × year level. Columns 1–3 report regressions for the period 2000–2019. Columns 4–6 report regressions for the period 2000–2008 (before the global financial crisis). Columns 7–9 report regressions for the period 2009–2019 (during and after the global financial crisis). Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table A.3: State Ownership, Bank Ownership and Firm Leverage: Sample-Split Regressions

			State bank share		
			<= 10%	(10%; 50%]	>50%
Foreign bank share	<= 10%	Coefficient	-0.049***	-0.031***	-0.012*
		SE	(0.003)	(0.004)	(0.007)
		N observations	5,824,114	419,985	55,761
		N firms	1,835,567	167,669	15,885
		N countries	20	17	6
	(10%; 50%]	Coefficient	-0.037***	-0.067***	-0.109***
		SE	(0.004)	(0.003)	(0.007)
		N observations	2,051,993	2,148,401	57,356
		N firms	717,005	706,777	27,198
		N countries	24	34	5
	>50%	Coefficient	-0.083***	-0.104***	
		SE	(0.003)	(0.002)	
		N observations	1,899,501	679,248	N/A
		N firms	616,062	226,874	
		N countries	24	11	

Notes: This table summarizes the results of OLS regressions where the dependent variable is firm leverage. Each cell reports the results of a separate regression ran on a different sample of countries. The vertical and horizontal axis legends indicate the percentage of all banking assets owned by state banks (horizontal axis) and by foreign banks (vertical axis) in the countries of that cell. Firm characteristics include the log of total assets, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country × two-digit NACE 2 sector × year level. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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Table A.4: State Ownership and Firm Leverage: Cross-Industry Heterogeneity

	Firm leverage		
	(1)	(2)	(3)
State-owned $\geq$ 20%	-0.060***	-0.059***	-0.065***
	(0.001)	(0.020)	(0.002)
State-owned $\geq$ 20% $\times$ EFD	0.035***		
	(0.005)		
State-owned $\geq$ 20% $\times$ Liquidity needs		0.082	
		(0.114)	
State-owned $\geq$ 20% $\times$ Tangibility (sector-level)			0.029***
			(0.005)
Firm characteristics	Yes	Yes	Yes
Country $\times$ Sector $\times$ Year FE	Yes	Yes	Yes
R-squared	0.214	0.207	0.219
N observations	19.1M	1.6M	16.1M
N firms	3.9M	285,324	3.3M
N countries	89	80	89

Notes: This table reports OLS regressions where the dependent variable is firm leverage. In columns 1 and 3, the sample includes all available firms. In column 2, the sample includes manufacturing firms only. EFD stands for external finance dependence. Firm characteristics include firm size, tangibility, profitability and non-debt tax shield. All regressions include interactive fixed effects (FE) at the country $\times$ two-digit NACE 2 sector $\times$ year level. Levels for EFD, liquidity needs and sector-level tangibility are absorbed in these fixed effects. Standard errors are clustered at the firm level. Appendix Table A.1 contains all variable definitions and data sources.

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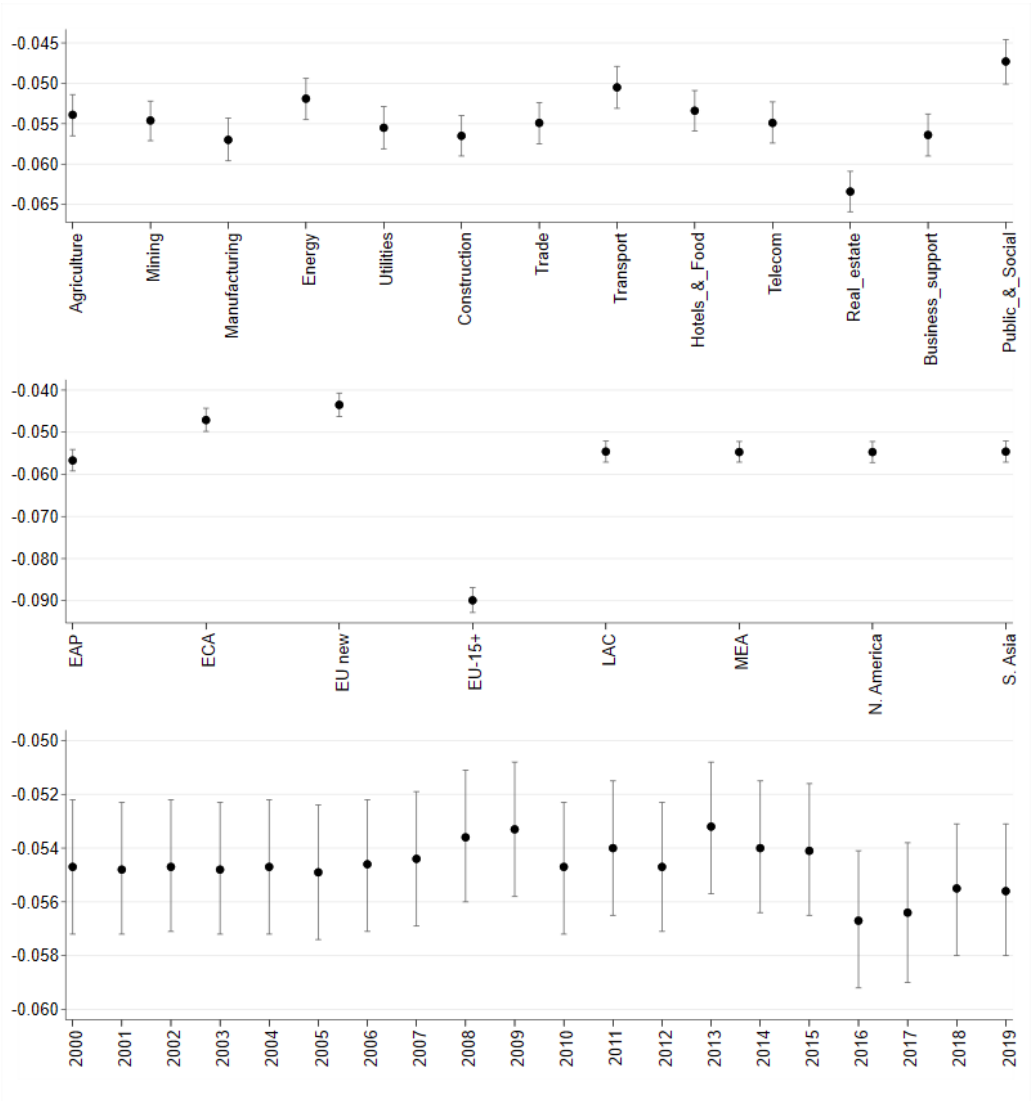
Figure A.1: State Ownership and Firm Leverage: Excluding One Industry/Region/Year at a Time



Notes: This figure reports coefficients for the variable "State-owned $\geq$ 20%" when re-running the regression reported in Table 2, column 2, while excluding one NACE Rev. 2 industry, geographic region or year at a time, with the 95 percent confidence interval. The industries 'Agriculture', 'Mining', 'Manufacturing', 'Energy', 'Utilities', 'Construction', 'Trade', 'Transport', 'Hotels & food', 'Telecom', 'Real estate', and 'Business support' correspond to NACE Rev. 2 sections A, B, C, D, E, F, G, H, I, J, L, and M, respectively. Industry 'Public & social' corresponds to aggregated NACE Rev. 2 sections N to U. Regions 'EAP', 'EAC', 'LAC', 'N. America' and 'S. Asia' correspond, respectively, to East Asia and Pacific, Europe and Central Asia (excluding countries grouped in 'EU15+' and 'EU new'), Latin America & the Caribbean, North America, and South Asia as defined by the World Bank country classification by region. The region 'MEA' is a combination of Middle East & North Africa and Sub-Saharan Africa. Region 'EU15+' includes the 15 member countries of the European Union prior to the accession of 10 candidate countries on 1 May 2004 as well as Gibraltar, Iceland, Liechtenstein, Norway and Switzerland. The region 'EU new' includes the 13 countries that have joined the EU since 1 May 2004.

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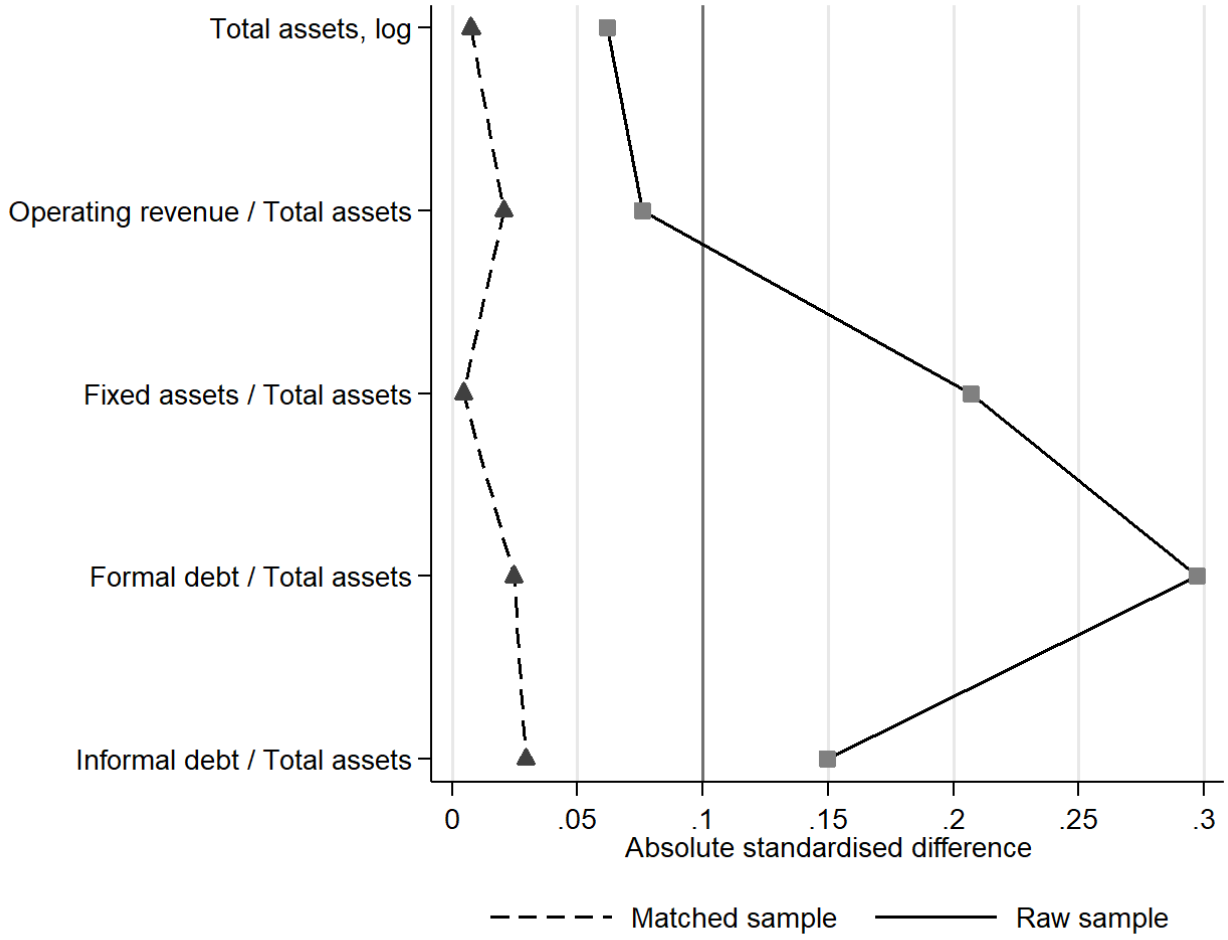
Figure A.2: Covariate Balance and Genetic Mahalanobis Matching



Notes: For each variable listed on the vertical axis, this figure reports the difference in the variance-standardized mean (the "standardized bias" reported in percentage points) between treated and control observations, for both the raw sample and the matched sample. The matched sample is obtained by genetic Mahalanobis distance matching on the variables above, forcing exact matching on country, two-digit NACE Rev.2 industry and year.

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