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Is commercial state ownership tax neutral?

Evidence from effective tax rates of European firms

Lukas Jakob

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Eberhard Karls
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Abstract

A pillar of the European Union's single market is the prohibition of state aid: governments must not discriminate against some firms by offering tax advantages to others. This study examines the tax neutrality of commercial state ownership in the European Union. It finds that commercial state-owned enterprises pay, on average, higher effective tax rates than comparable private firms but react to tax rate increases similarly. A likely explanation for this finding is the budgetary importance of commercial state ownership, which makes governments force distributions from their commercial companies via tax payments. Additional results indicate that this effect is not equally present in all member states.

Key words: Corporate Finance; State-Owned Enterprises; Effective Tax Rates; Firm-Level Data; Microeconometrics

JEL classification: F23, G32, G38, H25, H32

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† *Affiliation:* University of Tübingen. *Address:* University of Tübingen, Mohlstr. 36, 72074 Tübingen, Germany. *E-mail:* lukas.jakob@uni-tuebingen.de

1 Introduction

The European Union (EU) has led an intense policy and legislative debate on tax planning of multinational enterprises and state aid to such firms.[1] The debate originated from an assessment and corresponding action plan on tax base erosion and profit shifting by the Organization for Economic Cooperation and Development (OECD, 2013a,b). Governments potentially actively encouraged tax planning strategies by offering attractive conditions in their jurisdictions.[2] A significantly lower tax burden for one firm constitutes a competitive advantage relative to its peers. Therefore, state aid is a key concern to ensure the functioning of the EU's single market and prohibited by its legislation.[3] The European debate has neglected so far whether EU member states' extensive ownership of commercially active state-owned enterprises (SOEs) is tax neutral. This paper analyzes whether effective tax rates (ETRs) of commercially active SOEs differ from those of comparable private firms. It contributes to the existing literature by comprehensively assessing ownership tax neutrality within the EU.

Governments have granted special tax treatment to some private companies in return for investment and employment. Hence, they may grant tax advantages to their own commercially active SOEs out of similar considerations. Such behavior would lead to lower ETRs of SOEs and undermine competition in the single market at the expense of private firms. There are also theoretical arguments why ETRs of SOEs could be higher: First, EU governments receive substantial budgetary contributions from their commercial SOEs (European Comission, 2016). Under agency conflicts, taxes can force distributions from dividend-averse managers (Cui, 2015b). Second, SOE managers may face lower incentives to minimize tax payments than their private-firm counterparts.

[1] Specific events substantially shaped this debate. For example, a set of internal advance tax rulings of Luxembourgian authorities was leaked to the public in November 2014, revealing how multinational firms have engaged in aggressive tax planning strategies by shifting profits into the grand duchy. A second example is the tax-related record fine imposed on Apple by the European Commission in September 2016.

[2] Throughout this study, I use the term "tax planning" to describe all efforts of a company to reduce its effective tax rate. Hence, I do not distinguish between legal and illegal activities.

[3] Treaty on the Functioning of the EU (TFEU), Article 107.

This is because the owning state is the ultimate beneficiary of both taxes and dividends. Third, public scrutiny on SOE taxation may be higher and tax planning less acceptable in the public eye.

It is – to some extent – a political decision which firm is state-owned and which firm is not. Hence, ownership is not random but depends on a set of variables, which are partly tricky to observe. Consistent evaluation of how state ownership affects company ETRs needs to consider non-random ownership in its estimation procedure. Thus, this study follows a selection-on-observables approach and estimates a propensity score of state ownership similar to Borisova et al. (2012). The propensity score identifies a set of similar private firms by nearest neighbor matching, which serves as a control group to construct group-fixed effects. In a subsequent step, I estimate group-fixed-effects regressions that control for a state ownership dummy, a vector of time-varying firm characteristics as well as time and sector effects. Controlling for the group-fixed effect eliminates any unobserved time-constant factors between similar firms. Matching SOEs and private firms within a country ensures that this fixed effect absorbs relevant unobserved country factors such as tax policy attitudes or tax law enforcement quality (Burgstahler et al., 2006). Such factors can either be exploited by private firms or used to support SOEs (Nicodeme, 2001). This estimation approach consistently identifies the impact of state ownership on effective company taxation in the beta coefficient of the state ownership dummy variable.

This study uses a mostly balanced panel from 2009 to 2015 which forms part of Bureau van Dijk's Orbis database. Orbis contains detailed financial and ownership data from annual single and consolidated company financial statements. An advantage of Orbis is that it includes non-listed firms and takes ownership information from official sources. This substantially increases the sample size compared to studies focusing on manual ownership research and listed firms only. The America-focused tax literature identifies a critical issue of financial statement tax data: managers have an incentive to present high profit levels to investors and low profit levels to tax authorities (book-tax trade-off). Thus, differences could arise between the profit and tax items in a firm's

financial statement (aimed at investors) and the same firm's tax statement (targeted at authorities). The tax statement contains the actual taxes paid, the financial statement not necessarily. The book-tax trade-off is mostly relevant at the consolidated level – which is where the US levies corporate taxes. Differences arise in particular because of reporting incentives and the consolidation process itself. Hanlon (2003) and Mcgill and Outslay (2004) point out the limitations of financial statement data when looking at tax-related issues in the US. These concerns are less relevant in this study: EU member states levy taxes at the single-entity level, which leads to a higher degree of book-tax conformity (Hanlon and Heitzman, 2010; Watrin et al., 2014). The EU obliges every multi-entity company to present separate financial reports for all its single entities (subsidiaries). My sample consists of unconsolidated single-entity firm-years from EU countries. Deferred taxes cause a large share of book-tax differences, an issue I address in Section 5 by reporting outcomes for long-run ETRs similar to Dyreng et al. (2008). Hence, the overall inference of this study is relatively free from book-tax bias.

Empirical results strongly suggest that SOEs in the EU pay higher ETRs than private firms. The primary model predicts a robust markup of 1.6 percentage points using the pre-tax profit ETR as the dependent variable. The magnitude of the effect depends to some extent on the profit measure I use to compute ETRs, which is why this study employs three different ones through all model specifications. At the same time, estimated ETR elasticities to statutory tax rates are persistently inelastic for both ownership groups – suggesting that private firms and SOEs respond to an increase in statutory tax rates with more tax planning. This finding is consistent with empirically established tax planning strategies such as increased debt usage under higher tax rates (see Feld et al. (2013) for a meta-study) and anecdotal evidence suggesting that SOEs engage in tax planning just as private firms do.[4] Several explanations for this central finding seem plausible: First, owning governments may force distributions via tax payments (Cui, 2015a), which leads to higher ETRs of SOEs. This appears particularly credible

[4]A well-known case is "sale and leaseback" deals of municipal enterprises, which primarily aim at reducing tax payments.

considering the budgetary contributions of commercial SOEs. Second, tax payments of SOEs may be under closer public scrutiny than private-firm taxation, which has the same effect. Third, SOE managers could pursue a quiet life and refrain from active tax planning, especially at lower statutory rates, i.e., when the opportunity cost in forgone pet projects is low. Descriptive statistics suggest that the ETR markup for SOEs may not be equally strong in all countries. This is not surprising because EU member states have different intensities and regulatory backgrounds of state ownership. The main result of this study is robust to (i) exact matching within country and two-digit NACE2 sector, (ii) variations in the number of matched private cross-sectional units, (iii) changes in model and propensity score specifications, (iv) long-term ETRs as dependent variables, (v) alternative econometric approaches, (vi) the use of consolidated instead of unconsolidated financial data, and (vii) placebo falsification tests.

The contribution of this study is threefold: First, to the best of my knowledge, it is the first to undertake a comprehensive empirical analysis of effective firm-level taxation and state ownership in Europe. In this, it adds effective taxation to an established set of differences between private and state-owned firms. Second, it contributes to the policy discussion on tax planning by showing that effective taxation within the EU's single market is not ownership neutral. Hence, it indicates that private firms may be more successful in reducing their tax liabilities than SOEs, which could adversely affect competitive neutrality.

The rest of this study proceeds as follows: Section 2 deals with the ETR measures employed in empirical models, develops testable hypotheses and reviews the relevant literature on taxation and state ownership. Section 3 develops the empirical methodology and describes its implementation using the Orbis data set. Section 4 looks at descriptive statistics and contains the main estimates. Section 5 contains sensitivity analysis. Section 6 concludes.

2 Definitions: Effective taxation and state ownership

2.1 Effective taxation

Hanlon and Heitzman (2010) provide a comprehensive overview of ETR-based indicators used in prior taxation research. This study applies three different specifications of the most common one: the average backward-looking ETR.[5] All three are computed using balance sheet data from Orbis but employ different profit measures. The pre-tax profit ETR is defined as

$$ETR_{it}^{PTP} = \frac{TAX_{it}}{PTP_{it}}, \tag{1}$$

where TAX_{it} is firm i's aggregated tax liability in year t and PTP_{it} is its pre-tax profit in the same period.[6] The ETR_{it}^{PTP} is a standard measure in the literature and suggested as such in IAS 12.86.[7] A recent study that uses this indicator with a similar data set is Watrin and Thomsen (2016). The ETR_{it}^{PTP} is calculated using a company's pre-tax profit, i.e., after subtracting all operating and financial expenses of the firm's ordinary business activity in the given year. An advantage of this specification is that the profit measure should be relatively close to actual taxable income. The literature is, however, not entirely conclusive on which profit measure to use. Nicodeme (2001), for instance, suggests using a firm's operating profit in the denominator because its calculation does

[5] In this study, the abbreviation "ETR" always refers to the average backward-looking ETR. In addition to simple ETRs, I estimate all models using a second indicator type proposed by Hanlon and Heitzman (2010), namely ETR-tax rate differentials. Results point to similar conclusions and are available upon request.

[6] In Orbis, I divide the item *#taxa* (taxation) by *#plbt* (profit/loss before tax) in equation (1), *#oppl* (operating profit) in equation (2), and *#ebta* (EBITDA) in equation (3), respectively.

[7] More specifically, TAX_{it} should consist of current tax expenses minus deferred tax liabilities. Unfortunately, Orbis only provides an aggregate total tax variable which does not allow to identify a firm's deferred tax liabilities separately. All ETRs in this study rely on the total tax variable from Orbis.

not differ much across countries. Hence, as a second ETR specification, I define

$$ETR_{it}^{OPP} = \frac{TAX_{it}}{OPP_{it}}, \tag{2}$$

where TAX_{it} are again firm i's total tax expenses in year t and OPP_{it} its operating profit of the same period. I use a third specification based on earnings before interest, tax, depreciation, and amortization (EBITDA):

$$ETR_{it}^{EBI} = \frac{TAX_{it}}{EBI_{it}}. \tag{3}$$

With EBI_{it} as the denominator, results are less dependent on national accounting practices and depreciation policies of individual firms (Vause, 2009). There is no single best ETR definition, as each has advantages and drawbacks. It is also important to understand that ETRs based on alternative profit measures capture different things: for example, variations between SOEs and private firms in the ETR_{it}^{EBI} should not originate from deviating depreciation policies, whereas differences in ETR_{it}^{PTP} could arise because of depreciation-based tax planning. Therefore, this study always reports regression results using ETRs (1) to (3) to avoid relying on a single ETR definition.

A strength of all indicators is that they stem from actual firm data. A shared weakness arises from reliance on accounting tax data, which can differ from actual taxes paid. Companies usually keep at least two sets of books – one for accounting purposes and one for taxation. In the former, they target investors and attempt to present the company in an informative way. In the latter, they target tax authorities and attempt to minimize tax exposure. For this reason, numerous studies focusing on US data show that inferences from accounting data on tax-related topics do not always yield reliable results (Graham, 1996; Hanlon, 2003; Mcgill and Outslay, 2004; Dyreng et al., 2008). The fact that a considerable amount of studies have nevertheless attempted to do so stems from the non-disclosure of companies' tax statements.[8] Book-tax differences vary

[8]Of these, a first group of studies focuses on determinants of companies' ETRs (Zimmerman,

greatly between countries. In Europe, they are significantly lower, especially in single (individual) accounts (Mcgill and Outslay, 2004; Burgstahler et al., 2006; Goncharov and Werner, 2009; Hanlon and Heitzman, 2010). The EU obliges every entity by law to publish these accounts, which constitute the basis to assess taxable income (Watrin et al., 2014). For this reason, I use single financial statements of European firms in all models except for the consolidated model presented in Section 5. Goncharov and Werner (2009) argue that even "tax-dominated" single accounts are responsive to reporting incentives on an economically significant basis. This suggests that reporting incentives are more important than legal conformity. Book-tax differences in EU single accounts may therefore still exist (to a lesser degree) and are a source of concern I cannot control for. Nevertheless, the present study is less susceptible to biased inference than many previous studies using American data.

In addition to book-tax differences, a few other caveats remain: First, a company can reduce tax payments by reporting lower accounting earnings and lower taxable income. This "conforming tax planning" would not show up in the accounting information and cannot be captured by any indicator based on accounting figures. The same holds for permanent tax rebates, which would not show up in accounting tax data (Buijink et al., 2002). There is a strong reason to believe that permanent tax rebates to commercially active SOEs (or other firms) are mostly absent in the EU because they would fall foul on the EU's state aid legislation.[9] In contrast, the ETR measures in this study capture non-conforming tax planning strategies such as temporary rebates, transfer pricing or amortization techniques. Second, national accounting frameworks could affect results. Within the EU, regulation has harmonized accounting rules to a significant extent[10]. Cross-country differences in accounting practices persist. According

1983; Stickney and McGee, 1982; Gupta and Newberry, 1997) and a second group on cross-country comparisons (Collins and Shackelford, 1995; Buijink et al., 2002).

[9]TFEU, article 107. The introductory examples show that governments have wooed large multinational enterprises with precisely such rebates. However, they may rather be the exception than the rule.

[10]The Fourth and Seventh Company Law Directives harmonized accounting rules to a significant extent and were implemented into national law in the 1980s and 1990s. They oblige publicly traded and private companies to prepare audited financial statements following the directives.

to Collins and Shackelford (1995), critical areas of such differences are the treatment of depreciation, goodwill amortization, pension expense and expenses for research and development. Another possible source that has gained importance in recent years is the treatment of intangible assets. Differences in the legal framework should be captured to a large extent by the group-fixed effect, which controls for unobserved heterogeneity of SOEs and comparable private firms within a specific country. Firm-level accounting variations within a group are precisely the driving force that could make a private firm's tax strategy more effective than an SOE's. Third, company taxation is of a dynamic nature. Comparisons using yearly data alone may be misleading (Dyreng et al., 2008). To address this issue, I report results using long-term ETRs in Section 5.

2.2 State ownership in the EU and hypothesis development

The extent of state ownership in the EU varies from country to country. For example, the United Kingdom has completely privatized its energy and much of its transport sector, whereas SOEs are important players in the same industries in both France and Belgium. In most countries, state ownership is widespread: a recent report by the European Comission (2016) shows that in 13 of the block's 28 member countries the market value of central SOEs exceeds ten percent of GDP, among them France and Italy. The employment share of SOEs relative to the total workforce ranges between two and six percent in the majority of countries but goes up to ten percent in France. Budgetary contributions of SOEs are non-negligible: Finland, for instance, received an average of 1.5 percent of GDP from 2005 to 2014 from its SOEs. Numerous other countries like Sweden, Estonia, Slovakia and the Netherlands also received distributions in this period exceeding one percent of GDP. These are substantial numbers: in 2016, total government revenue from value-added tax ranged between 3 and 13 percent of GDP in EU member states. High budgetary contributions suggest that many SOEs in EU countries are of commercial nature.

Few studies have looked at the effect of ownership structure on ETRs. A study by

Chen et al. (2010) uses S&P 1500 effective book and cash tax rates to analyze whether family-owned firms are more or less tax-aggressive than non-family-owned firms. Their results indicate a lower aggressiveness of family-owned firms.

State ownership could alter company ETRs towards both lower and higher levels. From a regulatory perspective, commercial firm activity should be subject to the same legal framework across all EU member states irrespective of ownership structure. The purpose of this is that EU member states remain autonomous in their asset ownership decisions while ensuring that private companies or companies from other member states are not discriminated against. The competitive neutrality agenda of the EU leads to the benchmark Hypothesis 1:

Hypothesis 1 *Competitive neutrality in the EU single market extends to effective taxation, and there is no significant difference between SOE and private-firm ETRs.*

The EU single market is, however, still imperfect in many aspects. In theory, the European Commission ensures competitive neutrality and should prevent member states deviating from it. In practice, the Commission delegates a large share of monitoring and implementation of EU competition law to national competition authorities. As a result, oversight and implementation of EU competition law vary greatly between countries – a key concern of current EU legislative activity.[11] Besides, it is implausible to derive the existence of large state sectors from the non-commercial Atkinson and Stiglitz (2015) argument of market failure alone.[12] Instead, state ownership appears to have a clear political dimension (Shleifer and Vishny, 1994; Shleifer, 1998).[13] For example, about 21 percent of SOEs in Italy offer goods or services without any public

[11]COM (2017) 142: Proposal for a directive of the European Parliament and of the Council to empower the competition authorities of the member states to be more effective enforcers and to ensure the proper functioning of the internal market.

[12]In this "social" theory of state ownership, the government steps in when private companies would not provide an efficient level of products or services. An example to illustrate this argument is postal services to remote areas, which private companies would not provide because it would incur them a loss.

[13]The "political view" of state ownership argues that SOEs are vehicles of politicians' private interests such as extracting rents and pursuing employment or investment policies.

service obligation (European Comission, 2016). At least 3,000 Italian SOEs have less than six employees, and in about half of them, there are more directors than workers. If the state controls both the tax authority and the company, conflicts of interest can arise. On the one hand, a government must commit to competitive neutrality in the EU's single market and prevent preferential treatment of any commercially active cooperation – independently of ownership. On the other hand, favorable taxation may be preferred over job losses or private market entry. Moreover, some SOEs have become internationally active, and their success could be a question of national pride. As governments are willing to give privately owned firms special tax treatment for political considerations, they could do the same for their commercially active SOEs. Hence, the political view of state ownership offers an explanation why governments could be more lenient with their firms, which would lead to lower ETRs of SOEs. This leads to Hypothesis 2:

Hypothesis 2 *Commercial SOEs pay lower ETRs than comparable private firms because governments subsidize their firms out of political considerations.*

A number of empirical studies using non-European data find effects in this direction (Derashid and Zhang, 2003; Adhikari et al., 2006; Cui, 2015a).

Other empirical findings associated with state ownership offer predictions why ETRs of SOEs could be higher. SOEs have been found to suffer from worse corporate governance, lower profitability, softer budget constraints and lower labor intensities (Dewenter and Malatesta, 2001; Chen et al., 2011; Borisova et al., 2012; OECD, 2014; Chen et al., 2017). A possible explanation for the overall worse performance is low-powered incentives of the SOE management, i.e., a situation where returns from a transaction cannot be collected directly by the transacting party (Williamson, 1985; Tirole, 1994; Banerjee, 1997). SOE managers do not own shares in wholly owned SOEs and cannot be rewarded with share options because this would amount to privatization. Hence,

SOE managers may benefit from increased firm profit to a lesser extent than private firm managers. Aggressive tax planning is costly, requires effort and poses a potential employment risk in case of discovery, which could lead managers to prefer a "quiet life" (Hicks, 1935; Bertrand and Mullainathan, 2003). Hence, the presence of low-powered incentives of SOE managers compared to private firm managers could explain lower levels of tax planning and higher ETRs of SOEs. A second argument derives from weak monitoring of SOEs (Megginson and Netter, 2001; Musacchio and Lazzarini, 2012).[14] This could aggravate agency conflicts associated with free cash flow (Jensen, 1986) and lead to empire building and pet projects. Taxation is then a useful tool to force distributions from dividend-averse SOE managers (Cui, 2015a). The tax agency is already dealing with tax-optimizing private firms, and taxation of SOEs does not require any additional skills. This argument seems especially important when considering the substantial budgetary contributions of commercial SOEs. Taken together, these arguments give rise to Hypothesis 3:

Hypothesis 3 *Commercial SOEs pay higher ETRs than comparable private firms because governments force budgetary contributions via tax payments and private firms engage in more tax planning.*

A study that finds higher ETRs for SOEs than for private firms in Chinese data is the one by Wu et al. (2013). Note that Hypothesiss 1 to 3 complement each other. The procedure described in Section 3 provides a test for their validity.

[14]Weaker SOE monitoring could also be the result of low-powered incentives in responsible ministries or government agencies because they act as fiduciaries for the general public and not as owners (Frant, 1996).

2.3 Identification of ownership in Orbis and sample methodology

The study's sample period ranges from 2009 to 2015 and includes companies with non-missing unconsolidated financial statements in at least two of the seven years.[15] I identify unconsolidated financial statements with the indicators U1 and U2 from Orbis. U1 refers to firms for which only unconsolidated data is available and U2 to firms with both types. A single-entity company is state-owned if the Orbis variable *#ownership type* takes the form "Public authority, state, government". A group subsidiary is state-owned if the ownership path from the group company to the subsidiary is 100 percent and the state has at least a 25 percent interest in the group. If a company fulfills one of these criteria, the indicator variable is $SOE_i = 1$. A private firm may carry any other ownership label and takes on the indicator variable $SOE_i = 0$. To ensure a firm is truly private, I keep only observations with a single owning entity that does not fall into the SOE categories above.

For many firm-years, I do not observe any ownership information, which reduces the sample size significantly.[16] I partially mitigate this by imputing up to two consecutive years of missing ownership data if the same owner controls an observation before and after the information gap with equal share. This study focuses on state ownership in general and does not differentiate between different owning institutions. If a single entity firm has several direct state owners – say a ministry, a state-owned bank, and a municipality – they are summed up to a total state share. I drop an observation if its total percentage remains below 100 percent, i.e., any private owning entity remains. It is important to note that the sample includes only SOEs operating in the same country as the owning state. Thus, taxes and firm profit ultimately benefit the same state.[17]

[15]The average cross-sectional unit has more than five firm-years, which gives the panel a largely balanced structure.

[16]Missing values originate most likely from data collection and should not correlate with state ownership or any of the control variables because state holdings are public. Therefore, I assume the absence of sample selection based on ownership type.

[17]In some member states, like Germany or Italy, several levels of government collect corporate taxes.

This could alter ETRs in both directions: On the one hand, it ensures that political arguments for state ownership such as local employment are relevant. On the other hand, it could increase management incentives to live a quiet life without tax planning. I do not impose such an owner-location restriction on private firms in the sample.

The dataset only includes firms operating in the EU because European state aid legislation prohibits any structural taxation difference between commercially active SOEs and private firms. I assume SOEs are of commercial nature for several reasons: First, they exist as separate legal corporations. All German sample SOEs are either registered as *GmbH* (limited liability company) or *AG* (joint stock company), indicating that they do not form part of the general government and remain outside its boundary. Similarly, Italian firms are registered either as S.R.L. (limited liability) or S.P.A. (joint stock company). The same holds for SOEs in other countries, which are either limited liability companies or stock companies. Second, I consider only firms with positive ETRs. This ensures that sample SOEs are taxable entities and therefore of commercial nature. Third, I exclude firms that could be exempt from taxes because they provide non-profit services in the health or social sectors.[18] I identify these firms by their NACE2-categories *O: Public administration, defense, compulsory social security*, *P: Education*, and *Q: Human health and social work activities*. Furthermore, I exclude all financial firms (NACE2 category *K: Financial and insurance activities*) as state-owned banks have a special regulatory status in some member states. If a sample SOE has a partial public service obligation, this does not necessarily affect the taxation variable because, in OECD countries, compensation for such activities mostly consists of direct transfers (OECD, 2014). Summing up, sample SOEs should be commercially active companies and receive the same tax treatment as private firms.

The focus on EU data is useful from an accounting perspective as sufficient cross-country differences remain while holding underlying accounting standards constant

Taxes and profit may, therefore, benefit different levels of government.

[18]For instance, §52, Section 2 no. 3 and 4 of the *Abgabenordnung* in combination with §5 Section 1 no. 9 of the *Körperschaftssteuergesetz* exempts institutions of a purely non-profit character from income taxation in Germany.

(Burgstahler et al., 2006). Consolidated financial statements using IFRS are obligatory for companies in all EU countries. For single financial statements, national legislation differs across member states. Orbis contains both IFRS and local GAAP single financial statements with the large majority being local GAAP. All firms in my estimation sample use local GAAP to ensure that the same legal accounting framework applies to each company in country-specific sub-samples.[19]

Figure 1: Average pre-tax profit ETR by country

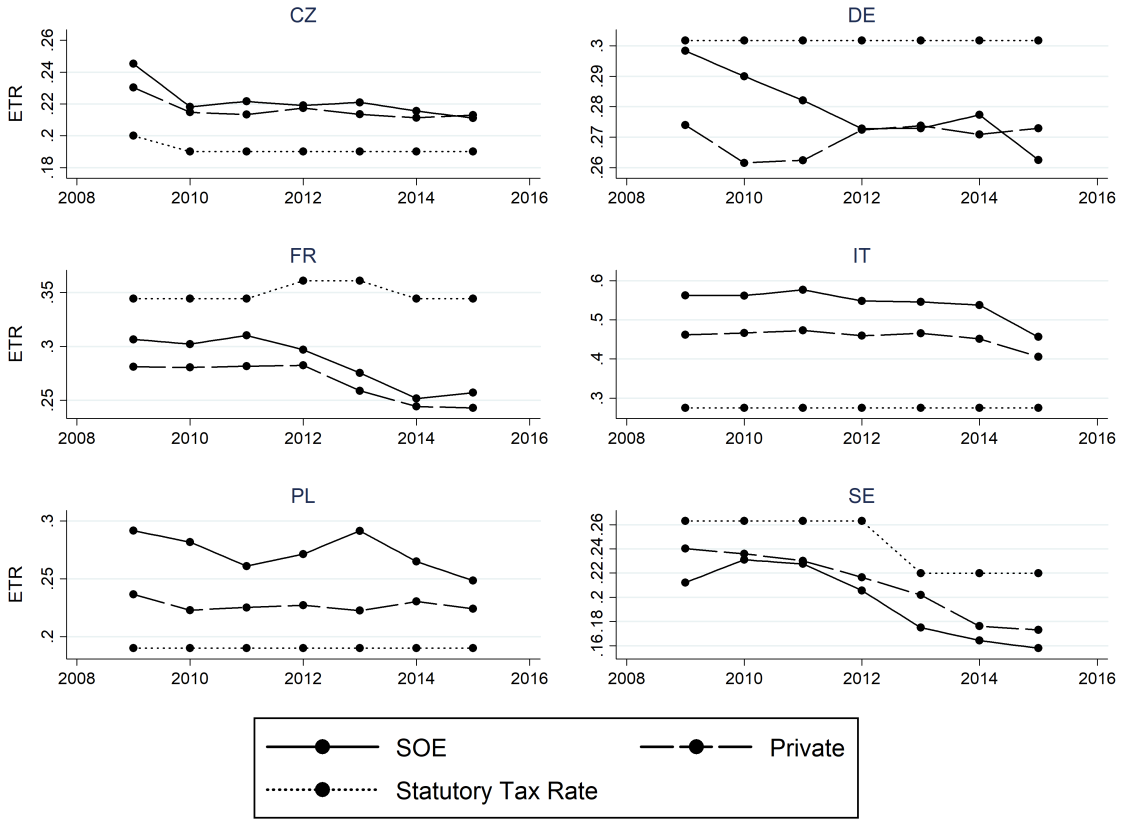

Figure 1 plots the ETR_{it}^{PTP} from equation (1) for both ownership groups in six EU member states.[20] The dotted curve represents the corresponding corporate statutory tax rates $TAXR_{kt}$. The highest statutory tax rate – at around 35 percent – applies in France (FR), followed by Germany (DE) and Italy (IT) at around 30 percent.[21] A

[19]Appendix Table A.1 presents estimates for the SOE_i variable including IFRS-firms.

[20]Figure 1 contains the countries with the highest sample number of state-owned companies. Appendix Figure 4 plots equivalent curves for Austria (AT), Belgium (BE), Estonia (EE), Finland (FI), Croatia (HR), and Slovenia (SI).

[21]Statutory tax rates are only a crude proxy of individual company taxation because in many

general trend is that ETRs for both SOEs and private firms are either constant or declining during the sample period. In the Czech Republic (CZ) and Sweden (SE), the decline coincides with a reduction in statutory rates. France briefly raised statutory taxes in 2012 and lowered them again in 2014. This coincides with a substantial decline in ETRs starting from the statutory rate increase. Germany, Italy, and Poland (PL) did not change their corporate tax rates in the sample period. The ETR_{it}^{PTP} of SOEs is constantly higher than the one of private firms in France, Italy, and Poland. In the Czech Republic and Germany, the two curves intersect, whereas in Sweden the opposite is the case: SOEs have constantly lower average ETR_{it}^{PTP} than private firms. This pattern also holds for a number of countries plotted in Appendix Figure 4. Figures 1 and 4 suggest that ETR differences depend on the country, which is most probably a consequence of different attitudes towards state ownership and taxation across member states.

Two additional observations can be made in Figure 1: The first refers to base erosion and profit shifting. A country with strong tax base erosion should have a constant statutory rate and a downward-sloping ETR curve. It is important to recall that the ETR measures in this study are based on financial statement profit and firms face little incentive to under-report these measures (in contrast to tax statement income). Only France has such a pattern for both private firms and SOEs and, interestingly, also has the highest corporate tax rate. In Germany and Poland, the trend is downward-sloping only for SOEs, but not for private firms. Hence, Figure 1 does not support claims of wide-spread tax base erosion, at least at tax rates levied by the majority of member states. The second observation is that in the Czech Republic, Italy an Poland, ETR curves are higher than statutory rates. Usually, ETRs are lower than statutory tax rates (Vause, 2009; OECD, 2013b). The Orbis variable TAX_{it}, which I use to compute the dependent ETR variables from equations (1) to (3), represents a firm's

countries different levels of government levy taxes. For instance, around half of corporate income tax expenditure in Germany depends on the municipality. As a consequence, $TAXR_{kt}$ necessarily is an average levy for the individual firm and may not include all taxes a firm has to pay.

total taxes, i.e. it may include other levies such as non-substantial regional taxes.[22] A second explanation is deferred taxes, which could raise the ETR_{it}^{PTP} of both ownership groups in these countries more than in other countries. It is important to recall that this study focuses on within-country differences between two ownership groups, and the group-fixed effect should absorb any time-constant unobserved effects at the country level. Hence, results should not depend on whether the average ETR_{it}^{PTP} is above or below the corresponding statutory rate.

3 Empirical approach

3.1 Methodology

The main goal of this study is to compare ETRs of SOEs with those of similar private firms in the EU. Hence, the primary effect of interest is the coefficient of the state ownership dummy SOE_i in regressions of the dependent ETR variables from equations (1) to (3).

In a first step, I identify groups of companies, where each group consists of one company that is state-owned ($SOE_i = 1$) and m companies which are not ($SOE_i = 0 \; \forall \; m$). The m companies should be similar to the SOE to ensure that the group-fixed effect absorbs reasonable cross-sectional differences between groups. Each company i has a propensity to be state-owned that depends on a vector of i-specific determinants $\boldsymbol{X}_{i1}$ and country k-specific determinants $\boldsymbol{Z}_k$. Additionally, the propensity depends on the industry ψ_s, which leads to the specification of the linear probability model index

$$SOE_{it_0} \quad = \quad \boldsymbol{\beta}_1 \boldsymbol{X}_{i1t_0} + \boldsymbol{\beta}_2 \boldsymbol{Z}_{kt_0} + \psi_s + \epsilon_{ikt_0}, \tag{4}$$

[22] In Italy, corporate income tax is based on two pillars, the national *imposta sul reddito sulle società* or IRES, and a regional tax, the *imposta regionale sulle attività produttive* or IRAP. Both apply to financial statement profit and are thus reflected in the ETR variable, whereas the statutory tax rate refers only to the IRES because it accounts for the lion's share of corporate tax (PWC, 2016).

to predict the propensity $\hat{p}_{it_0}^{\text{SOE}}$ that company i is state-owned, employing a probit model. The time index t_0 in equation (4) indicates that I use only data from the initial year of the sample.[23] Estimating equation (4) produces two vectors of probabilistic state ownership: one for SOEs, $\hat{\boldsymbol{p}}^{\mathbf{1}}$, and one for private companies, $\hat{\boldsymbol{p}}^{\mathbf{0}}$.

In a second step, I identify the m nearest neighbors for each SOE. Let c_i^1 denote the respective private firm j which is *closest* to the SOE i. The best match is determined by $c_i^1 = \min_{\{j\}}(|\hat{p}_i - \hat{p}_j^1| < \rho) \; \forall \; j \; \neq \; i$. The caliper ρ represents the maximum difference in propensities between i and j.[24] Identification of the second, third and mth best matches c_i^2, c_i^3 and c_i^m follows analogously. Matches are within country throughout this study to ensure comparability of companies within groups. I also match within two-digit NACE2 sector, which does not alter results significantly. Matching takes place without replacement, which causes a trade-off: On the one hand, a larger m increases the amount of information in the control group and makes economically good comparisons more likely. On the other hand, there may not be sufficient good matches for all SOEs, which leads to the exclusion of some of them. I mitigate this trade-off by presenting model estimates with varying numbers of matched control units.[25] Matching produces groups of companies $\{SOE_i = 1; SOE_i^1 = 0 \ldots, SOE_i^m = 0\}$ where, within each group, one observation is state-owned and m private firms are not.

After identifying $c_i^1 \; \ldots \; c_i^m$ for each SOE, I proceed and estimate

$$Y_{it} = \alpha_1 SOE_i + \boldsymbol{\alpha}_2 \boldsymbol{X}_{i2t} + \boldsymbol{\alpha}_3 \boldsymbol{Z}_{kt} + \phi_t + c_i^{gm} + \psi_s + \varepsilon_{iskt}, \tag{5}$$

where Y_{it} denotes the ETR dependent variables from equations (1) to (3) of company i in year t ($t = 2010, ..., 2015$). The dummy SOE_i is the main variable of interest, $\boldsymbol{X}_{i2t}$

[23]The initial year is 2010. The year 2009 drops out because of first differencing in control variables.

[24]The standard caliper $\rho = 0.1 * SD^{probit}$ is even stricter than the $\rho = 0.2 * SD^{probit}$ that Austin (2011) suggests. As a robustness check, I also present results using the calipers $0.2 * SD^{probit}$ and $0.01 * SD^{probit}$.

[25]The main model is based on $m = 3$ control units. Appendix Table A.1 presents results for the variable of interest SOE_i when matching takes place with $m = 1$, $m = 2$ and $m = 5$ private firms.

indicates a set of firm-level controls, $\boldsymbol{Z}_{kt}$ a set of country-level variables, and ϕ_t, c_i^{gm} and ψ_s denote time-, group- and sector-specific effects. Note that the index gm in c_i^{gm} indicates the number of best matches used to define the group-fixed effect. Conditioning on c_i^{gm} removes all time-constant cross-sectional differences between company groups. Hence, I can identify the differential impact of being state-owned by time-averaging over all treatment and control units within each group.

4 Descriptive statistics and basic results

4.1 Descriptive statistics

The final sample consists of 159,398 firm-years, of which 7,612 are SOEs and 151,786 private companies. I observe each company in at least two of the six years of the sample period. The average number of firm-years per company is 5, which gives the sample a largely balanced structure. Table 1 contains summary statistics and Appendix Table A.2 correlations for the dependent variables and controls I use to estimate the propensity score of state ownership (4) and the outcome equation (5).

The specification of the state ownership probit model (4) follows Borisova et al. (2012). On the firm level, I include sales $log(SALES)_{it}$ as a proxy for firm size, the return on total assets ROA_{it} as a proxy for profitability, the leverage ratio LEV_{it}, sales growth $\Delta log(SALES)_{it}$ and the change in fixed assets $\Delta log(FA)_{it}$ as investment proxy.[26] On the country level, controls are GDP growth $GDPG_{kt}$, GDP per capita $GDPPC_{kt}$, an indicator of a country's credit market size $CREDITM_{kt}$ and dummy variables representing the La Porta et al. (1998) legal origin. I add a set of sectoral dummies to control for different intensities of state ownership in different sectors. For example, 22 percent of SOEs operate in the NACE2 category *D: Electricity, gas, steam and air conditioning supply* whereas only 0.77 percent of private firms do. A

[26]Table A.4 contains definitions and sources of all variables.

Table 1: Descriptive statistics

The table presents summary statistics of the dependent variables ETR_{it}^{PTP}, ETR_{it}^{OPP}, ETR_{it}^{EBI}, state ownership SOE_i, and the control variables used to estimate models (4) and (5); Statistics are based on 159,398 observations.

Variable	**Firm-years**		**State-owned**	**Private**
SOE_i	159,398		7,612	151,786
Dependent Variables	**Mean**	**Std.Dev.**	**Min**	**Max**
ETR_{it}^{PTP}	0.31	0.18	0.00	0.92
ETR_{it}^{OPP}	0.26	0.15	0.00	0.84
ETR_{it}^{EBI}	0.18	0.11	0.00	0.68
Control Variables	**Mean**	**Std.Dev.**	**Min**	**Max**
$log(TA)_{it}$	8.63	1.64	2.71	18.11
$log(SALES)_{it}$	8.78	1.70	0.69	17.24
ROA_{it}	10.10	10.31	0.01	99.78
LEV_{it}	0.14	0.20	0.00	1.00
$ATANG_{it}$	0.25	0.27	0.00	1.00
$log(DEPR)_{it}$	4.79	1.96	0.00	14.84
$\Delta log(FA)_{it}$	0.01	0.51	-7.88	8.79
$\Delta log(SALES)_{it}$	0.03	0.35	-7.27	9.73
$GROP_{skt}$	-0.01	0.10	-2.69	3.15
$TAXR_{kt}$	0.27	0.06	0.10	0.36
$CREDITM_{kt}$	141.32	35.38	37.51	234.02
$GDPG_{kt}$	0.89	1.81	-3.78	7.58
$GDPPC_{kt}$	35,576.02	6,101.70	15,261.58	46,388.29

final control in the probit model is the respective dependent ETR variable from the outcome equation (5). The probit model also contains all non-binary variables as squared and cubic terms. Appendix Table A.3 contains the probit results for all three ETR specifications.

I winsorize the three dependent variables of outcome equation (5), ETR_{it}^{PTP}, ETR_{it}^{OPP}, and ETR_{it}^{EBI} at the top and bottom one percent to make results less dependent on outliers. The first, ETR_{it}^{PTP}, has a mean of 0.31, which is 13 percentage points higher than the mean of the EBITDA-based ETR_{it}^{EBI}. This is because a firm's EBITDA still contains amortization and interest, and is thus higher than pre-tax profit. ETR_{it}^{OPP} has a mean of 0.26 because operating profit lies between the other measures in a firm's profit cascade. Correlations in Appendix Table A.2 follow accordingly: ETR_{it}^{PTP} and ETR_{it}^{OPP} correlate stronger (0.73) than ETR_{it}^{PTP} and ETR_{it}^{EBI} (0.54). All three ETR specifications correlate weakly negatively with the binary state owners-

hip indicator SOE_i. The average ETR_{it}^{PTP} in the sample is higher than the average statutory tax rate $TAXR_{kt}$. Most likely this is because the sample contains a large share of companies operating in high-tax countries such as Germany and Italy.

The choice of covariates for the outcome equation (5) follows previous studies by Gupta and Newberry (1997) and Derashid and Zhang (2003). On the firm level, I include the ROA_{it} as a proxy for profitability. The sample's average ROA_{it} is 10 percent. Its correlation with SOE_i is -0.09, which suggests that SOEs are less profitable. The second firm-level control is a company's leverage LEV_{it} because interest payments are tax-deductible in all sample countries and thus affect effective taxation. Next is asset tangibility $ATANG_{it}$ – a proxy for capital intensity and thus for the nature of a business. Its correlation with state ownership is 0.25, which is possibly due to the fixed-asset-intensive sectors in which SOEs operate. I use $log(SALES)_{it}$ as a firm size proxy. On the one hand, a bigger firm can be subject to greater scrutiny from the tax administration, on the other hand, it can spend more on tax planning strategies. Whether firm size positively or negatively affects effective taxation is therefore not entirely clear, and several studies do not find the indicator to be a significant predictor at all (Stickney and McGee, 1982; Gupta and Newberry, 1997). Here, $Log(SALES)_{it}$ and the alternative size proxy $log(TA)_{it}$ correlate negatively with the dependent variables. The last firm-level variable is depreciation $log(DEPR)_{it}$. Depreciation is tax deductible and therefore reduces the outcome variables. Correlations from Appendix Table A.2 point in this direction. On the sectoral level, I include the growth opportunities indicator $GROP_{skt}$ as in Huizinga et al. (2008). A key advantage of my data is its extension to non-listed firms, which has the side effect of impeding the use of market-to-book ratios that other studies employ. The last covariate is the country-level statutory tax rate. In my sample, corporate tax rates range from ten percent in Bulgaria to 36.1 percent in France. High corporate tax rates may not only increase the dependent variables but also encourage tax planning. In addition to these controls, I use sectoral dummies, time dummies, and the group-fixed effects, which should absorb any time-constant unobserved heterogeneity on the country- and group level.

Table 2: Country data

The table presents country-level summary statistics of the dependent variables ETR_{it}^{PTP}.

	State-Owned				Private			
Country	n	N	Mean	Median	n	N	Mean	Median
Austria	50	217	0.25	0.25	574	2,552	0.22	0.25
Belgium	7	34	0.27	0.29	390	1,685	0.31	0.32
Bulgaria	3	12	0.09	0.10	411	1,555	0.14	0.13
Czech Republic	202	858	0.21	0.19	3,459	14,851	0.21	0.19
Germany	451	1,983	0.28	0.28	2,916	11,761	0.26	0.28
Estonia	8	35	0.16	0.16	78	322	0.12	0.07
Finland	56	236	0.16	0.15	669	2,920	0.20	0.21
France	118	469	0.30	0.30	8,412	36,966	0.27	0.28
Croatia	28	121	0.25	0.22	973	4,557	0.24	0.21
Hungary	5	25	0.06	0.06	126	578	0.13	0.11
Italy	351	1,399	0.52	0.49	11,849	50,685	0.45	0.41
Latvia	6	26	0.21	0.17	62	236	0.19	0.16
Poland	170	753	0.26	0.22	414	1,851	0.22	0.20
Romania	4	18	0.26	0.21	169	715	0.21	0.17
Sweden	337	1,366	0.20	0.19	4,032	17,592	0.21	0.21
Slovakia	2	6	0.20	0.19	243	1,066	0.26	0.23
Slovenia	13	54	0.19	0.20	380	1,816	0.18	0.17
Total	1,811	7,612	0.25	0.20	35,180	151,786	0.31	0.29

Table 2 shows the country-specific distribution of SOEs and private firms and also contains country-wise descriptive statistics of the dependent variable ETR_{it}^{PTP}. The distribution of companies across ownership groups and country is not representative. For example, we observe only 118 cross-sectional SOE units in France, compared to 351 in Italy, even though SOEs are no less dominant in the French economy. It is nevertheless plausible to assume that country sample shares are free of selection bias as the dataset only contains information that each firm is legally obliged to publish. Moreover, cross-country variation is fully taken into account by exact country matching. Table 2 indicates that SOEs have a higher mean ETR_{it}^{PTP} than private firms in 10 of the 17 countries. In six countries, the opposite is the case, and in the Czech Republic, there is no apparent mean difference. This suggests that tax neutrality of ownership depends on the EU member state. In a majority of 10 countries, the mean and median ETR_{it}^{PTP} of SOEs are close, that is, they do not differ by more than 0.01. In this case, the density above and below the mean ETR value is similar. ETR distributions of private companies have a larger density for lower ETR levels in 10 countries (mean > median). This could point to a higher degree of tax-planning by private firms.

4.2 Basic result

The main specification of model (5) uses three nearest neighbors per SOE to construct the group-fixed effect. Table 3 presents the conditional results. It contains coefficient estimates for the variable of interest, SOE_i, and all time-varying controls. In addition to group effects, the model also contains sector- and time effects, which I do not report separately. The estimates predict a higher dependent variable for state-owned firms irrespective of its specification. The effect of SOE_i on ETR_{it}^{PTP} (Column A) is 0.0160, which translates into a 1.6 percentage point higher ETR for SOEs. The impact of SOE_i on ETR_{it}^{OPP} is 0.0173 (Column B), and thus – at 1.73 percentage points – slightly stronger in magnitude. The coefficient of SOE_i using ETR_{it}^{EBI} as the dependent variable is only 0.0073 and the weakest (Column C). The effect is statistically significant at the one percent level in Columns A and B and at the five percent level in Column C.

State ownership has a bigger impact on ETR_{it}^{PTP} and ETR_{it}^{OPP} compared to ETR_{it}^{EBI}, which suggests that amortization plays an important role in tax planning. To see why, recall that ETR_{it}^{PTP} is calculated using pre-tax profit, i.e., after depreciation and interest. Previous literature has related both balance sheet items with tax planning strategies (among many others, see Collins and Shackelford (1995) and Huizinga et al. (2008)). ETR_{it}^{EBI} derives from EBITDA, i.e., profit before interest and depreciation, and leaves less room for tax planning. Consequently, deviating coefficient intensities may point to different depreciation policies between SOEs and private firms.

This main result clearly rejects Hypotheses 1 and 2. Neither do commercial SOEs have similar ETRs on the EU level nor do they benefit from noticeable tax subsidies (which would lower ETRs). Instead, it supports Hypothesis 3. I calculate elasticities of ETR_{it}^{PTP} by ownership groups for different levels of the statutory tax rate $TAXR_{kt}$ to further examine differences between the two ownership groups.[27] Elasticities are almost identical and persistently inelastic for both ownership groups – which could suggest that

[27]The statutory tax rate $TAXR_{kt}$ only affects the ETR_{it}^{PTP} statistically, which is why I restrict elasticity analysis to Column A.

Table 3: Basic result

The table presents pair-FE regressions based on $N_A = 12,868$, $N_B = 13,156$, and $N_C = 15,505$ observations, respectively; Group-fixed effects are based on 3 nearest neighbors in 2010; Matches are within country; Standard errors are clustered at the firm level; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

	A: ETR_{it}^{PTP} *Coeff.* *(s.e.)*	C: ETR_{it}^{OPP} *Coeff.* *(s.e.)*	B: ETR_{it}^{EBI} *Coeff.* *(s.e.)*
SOE_i	0.0160***	0.0173***	0.0073**
	(0.0045)	(0.0040)	(0.0030)
LEV_{it}	0.0167	-0.1479***	-0.0706***
	(0.0112)	(0.0097)	(0.0064)
$log(SALES)_{it}$	-0.0082***	-0.0078***	0.0181***
	(0.0024)	(0.0023)	(0.0016)
$ATANG_{it}$	-0.0196*	-0.0669***	-0.0401***
	(0.0104)	(0.0105)	(0.0071)
$log(DEPR)_{it}$	-0.0038*	0.0007	-0.0272***
	(0.0020)	(0.0019)	(0.0014)
ROA_{it}	-0.0028***	-0.0002	0.0022***
	(0.0003)	(0.0002)	(0.0002)
$GROP_{skt}$	-0.0237*	0.0326**	0.0124
	(0.0141)	(0.0151)	(0.0093)
$TAXR_{kt}$	0.8351***	0.1055	0.1262
	(0.1495)	(0.1335)	(0.0935)
Group effects	Yes	Yes	Yes
Sector effects	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes

private firms and SOEs respond to an increase in statutory tax rates with more tax planning. A further indication in this direction is that elasticities are not significant at the 25 percent $TAXR_{kt}$ quantile (a tax rate of 22 percent and elasticities of 0.79 for SOEs and 0.80 for private firms), but highly significant at the 75 percent quantile (a tax rate of 30.18 percent and an elasticity of 0.79 for both ownership types). These findings are consistent with empirically established tax planning strategies such as increased debt usage under higher tax rates (see Feld et al. (2013) for a meta-study) and anecdotal evidence suggesting that SOEs engage in tax planning just as private firms do. The main conditional result does not unequivocally support the theory of SOE managers engaging in a quiet life without tax planning (because elasticities are almost identical). Instead, it supports the argument of governments forcing distributions via tax payments

(Cui, 2015a) and of closer public scrutiny for SOE taxation. Especially the first seems relevant, given the substantial budgetary contributions some EU governments receive from their commercially active SOEs (European Comission, 2016).

The remaining control variables have the predicted effects. A higher debt share LEV_{it} significantly reduces ETR-specifications with pre-interest profit measures (Columns B and C) and is not significant in Column A. The firm size proxy $log(SALES)_{it}$ has an adverse effect in Columns A and B and a positive effect in Column C. Nevertheless, results do suggest that larger firms pay lower ETRs. Asset tangibility $ATANG_{it}$ and depreciation $log(DEPR)_{it}$ have a negative impact in all specifications except for the insignificant $log(DEPR)_{it}$ coefficient in Column B. Both variables measure capital intensity, which previous studies associated with lower ETRs (Stickney and McGee, 1982; Gupta and Newberry, 1997; Derashid and Zhang, 2003).

The rest of this study will mainly deal with the question of how robust this main finding is. In addition to the analysis presented in Section 5, I conduct a broad set of checks. First, I use ETR-tax rate differences as dependent variables. Second, I match within sectors, use one, two, and five nearest neighbors, and change the propensity calipers. Third, I modify the probit model (4). Fourth, I include additional controls in the estimation of the outcome equation (5) and fifth; I vary the design of the dataset. The benchmark result is robust to all modifications. For more details on these tests, I refer to appendix Section 7.1.

5 Sensitivity analysis

5.1 Long-term ETR measures

As companies pay taxes regularly, tax planning may not materialize in yearly tax data due to its dynamic nature (Dyreng et al., 2008). Additionally, business cycles can affect yearly tax rates and lead to incorrect coefficient interpretations for longer time

periods. Dyreng et al. (2008) propose a "long-run cash effective tax rate" to cope with these issues. Unfortunately, Orbis does not allow to explicitly isolate cash taxes in the specific year from deferred or other taxes. Hence, I cannot reproduce their long-run measure directly. Nevertheless, I compute a similar indicator for each cross-sectional unit as

$$LTETR_i^{PTP} = \frac{\sum_{t=1}^{T} TAX_{it}}{\sum_{t=1}^{T} PTP_{it}}. \tag{6}$$

The long-term operating profit and EBITDA specifications, $LTETR_i^{OPP}$ and $LTETR_i^{EBI}$, follow analogously. I impose an additional restriction on the sample by only computing long-run ETRs for firms with at least six years of non-missing data. This ensures that results capture long-term effective firm taxation but eliminates some countries from the sample. Table 4 contains country-level mean values for the long-run $LTETR_i^{PTP}$.

Table 4: Long-term descriptives

The table presents summary statistics and tests for differences in means of the dependent variable $LTETR_i^{PTP}$ by country; The table only contains countries with at least 50 SOE firm-years; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

Country	**N**	**Mean** $SOE_i = 1$	**Mean** $SOE_i = 0$	**Difference**	**T-statistic**
Austria	4,722	0.23	0.23	0.0155	1.38
Czech Republic	12,515	0.20	0.20	-0.0054***	-3.37
Germany	19,940	0.27	0.27	0.0045	1.81
Finland	2,601	0.15	0.20	-0.0500***	-8.02
France	31,001	0.30	0.28	0.0151***	4.81
Croatia	4,649	0.23	0.21	0.0096***	2.38
Italy	40,006	0.46	0.40	0.0568***	15.18
Latvia	4,595	0.20	0.16	0.0402***	7.66
Poland	3,186	0.24	0.21	0.0308***	11.43
Sweden	16,376	0.18	0.19	-0.0162***	-7.74
Slovenia	1,802	0.19	0.18	0.0187**	2.83

Long-term rates of both ownership groups relate similarly to short-term ETRs (Table 2): a trend is that long-term mean values for both SOEs and private firms are lower than annual means. For SOEs, this is the case in ten of eleven countries. For private firms, this holds for eight countries. The last two columns of Table 4 contain the country-wise differences in long-term ETR means between SOEs and private firms and the t-statistic

of a two-sided test. In six countries, the difference is statistically significant and positive, two have positive but insignificant differences, and in three it is significantly negative. Hence, country-level evidence points to somewhat higher long-term ETRs of SOEs, even though this is not the case in all countries.

Table 5: Long-run ETRs

The table presents pooled OLS regressions based on $N_A = 19,772$, $N_B = 21,441$, and $N_C = 23,947$ observations, respectively; The dependent variables are defined as indicated in equation (6); Superscript m indicates that controls are time-averaged; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

	A: $LTETR_i^{PTP}$ *Coeff.* *(s.e.)*	C: $LTETR_i^{OPP}$ *Coeff.* *(s.e.)*	B: $LTETR_i^{EBI}$ *Coeff.* *(s.e.)*
SOE_i	0.0111***	0.0016	0.0044*
	(0.0035)	(0.0031)	(0.0023)
LEV_i^m	-0.0012***	0.0003***	0.0022***
	(0.0001)	(0.0001)	(0.0001)
$log(SALES)_i^m$	0.0117***	-0.1497***	-0.0972***
	(0.0041)	(0.0034)	(0.0026)
$ATANG_i^m$	-0.0114***	-0.0326***	-0.0403***
	(0.0041)	(0.0035)	(0.0026)
$log(DEPR)_i^m$	0.0021***	0.0008	0.0206***
	(0.0008)	(0.0007)	(0.0005)
ROA_i^m	-0.0276	0.0170	0.0220
	(0.0197)	(0.0177)	(0.0136)
$GROP_{sk}^m$	-0.0016**	0.0026***	-0.0220***
	(0.0007)	(0.0006)	(0.0005)
Country effects	Yes	Yes	Yes
Sector effects	Yes	Yes	Yes

Next, I estimate the model with pooled OLS by collapsing the panel control variables into time averages. The model also includes sector and country effects, the latter of which captures all country variables such as the statutory tax rate $TAXR_{kt}$.

The estimates are weaker compared to the yearly primary result from Table 3. The SOE_i coefficient indicates an increase of 1.11 percent for the $LTETR_i^{PTP}$ (Column A). The effect on the $LTETR_{it}^{OPP}$ is positive but not significant (Column B). The impact on the $LTETR_{it}^{EBI}$ is 0.44 percent and significant at the ten percent level (Column C). Summing up, Tables 4 and 5 show that the yearly results also hold for long-term dependent variables, even though results are less robust than the benchmark.

5.2 Pooled OLS

In this section, I re-estimate the main model using pooled ordinary least squares (POLS) as an alternative estimation strategy. This ignores the panel structure of the data but offers the advantage of a much bigger sample size. In fact, a substantial share of firm-years contains missing values already in controls of the state ownership specification from equation (4). The matching procedure further reduces the sample size in case insufficient matches exist for all SOEs. Whereas the basic estimates from Table 3 use between 12,000 and 16,000 firm-years, POLS allows to draw on 170,000 to 200,000 firm-years. Table 6 presents the results. All POLS estimates contain country-, sector-, and time-fixed effects, which I do not report separately.

Table 6: Pooled OLS

The table presents pooled OLS regressions based on $N_A = 172,574$, $N_B = 180,698$, and $N_C = 194,501$ observations, respectively; Standard errors are clustered at the firm level; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

	A: ETR_{it}^{PTP} *Coeff.* *(s.e.)*	B: ETR_{it}^{OPP} *Coeff.* *(s.e.)*	C: ETR_{it}^{EBI} *Coeff.* *(s.e.)*
SOE_i	0.0255***	0.0129***	0.0089***
	(0.0036)	(0.0030)	(0.0021)
LEV_{it}	0.0241***	-0.1495***	-0.0854***
	(0.0033)	(0.0027)	(0.0019)
$log(SALES)_{it}$	0.0008	0.0007	0.0221***
	(0.0006)	(0.0006)	(0.0004)
$ATANG_{it}$	-0.0122***	-0.0418***	-0.0387***
	(0.0034)	(0.0030)	(0.0021)
$log(DEPR)_{it}$	-0.0019***	0.0020***	-0.0241***
	(0.0005)	(0.0005)	(0.0004)
ROA_{it}	-0.0026***	-0.0004***	0.0018***
	(0.0001)	(0.0000)	(0.0000)
$GROP_{skt}$	-0.0135***	-0.0017	-0.0040
	(0.0040)	(0.0036)	(0.0026)
$TAXR_{kt}$	0.3908***	0.2614***	0.2094***
	(0.0351)	(0.0314)	(0.0220)
Country effects	Yes	Yes	Yes
Sector effects	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes

Estimates of the state ownership coefficient are stronger in magnitude in Columns

A-C of Table 6 than in Table 3. If a company is state-owned, the model predicts an increase of 2.55 percentage points for the ETR_{it}^{PTP}, a rise of 1.29 percentage points for the ETR_{it}^{OPP}, and an increase of 0.89 percentage points for the ETR_{it}^{EBI}. All SOE_i coefficients are significant at the one percent level. The stronger magnitude of effects could be due to the lack of group-fixed effects, which absorb cross-sectional variation in the primary results. Most control variables are similar to the benchmark results.

Elasticities of the $TAXR_{kt}$ variable are persistently inelastic and do not differ significantly across ownership groups. This supports the arguments from above of closer public scrutiny for SOEs and governments forcing distributions via tax payments. I conclude that the general results are robust to a different estimation technique applied to a very big sample.

5.3 Consolidated data

The next robustness test uses consolidated financial statements to estimate equation (5). The analysis allows to a certain extent to control for conforming tax planning strategies, which affect both the numerator and the denominator of the ETR (Watrin and Thomsen, 2016). This is because the TAX_{it} and respective profit variables capture the behavior of the group as a whole. However, it is important to remember that EU member states levy taxes usually on single accounts.

I identify consolidated financial statement in Orbis with the consolidation codes C1 and C2. C1 refers to firms for which only consolidated data is available and C2 to firms with consolidated and unconsolidated data. I use both types and apply the same data management and estimation procedure as above.[28] The sample sizes are much smaller compared to the benchmark estimate from Table 3 but are still above 1,000 firm-years

[28]A few minor differences exist: First, I use IFRS and local GAAP firms. IFRS is the mandatory reporting language for consolidated financial statements in the EU. Nevertheless, some firms chose voluntarily to publish accounts in local GAAP. Orbis sometimes only contains these accounts. Second, I use a probit specification of model (4) without the sales growth variable $\Delta log(SALES)_{it}$ due to the lack of convergence otherwise. Third, I use a caliper of $0.2 * SD^{probit}$ instead of $0.1 * SD^{probit}$. Results are robust for both calipers, but the sample size decreases significantly for the 0.1 caliper.

for all specifications. Table 7 presents the results.

Table 7: Consolidated financial statements

The table presents pair-FE regressions based on $N_A = 1,393$, $N_B = 1,349$, and $N_C = 1,605$ observations, respectively; group-fixed effects are based on 3 nearest neighbors in 2010; matches are within country; Standard errors are clustered at the firm level; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

	A: ETR_{it}^{PTP}	B: ETR_{it}^{OPP}	C: ETR_{it}^{EBI}
	Coeff.	*Coeff.*	*Coeff.*
	(s.e.)	*(s.e.)*	*(s.e.)*
SOE_i	0.0316**	0.0312***	0.0201**
	(0.0137)	(0.0115)	(0.0079)
LEV_{it}	0.0531	-0.1565***	-0.0516***
	(0.0337)	(0.0336)	(0.0184)
$log(SALES)_{it}$	-0.0034	0.0075	0.0240***
	(0.0080)	(0.0073)	(0.0047)
$ATANG_{it}$	-0.0662*	-0.0531*	-0.0469**
	(0.0398)	(0.0288)	(0.0185)
$log(DEPR)_{it}$	0.0003	-0.0039	-0.0201***
	(0.0065)	(0.0063)	(0.0041)
ROA_{it}	-0.0038***	-0.0017*	0.0010*
	(0.0009)	(0.0010)	(0.0006)
$GROP_{skt}$	-0.0460	0.0478	-0.0141
	(0.0386)	(0.0381)	(0.0271)
$TAXR_{kt}$	0.6304*	-0.1425	-0.2383
	(0.3442)	(0.2522)	(0.1732)
Group effects	Yes	Yes	Yes
Sector effects	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes

The general pattern from the basic results does not change. The coefficients of SOE_i have a positive and significant impact on all specifications of the dependent variable. Ceteris paribus, SOE_i increases the ETR_{it}^{PTP} by 3.16 percentage points, the ETR_{it}^{OPP} by 3.12 percentage points and the ETR_{it}^{EBI} by 2.01 percentage points. These magnitudes are stronger compared to the benchmark result from Table 3.

One possible interpretation of this finding is that private firms use the consolidation process to reduce their tax liabilities, whereas SOEs do so to a lesser extent. Alternatively, there may be subsidiaries or affiliates in low-tax third countries, which the unconsolidated dataset does not contain. Such affiliates would reduce a group's overall ETR. I conclude that the basic result extends to consolidated financial statements of

companies registered in EU countries.

5.4 Falsification tests

In this section, I use a falsification test to assess if the predicted effect of state ownership could be random, i.e., a statistical coincidence without causal relation. In doing so, I follow other studies that have used similar falsification tests (De Simone, 2016; Goldbach et al., 2017). In a first step, I randomly assign state ownership $SOE_i = 1$ to the same number of cross-sectional private firms as there are SOEs in the sample.[29] Then, I repeat the estimation procedure from Section 3 using the "pseudo" state-owned firms 1000 times.

Figures 2 and 3 contain empirical cumulative distribution functions (CDFs) of the state ownership coefficients and the respective five percent confidence intervals (CIs) for all three ETR definitions ETR_{it}^{PTP}, ETR_{it}^{OPP} and ETR_{it}^{EBI}. The left panel of both figures contains the coefficient CDFs, the right panel the five percent CIs. The vertical lines represent the benchmark results from Table 3.

In Figure 2, I assign pseudo-SOE status across countries. Coefficient estimates locate evenly around zero – 50 percent of repetitions suggest a positive, and 50 percent a negative impact of pseudo-ownership on all three ETR definitions. The benchmark coefficients from Table 3 are much stronger in magnitude than all estimates with random ownership assignment, suggesting that the effect is not statistical noise. The same holds for the five percent CIs (right panel of Figure 2): the original estimates produce a much stronger effect than any randomized estimate.

In Figure 3, I assign random state ownership to the same number of cross-sectional units within countries as there are SOEs in the sample, which leaves the country weights from the basic results in Table 3 unchanged. The additional constraint has no effect on the empirical CDFs for both the ETR_{it}^{PTP} and the ETR_{it}^{OPP}. In all cases, coefficients are

[29] As no algorithm is genuinely random, I use a pseudo-random seed based on system time to assign treatment status.

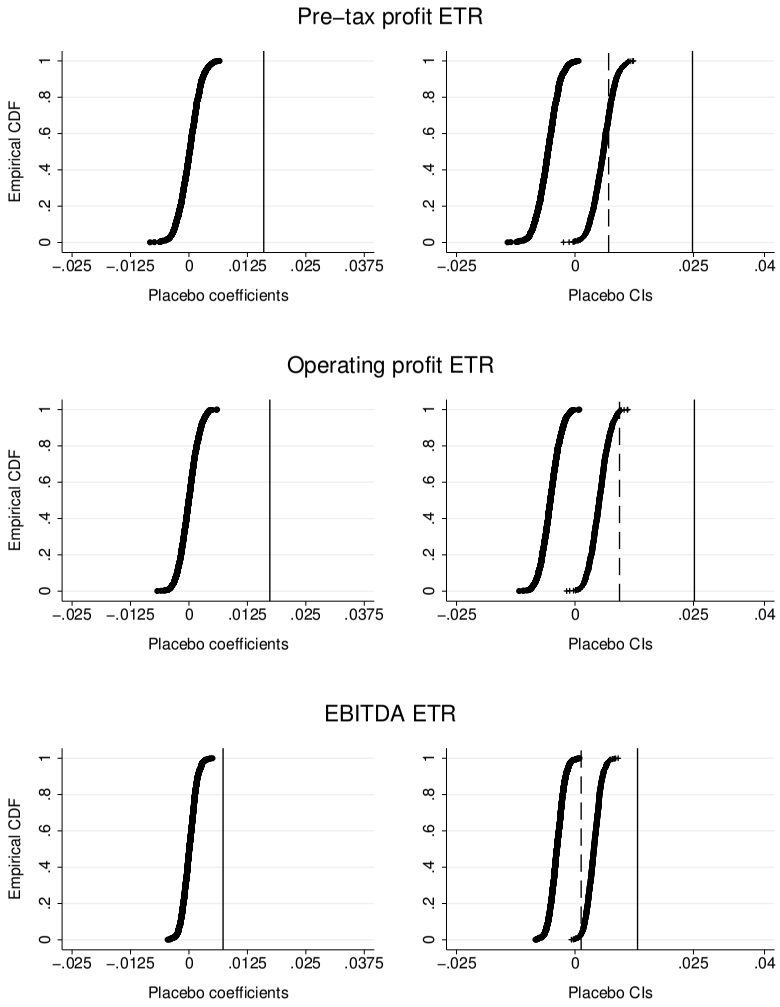

Figure 2: Cross-country pseudo-SOE assignment

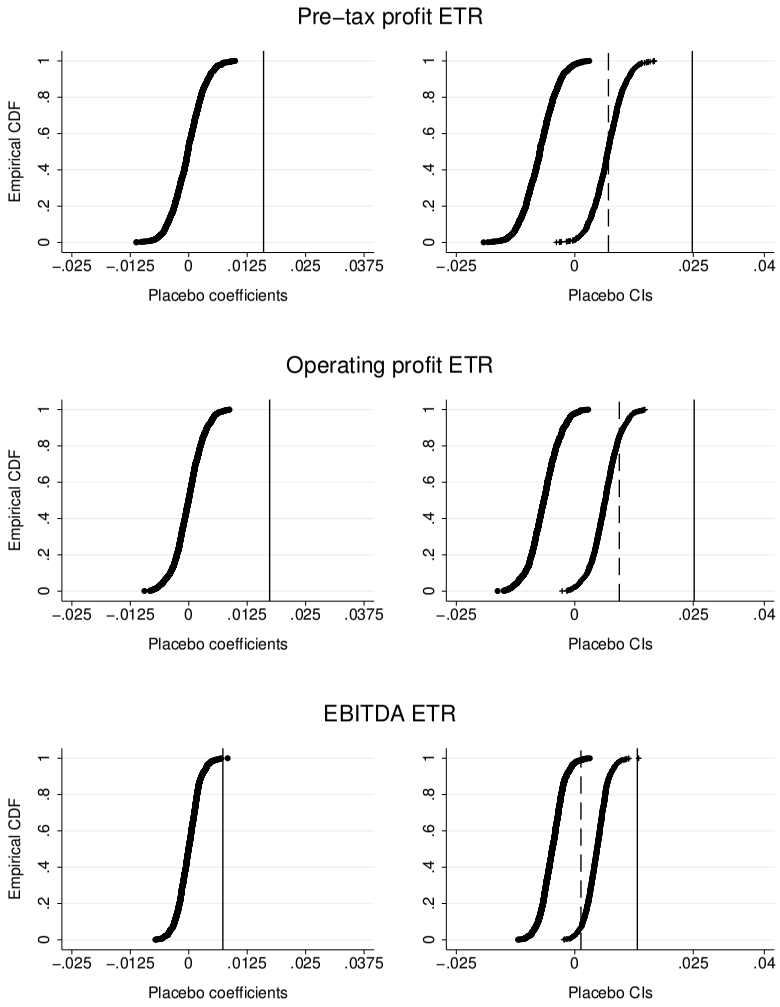

Figure 3: Within-country pseudo-SOE assignment

close to zero, and with equal probability above or below zero. For the third dependent variable, ETR_{it}^{EBI}, one pseudo-estimate exists which predicts a stronger statistically robust effect. Recall that the ETR_{it}^{EBI} derives from EBITDA, and thus before the major tax-planning items depreciation and interest of the profit cascade. Therefore, the fact that random estimates are closer to the benchmark for the ETR_{it}^{EBI} suggests that differences in other definitions of the dependent variable relate to these items. I conclude that the effect of state ownership on the dependent variables depends on true ownership and is not a product of statistical noise.

6 Conclusion

This study examines the tax neutrality of commercial state ownership in the EU. Results suggest that SOEs in Europe pay, on average, higher effective tax rates than comparable privately owned firms. I attribute this finding mainly to the budgetary importance of commercial state ownership, which makes governments force distributions from their profitable companies via tax payments. A complementing explanation is higher levels of tax-planning in private firms.

The study uses financial statement data from 17 EU member countries and employs selection-on-observables propensity score matching to identify a suitable control group for each SOE. The control group consists of firms within a relatively strict caliper that also operate in the same country as the SOE. This approach controls for non-random selection into state ownership. In the outcome regressions, I additionally control for a vector of time-varying firm characteristics that have been used in previous studies as well as time- and sector effects.

I conduct an extensive set of robustness tests. In particular, I analyze if the central finding extends to variations in model specification and parametrization, consolidated financial statement data, long-term specifications of the effective tax rate, and different estimation techniques. I also verify if results are a mere statistical coincidence by

conducting an extensive falsification test with pseudo-ownership assignment.

A central policy implication of my main finding is that tax neutrality in the EU's single market remains imperfect towards wide-spread state ownership, and the extent and direction of imperfection depends on the member state. Therefore, regulators should pay closer attention to tax neutrality topics that may not grab the headlines like tax planning of multinational enterprises does but could distort competitive neutrality to a significant extent.

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7 Appendix

7.1 Additional robustness tests

The benchmark result in Table 3 is robust to a large set of additional checks. Table A.1 reports the coefficient estimates of these tests for the variable of interest, SOE_i. Each row represents a variation from the primary result, which the first column specifies in more detail. I divide additional sensitivity analysis into five subgroups, namely variations in the dependent variable specification, changes in the matching procedure, modifications in the probit model (4) and the outcome equation (5), and modifications in the dataset.

The first line defines the dependent variable as the difference between the respective ETR and a country's statutory tax rate. The SOE_i variable then measures differences between SOEs and private firms in the ability to undercut statutory taxes. A positive coefficient of the ownership variables indicates a lower ability to undercut statutory rates. Results unambiguously show that this is the case for SOEs.

The next six lines refer to variations in the matching procedure. The first modification presents results when group-fixed effects capture time-constant sector characteristics (instead of the benchmark country characteristics). The reasoning behind this test is the fact that sectoral characteristics may have a significant impact on taxes and ownership structure. Thus, a sector group-fixed effect targets the business activity of firms more precisely. Coefficients remain robust but are less significant. The next three rows contain estimates for five, two and one nearest neighbors (instead of three). All SOE_i coefficients remain significant at the one percent level. The single exception is the coefficient for one nearest neighbor and the ETR_{it}^{OPP} as the dependent variable, which is significant at the five percent level. Furthermore, I vary the caliper, which is the maximum distance a private firm can have in the linear probit index from a treated firm to qualify as a group-fixed effect control. For a looser caliper of 0.2 times the probit standard deviation, estimates increase in magnitude and remain significant.

A very strict caliper of 0.01 times the probit standard deviation yields a positive effect only for the ETR_{it}^{PTP}. Note that a caliper of 0.01 times the probit standard deviation is much stricter than the 0.2 factor proposed by Austin (2011). Hence, the matching procedure discards a relatively large share of useful information.

The next test refers to a variation in the probit model (4). I exclude the dependent variable to align the specification more with Borisova et al. (2012). Results are stronger in magnitude and remain significant.

The next block deals with modifications of the outcome regression (5). First, I scale depreciation in a given year by a firm's sales and use this indicator instead of $log(DEPR)_{it}$. The reasoning is that the indicator now controls for relative depreciation in contrast to absolute depreciation. Except for the coefficient of ETR_{it}^{EBI} (Column C), the impact remains unchanged. Second, I include a proxy for intangible assets as an additional control. In doing so, I address another balance sheet item that previous literature associates with tax planning (Collins and Shackelford, 1995). Coefficient estimates of SOE_i do not change significantly. Third, I use $log(TA)_{it}$ instead of $log(SALES)_{it}$ as a size proxy. This increases the sample slightly and mitigates concerns that results depend on the choice of the size proxy. Results show that this is not the case.

The final set of variations deals with data management. First, I include financial firms (NACE2 category K: Financial and insurance activities) to verify if results depend on their exclusion. This is not the case. Second, I include all IFRS firms in the sample. The sample now extends to Spanish firms but is not necessarily homogenous concerning accounting techniques in other countries. The effect of SOE_i is robust to this modification.

Summing up, I conclude that the primary results do neither depend on the definition of the dependent variable, the matching procedure, the specification of the probit or outcome equations, nor on the design of the dataset.

Table A.1: Robustness

The table presents coefficient estimates for the variable of interest SOE_i; Each row represents a modification from the benchmark result in Table 3; Results of covariates are not reported but available upon request; Standard errors are clustered at the firm level; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

	A: ETR_{it}^{PTP} *Coeff.* *(s.e.)*	B: ETR_{it}^{OPP} *Coeff.* *(s.e.)*	C: ETR_{it}^{EBI} *Coeff.* *(s.e.)*
Dependent variable			
ETR - tax rate difference	0.0153***	0.0184***	0.0094***
	(0.0048)	(0.0043)	(0.0030)
Matching procedure			
2-digit NACE2 matching	0.0121*	0.0117**	0.0083**
	(0.0064)	(0.0051)	(0.0034)
5 Nearest neighbors	0.0176***	0.0169***	0.0084***
	(0.0047)	(0.0040)	(0.0030)
2 Nearest neighbors	0.0154***	0.0119***	0.0079***
	(0.0045)	(0.0042)	(0.0029)
1 Nearest neighbor	0.0156***	0.0088**	0.0101***
	(0.0048)	(0.0044)	(0.0030)
Caliper 0.2*probit-SD	0.0214***	0.0205***	0.0100***
	(0.0047)	(0.0042)	(0.0030)
Caliper 0.01*probit-SD	0.0144***	0.0065	0.0038
	(0.0051)	(0.0046)	(0.0033)
Variations in Model (4)			
Probit ex ETR_{it}	0.0306***	0.0225***	0.0060**
	(0.0051)	(0.0042)	(0.0029)
Variations in Model (5)			
Depreciation/sales	0.0160***	0.0167***	0.0018
	(0.0045)	(0.0040)	(0.0031)
Intangible Assets	0.0158***	0.0180***	0.0082***
	(0.0046)	(0.0041)	(0.0031)
Log(Total Assets)	0.0158***	0.0161***	0.0080***
	(0.0044)	(0.0040)	(0.0031)
Dataset specification			
Incl. financial firms	0.0200***	0.0171***	0.0113***
	(0.0045)	(0.0042)	(0.0029)
Incl. IFRS	0.0116***	0.0178***	0.0096***
	(0.0043)	(0.0039)	(0.0029)

7.2 Additional figures and tables

Figure 4: Average pre-tax profit ETR by country

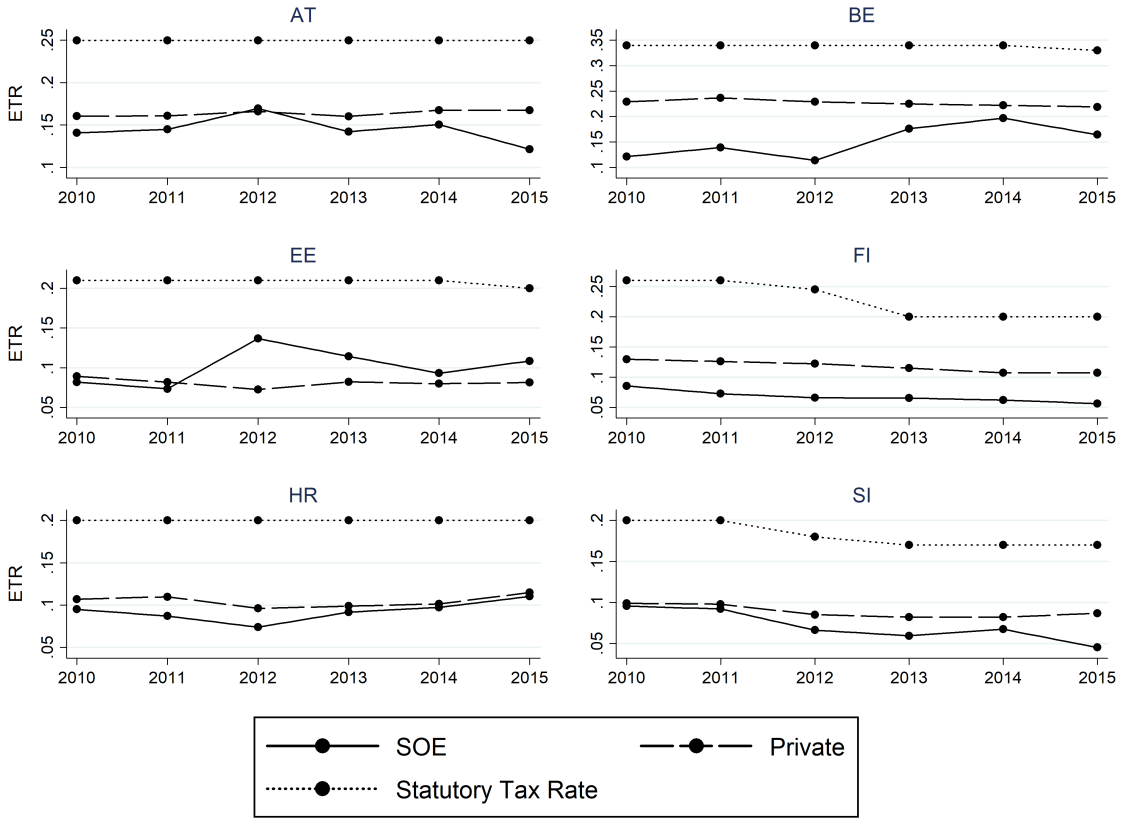

Table A.2: Correlation matrix

The table presents correlations of the dependent variables ETR_{it}^{PTP}, ETR_{it}^{OPP}, ETR_{it}^{EBI}, state ownership SOE_i and the control variables used to estimate models (4) and (5); Correlations are based on 159,398 observations.

	SOE_i	ETR_{it}^{PTP}	ETR_{it}^{OPP}	ETR_{it}^{EBI}	$log(TA)_{it}$	$log(SALES)_{it}$	ROA_{it}	LEV_{it}	$ATANG_{it}$	$log(DEPR)_{it}$	$\Delta log(FA)_{it}$	$\Delta log(SALES)_{it}$	$GROP_{skt}$	$TAXR_{kt}$	$CREDITM_{kt}$	$GDPG_{kt}$	$GDPPC_{kt}$
SOE_i	1.00																
ETR_{it}^{PTP}	-0.02	1.00															
ETR_{it}^{OPP}	-0.05	0.74	1.00														
ETR_{it}^{EBI}	-0.12	0.54	0.81	1.00													
$log(TA)_{it}$	0.20	-0.09	-0.06	-0.09	1.00												
$log(SALES)_{it}$	0.09	-0.12	-0.03	-0.00	0.79	1.00											
ROA_{it}	-0.09	-0.21	0.01	0.25	-0.12	0.07	1.00										
LEV_{it}	0.06	0.05	-0.24	-0.28	0.06	-0.11	-0.26	1.00									
$ATANG_{it}$	0.25	-0.07	-0.22	-0.40	0.18	-0.17	-0.20	0.38	1.00								
$log(DEPR)_{it}$	0.22	-0.09	-0.09	-0.30	0.79	0.68	-0.08	0.12	0.38	1.00							
$\Delta log(FA)_{it}$	-0.01	-0.00	0.00	0.03	0.00	-0.01	-0.00	0.03	0.04	-0.03	1.00						
$\Delta log(SALES)_{it}$	-0.02	0.01	0.01	0.04	-0.03	0.03	0.08	0.01	-0.02	-0.03	0.14	1.00					
$GROP_{skt}$	-0.03	0.00	0.01	0.02	0.02	0.06	0.05	0.01	-0.01	0.03	0.10	0.28	1.00				
$TAXR_{kt}$	-0.07	0.14	0.23	0.28	0.05	0.12	0.04	-0.06	-0.24	-0.03	-0.00	0.00	-0.01	1.00			
$CREDITM_{kt}$	-0.05	0.37	0.35	0.33	0.05	-0.03	-0.07	0.08	-0.09	-0.03	-0.01	0.02	-0.04	0.59	1.00		
$GDPG_{kt}$	0.08	-0.29	-0.24	-0.19	0.11	0.13	0.08	0.03	0.11	0.11	-0.02	-0.01	0.01	-0.08	-0.25	1.00	
$GDPPC_{kt}$	0.03	-0.03	0.01	0.06	0.23	0.20	0.02	0.08	0.01	0.14	-0.01	-0.00	0.02	0.49	0.60	0.23	1.00

Table A.3: Probit regressions of the basic result

The table presents probit results for model (4); The predicted propensities of state ownership are used to construct the group-fixed effect of the outcome regressions in Table 3; *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

	A: ETR_{it}^{PTP} *Coeff.* *(s.e.)*	B: ETR_{it}^{OPP} *Coeff.* *(s.e.)*	B: ETR_{it}^{EBI} *Coeff.* *(s.e.)*
LEV_{it}	-1.7343***	-1.6379***	-1.3258***
	(0.4684)	(0.4567)	(0.4376)
LEV_{it}^2	4.1351***	5.0455***	3.5452**
	(1.5912)	(1.5211)	(1.4598)
LEV_{it}^3	-2.8080**	-3.9321***	-2.6152**
	(1.3286)	(1.2545)	(1.2076)
ROA_{it}	-0.0543***	-0.0193***	-0.0190***
	(0.0079)	(0.0035)	(0.0031)
ROA_{it}^2	0.0016***	0.0001	0.0000
	(0.0004)	(0.0001)	(0.0001)
ROA_{it}^3	-0.0000***	0.0000	0.0000**
	(0.0000)	(0.0000)	(0.0000)
$log(TA)_{it}$	-1.7738***	-1.7092***	-1.6952***
	(0.2612)	(0.2672)	(0.2618)
$log(TA)_{it}^2$	0.1792***	0.1734***	0.1730***
	(0.0260)	(0.0269)	(0.0262)
$log(TA)_{it}^3$	-0.0053***	-0.0051***	-0.0051***
	(0.0008)	(0.0009)	(0.0008)

Table A.3: Probit regressions of the basic result (continued)

	A: ETR_{it}^{PTP}	B: ETR_{it}^{OPP}	C: ETR_{it}^{EBI}
	Coeff.	*Coeff.*	*Coeff.*
	(s.e.)	*(s.e.)*	*(s.e.)*
$\Delta log(FA)_{it}$	0.0754*	0.0815*	0.1271***
	(0.0443)	(0.0454)	(0.0481)
$\Delta log(FA)_{it}^2$	-0.0351	-0.0503*	-0.0987***
	(0.0244)	(0.0265)	(0.0304)
$\Delta log(FA)_{it}^3$	0.0034	0.0060	0.0114***
	(0.0034)	(0.0037)	(0.0040)
$\Delta log(SALES)_{it}$	-0.1083**	-0.1145**	-0.1428***
	(0.0472)	(0.0452)	(0.0434)
$\Delta log(SALES)_{it}^2$	-0.0241*	-0.0211	-0.0139
	(0.0134)	(0.0148)	(0.0134)
$\Delta log(SALES)_{it}^3$	0.0014	0.0028	0.0025
	(0.0023)	(0.0021)	(0.0020)
$CREDITM_{kt}$	-0.0022	-0.0400	-0.1174**
	(0.0435)	(0.0442)	(0.0472)
$CREDITM_{kt}^2$	0.0000	0.0004	0.0011**
	(0.0004)	(0.0004)	(0.0004)
$CREDITM_{kt}^3$	-0.0000	-0.0000	-0.0000**
	(0.0000)	(0.0000)	(0.0000)
$GDPG_{kt}$	0.2512***	0.2596***	0.2104***
	(0.0490)	(0.0500)	(0.0508)
$GDPG_{kt}^2$	0.0247***	0.0303***	0.0556***
	(0.0085)	(0.0086)	(0.0156)
$GDPG_{kt}^3$	-0.0088***	-0.0101***	-0.0142***
	(0.0022)	(0.0022)	(0.0030)
$GDPPC_{kt}$	-0.0003*	-0.0004**	-0.0006***
	(0.0002)	(0.0002)	(0.0002)
$GDPPC_{kt}^2$	0.0000	0.0000*	0.0000***
	(0.0000)	(0.0000)	(0.0000)
$GDPPC_{kt}^3$	-0.0000	-0.0000*	-0.0000***
	(0.0000)	(0.0000)	(0.0000)
LO: French	-0.2175	-0.5276	-1.6815**
	(0.6146)	(0.6240)	(0.6775)
LO German	0.1821	-0.2840	-1.9399**
	(0.8365)	(0.8520)	(0.9313)
LO Scandinavian	-0.1057	-0.5133	-1.9410**
	(0.7901)	(0.8036)	(0.8729)
NACE2 B	-0.1285	-0.0545	-0.0807
	(0.2510)	(0.2485)	(0.2434)
NACE2 C	-1.0416***	-1.0341***	-1.1003***
	(0.1458)	(0.1425)	(0.1382)
NACE2 D	1.7681***	1.7642***	1.6538***
	(0.1445)	(0.1412)	(0.1367)
NACE2 E	1.3660***	1.3650***	1.3465***
	(0.1473)	(0.1439)	(0.1391)
NACE2 F	-0.2305	-0.2455*	-0.2868**
	(0.1416)	(0.1387)	(0.1341)
NACE2 G	-0.8111***	-0.7911***	-0.7782***
	(0.1415)	(0.1382)	(0.1332)
NACE2 H	0.3167**	0.4031***	
	(0.1417)	(0.1386)	(0.1323)
NACE2 I	-0.3134*	-0.3455*	-0.4104**
	(0.1865)	(0.1837)	(0.1733)
NACE2 J	-0.0806	-0.1121	-0.0974
	(0.1537)	(0.1516)	(0.1448)
NACE2 L	0.2176	0.2463*	0.2051
	(0.1388)	(0.1351)	(0.1303)
NACE2 M	-0.0136	-0.0302	-0.0495
	(0.1445)	(0.1425)	(0.1373)
NACE2 N	0.1204	0.1588	0.1717
	(0.1478)	(0.1439)	(0.1381)
NACE2 R	0.7640***	0.8271***	0.7981***
	(0.1805)	(0.1786)	(0.1676)
NACE2 S	0.2424	0.1907	0.2183
	(0.1997)	(0.1990)	(0.1882)
NACE2 U	1.3309	1.4906	0.9155

Table A.3: Probit regressions of the basic result (continued)

	A: ETR_{it}^{PTP} *Coeff.* *(s.e.)*	B: ETR_{it}^{OPP} *Coeff.* *(s.e.)*	C: ETR_{it}^{EBI} *Coeff.* *(s.e.)*
	(0.9113)	(0.9138)	(0.7608)
ETR_{it}^{PTP}	-1.2246**		
	(0.6063)		
ETR_{it}^{PTP2}	3.8465**		
	(1.7071)		
ETR_{it}^{PTP3}	-1.9253		
	(1.3122)		
ETR_{it}^{OPP}		-2.1783***	
		(0.6451)	
ETR_{it}^{OPP2}		5.6906***	
		(2.0412)	
ETR_{it}^{OPP3}		-2.4843	
		(1.7532)	
ETR_{it}^{EBI}		-4.5698***	
			(0.7556)
ETR_{it}^{EBI2}			17.3336***
			(3.2164)
ETR_{it}^{EBI3}			-15.3592***
			(3.6992)
constant	8.2735***	9.8044***	14.6239***
	(2.9562)	(3.0402)	(3.1906)

7.3 Data assumptions

- Ownership assumption on SOE part:
  - Historical ownership data base from Orbis: label "public authority, state, government".
  - 100 percent stand-alone SOE or 100 percent group subsidiary where the group is classified by Orbis as "SOE".
- Ownership assumption on private firms:
  - Historical ownership data base from Orbis: any other label.
  - 100 percent private stand-alone firms and subsidiaries.
- I consider only *#conscode* "U1" and "U2" subsidiaries, i.e. unconsolidated financial statements. Robustness is performed with "C1" and "C2" in Section 5.
- I use only data from EU countries because commercially active SOEs and private firms should receive the same tax treatment.
- A cross-sectional unit needs at least two firm-years in $[2009, 2015]$. The average – at five firm-years – is much higher.
- Only local GAAP firms. Robustness including IFRS firms in the Appendix.
- $\#Taxation > 0$
- $\text{ETR}_{it} \in]0; 1[$. Top and bottom 1 percent are winsorized. This holds for all ETR specifications.
- $\text{TAN}_{it} \in [0; 1]$.
- $\text{LEV}_{it} \in [0; 1[$.

Table A.4: Variable definitions

Firm level	(Source: Orbis)
SOE_i	Binary indicator of state ownership.
TAX_{it}	Total financial statement tax payments of firm i in year t.
PTP_{it}	Pre-tax profit of firm i in year t.
OPP_{it}	Operating profit of firm i in year t.
EBI_{it}	Earnings before interest, tax, depreciation and amortization (EBITDA) of firm i in year t.
ETR_{it}^{PTP}	Pre-tax profit effective tax rate (TAX_{it}/PTP_{it}).
ETR_{it}^{OPP}	Operating profit effective tax rate (TAX_{it}/OPP_{it}).
ETR_{it}^{EBI}	EBITDA effective tax rate (TAX_{it}/EBI_{it}).
$log(TA)_{it}$	Log(total assets) of firm i in year t.
$log(SALES)_{it}$	Log(turnover) of firm i in year t.
ROA_{it}	Return on assets of firm i in year t.
LEV_{it}	Total debt / total assets of firm i in year t.
$ATANG_{it}$	Asset tangibility: fixed assets / total assets of firm i in year t.
$log(DEPR)_{it}$	Log(depreciation and amortization) of firm i in year t.
$\Delta log(FA)_{it}$	Investment proxy: $log(\text{fixed assets})_{it} - log(\text{fixed assets})_{i,t-1}$.
$\Delta log(SALES)_{it}$	Sales growth: $log(\text{turnover})_{it} - log(\text{turnover})_{i,t-1}$.
Country level	
$TAXR_{kt}$	Statutory tax rate of country k in year t. (Source: Paying Taxes, PWC).
$CREDITM_{kt}$	Domestic credit provided by banking sector in country k and year t as percentage of GDP (Source: Worldbank).
$GDPG_{kt}$	Annual GDP growth in percent in country k and year t (Source: Worldbank).
$GDPPC_{kt}$	GDP per capita in country k and year t, PPP at constant 2011 international USD (Source: Worldbank). .
Legal origin dummies	Legal origin dummy variables of country k based on La Porta et al. (1997).
Sector level	
Sector dummies	Sector dummies are based on NACE2 categories.
$GROP_{skt}$	Growth opportunities are defined as in Huizinga et al. (2008): the growth rate median of subsidiary sales in a subsidiary's industry s, country k and year t.