

FAccT Center Working Paper Series

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FAccT Center Working Paper Nr. 24/2017

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Heterogeneity in Tax Rate Elasticities of Capital: Evidence from Local Business Tax Reforms*

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ABSTRACT

This study examines heterogeneity in tax rate elasticities of corporate capital using staggered variation in local business tax rates of German municipalities. The results suggest an average long-run capital decline of 0.97% after a 1% increase in the tax rate. In line with prior literature that suggests higher investment-cash flow sensitivities of firms with financing constraints tax rate elasticities are up to half times larger for financially constrained firms than for unconstrained firms. Moreover, capital responses are about half times larger for firms with fewer tax avoidance possibilities. Finally, this study contributes to the literature on tax incidence. I find a weaker relation between taxes and capital for firms that are less likely to bear the economic burden of the tax because they shift the tax incidence to their stakeholders.

Keywords: Corporate taxation, local taxes, corporate investments, financial constraints, tax avoidance, tax incidence

JEL classification: G31, H22, H25, H71

* I am grateful to Antonio De Vito, Michael Devereux, Martin Jacob, Maximilian Müller, Wayne Landsman, Silke Rüniger, David Samuel, Philip Schnorpfel, seminar participants at WHU – Otto Beisheim School of Management, and seminar participants of the 3rd Doctoral Research Seminar at WU, Vienna for helpful comments and suggestions.

1. Introduction

Policy makers are interested in stimulating corporate investments to foster economic growth and employment (e.g., Keynes 1936, de Long and Summers 1991). Tax cuts are usually seen as useful tools to spur capital investments, as suggested in the U.S. President's Framework for Business Taxation in April 2016 which states that a reduction in the U.S. federal rate from 35 % to 28% would "help encourage greater investment",¹ or in the Summer Budget Speech of the British Chancellor, George Osborne, in July 2015 who claims that the staggered tax cut from 28% to 20% in 2015 "increased much needed investment".²

While there is large theoretical and empirical evidence for a negative relation between taxes and capital investments, there is no consensus estimate on the size of the tax rate elasticity of capital and scarce evidence exists for cross-sectional differences in the relation between taxes and capital expenditures. This is mostly due to previous research design choices. For example, studies that combine tax rate and tax base elements using the cost of capital or q-approach to study tax elasticities of capital (e.g. Jorgenson 1963, Hall and Jorgenson 1967, Summers 1981, Cummins, Hassett, and Hubbard 1994, Cummins, Hassett, and Hubbard 1996, Chirinko, Fazzari, and Meyer 1999, Dwenger 2014) do not provide estimates for the pure tax rate effect. Most tax reforms do not allow to disentangle tax base and tax rate effects because tax rate changes are usually accompanied by a change in the tax base. Analyzing changes in local business tax rates set at municipality level allows me to isolate the tax rate effect as regulations for the computation of the tax base are set at federal level. Moreover, using firm-level data enables me to control for cross-sectional differences in capital responses to tax rate changes which could lead to more precise estimates than studies on aggregate investment effects using macro data (e.g., Auerbach 1983, Djankov et al. 2010).

Identifying heterogeneity in capital responses to tax rate changes helps policy makers (i) to identify which firms are affected most by a change in tax policy and (ii) to understand potential behavioral responses of those showing lower investment sensitivities in order to adjust tax policy accordingly. In addition, providing evidence on heterogeneity in firms' investment

¹ See The President's Framework for Business Tax Reform: An Update, April 2016, available at: <https://www.treasury.gov/resource-center/tax-policy/Documents/The-Presidents-Framework-for-Business-Tax-Reform-An-Update-04-04-2016.pdf>, (last accessed March 24, 2017).

² George Osborne, Chancellor of the Exchequer, July 2015, available at: <https://www.gov.uk/government/speeches/chancellor-george-osbornes-summer-budget-2015-speech>, (last accessed March 24, 2017).

responses may also help to explain the wide range of estimates for user cost elasticities of capital that mostly range between -1 and 0.³

This study contributes to existing literature by examining heterogeneity in capital responses to tax rate changes with respect to three characteristics. First, I provide evidence that financially constrained firms show capital elasticities that are about half times larger than those of unconstrained firms. Given that taxes affect a firm's after-tax cash flows, this finding is in line with the notion of higher investment-cash flows sensitivities of financially constrained firms (see e.g., Fazzari, Hubbard, and Petersen 1988; Rauh 2006; Faulkender and Petersen 2012).

Second, I argue that tax avoidance possibilities mitigate the effect of tax rate changes on capital expenditures because changes in statutory rates translate into smaller changes in effective tax rates if firms engage in tax avoidance. This is in line with findings in Schreiber and Overesch (2010) who show that the tax sensitivity of investments of multinationals decreases with rising R&D intensity, i.e., profit shifting possibilities. Moreover Simmler (2015) and Dobbins and Jacob (2016) find stronger investment responses of domestic group firms relative to multinational groups to a large business tax reform in 2008. In line with this notion, the results suggests that single-jurisdictional firms without profit shifting possibilities show about half times larger capital elasticities than firms that belong to a multi-jurisdictional group. To the extent that prior studies relied on corporate tax rate changes that were accompanied by changes in the tax base to identify the tax effect my setting allows cleaner estimates of the pure tax rate effect as the computation of the tax base is not affected by the local tax reforms.

Lastly, my study contributes to the literature on tax incidence (e.g., Harberger 1962; Krzyzaniak and Musgrave 1963; Dye 1998; Vasquez-Ruiz 2012; Arulampalam, Devereux, and Maffini 2012; Fuest, Peichl, and Sieglöckh 2015; Jacob and Müller 2016). As pointed out by Jacob and Müller (2016), the ability to shift the tax burden to stakeholders via price increases or wage reductions could impact the relation between taxes and investment or financing decisions. This study is the first to test this notion empirically. My findings suggest that firms show lower capital elasticities if they are better able to shift the tax incidence to their stakeholders. I find lower capital elasticities for highly profitable firms which is in line with the notion that these firms shift the tax burden to their stakeholders. One limitation of my analysis is that I do not observe output prices or individual wages directly. Given that my analysis relies on indirect proxies to measure the extent to which firms transfer the additional tax burden to their stakeholders, the results need to be interpreted with caution.

³ For user cost elasticities see e.g. Jorgenson (1963), Hall and Jorgenson (1967), Chirinko, Fazzari, and Meyer (1999), Cummins, Hassett, and Hubbard (1994), Cummins, Hassett, and Hubbard (1996). For a discussion and overview see Dwenger (2014).

For the identification of the tax rate effect, my research design exploits staggered variation in local business taxes in Germany. While local business tax rates are set at municipality level, regulations for the computation of the tax base are set at federal level. The setting allows me to disentangle tax rate and tax base effects and to study investment responses in a very homogeneous institutional and economic environment.⁴ Cross-country studies (e.g., Cummins, Hassett, and Hubbard 1996) usually have difficulties to comply with the common trends assumption due to different economic and legal conditions and different tax base definitions. Failure to control for these omitted variables could lead to biased coefficient estimates for the tax rate effect if these factors change over the observation period and if they affect capital expenditures. For example, if changes in economic conditions induce a change in tax policy, estimations for the tax rate effect will as well reflect investment changes that are due to the different economic environment. In my setting, instead, treatment and control group face the same legal and economic environment which allows cleaner estimates of the tax rate elasticity of capital.

I compare changes in capital stock of firms that face a change in the local business tax rate to the change in capital stock of firms operating in a different municipality but the same county. That is, the inclusion of county-year fixed effects removes all regional and year specific observable and unobservable factors that determine a firm's capital stock which makes the approach similar to a spatial discontinuity design.⁵ Limiting the counterfactuals to firms from the same county mitigates potential endogeneity concerns of tax policy. If the change in tax policy follows or anticipates changes in economic conditions, I assume that control firms face the same change in economic conditions due to their geographical proximity. Moreover, an additional test using leads and lags of the explanatory variable supports the assumption that potential endogeneity of tax policy does not bias my results because there are no differences between treatment and control firms prior to the tax reform. I further control for a large variety of observable firm characteristics that vary over time and that influence the level of capital stock. I additionally include firm fixed effects that control for unobservable time invariant firm characteristics (e.g. industry, ownership structure, manager characteristics) that could influence the level of capital stock.

⁴ Other studies have exploited this setting to examine e.g., the tax rate setting process (Buettner 2006, Baskaran 2014, Foremny and Riedel 2014), behavioral responses to a formula apportionment regime (Riedel 2010, Buettner, Riedel, and Runkel 2011), location decisions of multinational firms (Becker, Egger, and Merlo 2012), or the tax incidence on wages (Fuest, Peichl, and Sieglöcher 2015).

⁵ For the application of a spatial discontinuity design in the context of local taxes see e.g., Ljungqvist and Smolyansky (2014).

Financial as well as ownership information is provided by Amadeus. My sample includes 26,894 listed and (mostly) private firms from 3,897 different municipalities between 2005–2014. Private firms show more heterogeneity than public firms with respect to financial constraints because they are more prone to information asymmetries (Hale and Santos 2009; Saunders and Steffen 2011; Behr, Norden, and Noth 2013).⁶ This characteristic is useful when analyzing the role of financing constraints in the relation between taxes and capital expenditures. In addition, private firms are usually smaller than public firms which facilitates the analysis of capital responses of stand-alone firms and small group firms that operate in only one taxing jurisdiction. Moreover, it is important to understand the behavior of private firms because they represent a substantial part of the overall firm population that employs about two-thirds of all workers in the European Union.

The results suggest that a one percentage point increase in the statutory tax rate leads to a decrease in capital (fixed assets) by up to 0.97% in the long-run. The inclusion of different firm-level control variables such as wage expense, sales, sales growth, age, EBIT, cash holdings, and liabilities slightly decreases the effect. I find that capital responses are persistent in later years and do not incur prior to the tax reform. To corroborate the validity of the approach, I show weaker responses of firms for which I expect lower elasticities of capital, i.e., loss firms. Since loss firms are not subject to tax in the year of the loss and in following periods in which loss carryforwards shield their profits from taxation, I do not expect their investment decisions to depend on the tax rate. In line with this argument, I find a weaker relation between taxes and capital for loss firms.

I further exploit cross-sectional variation in the size of the effect depending on the level of financial constraints. Since tax rate increases reduce after-tax cash flows, I expect firms to change their investment behavior in response to the change in tax policy. Following prior literature that shows higher investment-cash flow sensitivities of financially constrained firms (e.g., Fazzari, Hubbard, and Petersen 1988; Rauh 2006; Faulkender and Petersen 2012), I expect that a firm's responsiveness to tax rate changes increases with the wedge between internal and external financing costs (i.e. financing constraints). I use size and age to determine a firm's degree of financial constraint suggesting that young and small firm are more likely to be financially constrained (see e.g., Hadlock and Pierce 2010). While I find a negative relation between tax rate changes and capital for both, financially constrained and unconstrained firms,

⁶ Moreover, prior literature (e.g., Brown and Petersen 2009, Chen and Chen 2012) shows a decline (or disappearance) in investment-cash flow sensitivities (i.e., financing constraints) for public firms that could be due to e.g., the rising importance of equity markets.

the results suggest that financially constrained firms decrease investments more than unconstrained firms when facing a change in corporate tax rates.

In addition to that, this study provides evidence on the difference in the investment response between single-jurisdictional and multi-jurisdictional firms. In line with e.g., Schreiber and Overesch (2010), Simmler (2015) and Dobbins and Jacob (2016), I expect firms operating in multiple municipalities to show lower tax rate elasticities of capital because they have better tax avoidance possibilities.⁷ Multi-jurisdictional firms can exploit differences either in local business tax rates within Germany or in corporate tax rates across countries.⁸ In this regard, I find a stronger relation between taxes and capital in single-jurisdictional firms. The results suggest that the effect of taxes on capital is about half times larger for single-jurisdictional than for multi-jurisdictional firms in the long run. Given that single-jurisdictional firms are not able to relocate investments to other jurisdictions, estimates for the tax rate elasticities of single-jurisdictional firms represent estimates for the change in the scale of a firm's investments after a tax rate change.

Moreover, I examine the role of tax incidence in the relation between taxes and capital as suggested by Jacob and Müller (2016) who examine the relation between tax avoidance and tax incidence. If firms do not bear the economic burden of a tax increase, they are less likely to adjust their capital in response to tax changes. Firms that face a less elastic consumer demand will face lower declines in demand after an increase in consumer prices. These firms are thus more likely to increase their prices after a tax increase to compensate for the additional costs. Following e.g., Lerner (1934), Kubick et al. (2015), Jacob, Michaely, and Müller (2016), and Jacob and Müller (2016), I expect firms with high profit margins to have more market power which suggests that they face a less elastic demand. In addition, Fuest, Peichl, and Siegloch (2015) show that firms with high profit margins transfer more of the additional tax burden to their employees via a cut in wages.⁹ The results suggest that firms with a better ability to shift the tax incidence to their stakeholders (firms with high profit margins) show about 25% lower tax rate elasticities of capital.

⁷ For empirical evidence on profit shifting of multinational firms see e.g., Dischinger and Riedel 2011, Dharmapala and Riedel 2013.

⁸ Formula apportionment mitigates profit shifting possibilities within Germany because profits are allocated to each affiliate according to its payroll share. However, this applies only if the group firms form a fiscal unity for local business tax purposes. Moreover, prior literature provides evidence that firms engage in tax avoidance under formula apportionment by manipulating payroll expenses (Riedel 2010, Eichfelder, Hechtner, and Hundsdorfer 2015).

⁹ This follows the reasoning of fair wage models in which wages are a function of a firm's after-tax profits. Given that more profitable firms will face a larger decline in after-tax profits in absolute values, wage adjustments are likely to be stronger.

Fuest, Peichl, and Siegloch (2015) suggest that the ability to shift the tax incidence on employees depends on the labor supply elasticity, i.e. the mobility of employees. They show that blue collar workers experience larger wage cuts relative to white collar workers because the latter are expected to be more mobile. In line with the notion that these firms will show lower investment responses to a change in tax policy, the results indicate that firms with a higher share of blue collar workers (lower average wages) show lower capital responses.

This study contributes to the large literature on the investment effect of tax policy (e.g. Jorgenson 1963; Hall and Jorgenson 1967; Summers 1981; Cummins, Hassett, and Hubbard 1994; Cummins, Hassett, and Hubbard 1996; Chirinko, Fazzari, and Meyer 1999; Auerbach 2002) by shedding light on the heterogeneity in capital elasticities to changes in the tax policy with a setting that allows the analysis of corporate capital responses in a homogenous institutional and economic environment. The findings help policy makers to identify firms that are most affected by corporate tax rate changes. My findings suggest stronger capital responses of financially constrained firms which is line with the notion that financially constrained firms show higher investment-cash flow sensitivities. This contributes to existing studies on investment-cash flow sensitivities in general (e.g., Fazzari, Hubbard, and Petersen 1988; Kaplan and Zingales 1997; Faulkender and Petersen 2012) and more specifically on the role of financial constraints in private firms (Behr, Norden, and Noth 2013; Erel, Jang, and Weisbach 2015; Farre-Mensa and Ljungqvist 2016). Moreover, single-jurisdictional firms show higher tax rate elasticities of capital, presumably because they have higher effective tax rates than multi-jurisdictional firms due to fewer tax avoidance possibilities which is in line with findings of e.g., Schreiber and Overesch (2010); Simmler (2015) and Dobbins and Jacob (2016). Moreover, firms that are not able to transfer the additional tax burden to one of their stakeholders show a stronger relation between taxes and capital. With this finding, I contribute to the large literature on tax incidence (see e.g., Harberger 1962; Krzyzaniak and Musgrave 1963; Dye 1998M; Vasquez-Ruiz 2012; Arulampalam, Devereux, and Maffini 2012; Fuest, Peichl, and Siegloch 2015) by providing evidence for the mitigating effect of tax incidence on the relation between taxes and investments.

The remainder of the paper is structured as follows: Section 2 develops the hypotheses, Section 3 describes the institutional background of local business taxes in Germany and the data. In Section 4, I explain the estimation strategy and Section 5 presents the results. Section 6 provides a conclusion.

2. Hypothesis Development

While prior studies show that taxes have an adverse effect on a firm's capital stock, this study exploits heterogeneity of firms' investment responses to changes in tax policy.

There are two channels that explain the negative relation between tax rates and investments. First, taxes reduce expected after-tax cash flows of investment projects and thereby reduce the set of positive NPV projects available to a firm. Put differently, tax rates increase required rates of return before taxes of corporate investment projects because shareholders would otherwise prefer to undertake investments outside the firm when facing an increase in corporate taxes and vice versa (e.g., Dobbins and Jacob 2016; Asker, Farre-Mensa, and Ljungqvist 2015).¹⁰ Second, firms reduce capital expenditures in response to tax rate changes due the detrimental effect on contemporaneous after-tax cash flows, i.e., a firm's cash that is available for investments. This assumes imperfect capital markets, i.e., a wedge between costs of internal and external financing that could be due to e.g., agency costs or information asymmetries. If external financing cost exceed the cost of internal financing, freeing up additional cash by lowering tax rates will allow the firm to undertake investment projects that were not beneficial when financed with external capital. Consequently, tax rate increases will limit the amount of cash that is available for investments and thereby reduce investment activity of financially constrained firms.

Therefore, I assume that financing constraints increase tax rate elasticities of capital because they lead to higher investment-cash flow sensitivities (e.g., Fazzari, Hubbard, and Petersen 1988; Rauh 2006; Faulkender and Petersen 2012).¹¹

***H1:** Financially constrained firms show higher tax rate elasticities of capital.*

Previous literature finds that financially constrained firms engage in more tax avoidance than their unconstrained peers (see e.g. Law and Mills 2015; Edwards, Schwab, and Shevlin 2016). Thus, it is possible that financially constrained firms show lower tax elasticities of capital as changes in the statutory tax rate do not affect their effective tax rates as much as effective tax rates of unconstrained firms. This would lead to no or a smaller decline in a firm's set of positive NPV projects or to a smaller decline in after-tax cash flows that are available for investments.

¹⁰ Appendix A derives the relation between taxes, required rates of return, and the optimal level of capital stock more formally following standard neoclassical investment theory (Jorgenson 1963, 1967, Hall and Jorgenson 1967).

¹¹ There is another stream of literature questioning stronger investment-cash flow sensitivities of financially constrained firms due to e.g., precautionary saving motives (see e.g., Kaplan and Zingales 1997). For a discussion see Fazzari, Hubbard, and Petersen (2000) and Kaplan and Zingales (2000).

Therefore, the effect of financing constraints on a firm's investment response to tax rate changes is an empirical question.

I expect that tax avoidance possibilities mitigate the effect of taxes on investments. If firms engage in tax avoidance they have lower effective tax rates. This will translate into smaller effects of a change in tax policy on after-tax cash flows and required rates of return before taxes. Therefore, these firms should show lower tax rate elasticities of capital. Multi-jurisdictional firms are expected to engage in more tax avoidance than firms that operate in only one location because they have better tax planning possibilities, including e.g. profit shifting to lower tax jurisdictions.¹² Therefore, I expect lower tax elasticities of capital of multi-jurisdictional firms relative to single-jurisdictional firms (see also Simmler 2015; Dobbins and Jacob 2016).

H2: Firms with better tax avoidance possibilities show lower tax rate elasticities of capital.

On the other hand, multi-jurisdictional firms have the option to relocate capital to lower tax jurisdictions in case of a change in tax policy.¹³ This would translate into higher tax elasticities of capital of multi-jurisdictional firms. However, I assume that firms prefer to shift profits instead of relocating their production capacities as long as the cost associated with tax avoidance (higher uncertainty, reputational costs, agency costs, see e.g., Gallemore, Maydew, and Thornock 2014; Desai and Dharmapala 2009) do not exceed the cost for relocation.

Several studies examine the extent to which the corporate tax burden does not fall on the firm but is transferred to other stakeholders, such as employees or consumers via decreases in wages or increases in prices (see e.g., Harberger 1962; Krzyzaniak and Musgrave 1963; Dye 1998; Vasquez-Ruiz 2012; Arulampalam, Devereux, and Maffini 2012; Fuest, Peichl, and Siegloch 2015). Jacob and Müller (2016) who examine the effect of tax incidence on tax avoidance point out a potential mitigating effect of tax incidence on the responsiveness of investment or financing decisions to a change in tax policy. This study tests this proposition empirically. In particular, I examine whether firms that bear only a small fraction of the tax burden show lower tax rate elasticities of capital.

Price adjustments in response to a tax rate change assume that profit taxes are seen as costs of production.¹⁴ This would lead to a shift in the supply curve and therefore to an increase in

¹² For empirical evidence on profit shifting of multinational firms see e.g., Dischinger and Riedel 2011, Dharmapala and Riedel 2013).

¹³ Grubert and Slemrod (1998) show that the income shifting advantage is the predominant reason for capital investments of U.S. firms in Puerto Rico.

¹⁴ However, price increases in response to tax rate increases appear to contradict the traditional theory of price setting. First, in a perfectly competitive market, firms have zero profits and thus their production function cannot be affected by profit taxes. For a monopolist the profit maximizing price will not be affected by a change in profit taxes because price adjustments will lead to lower profits before taxation (otherwise, he would not

prices and a decline in demand. The degree of the price increase and the decline in demand (i.e., the effect on profits) depends on the elasticity of demand. Assuming inelastic consumer demand the shift in the supply curve will lead to a larger price increase and to a smaller decline in demand relative to a shift in case of a more elastic consumer demand. Put differently, a price increase leads to a higher tax incidence on consumers if the firm faces an inelastic demand. Thus, a tax rate change will have a smaller effect on a firm's after-tax profits if it faces an inelastic consumer demand. If a firm's cash flows are less affected by a tax change, I would expect lower investment responses to a change in tax policy.¹⁵

I provide analytical evidence for the role of demand elasticity in the relation between taxes and the optimal level of capital in Appendix A. Results suggest that the effect of taxes on the marginal product of capital are stronger in case of a more elastic demand. This implies increasing tax rate elasticities of capital with increasing elasticity of demand.

Wage adjustments in response to a change in tax policy follow e.g., the reasoning of the fair wage model that assumes wages to be a function of inter alia a firm's profits (see e.g., Akerlof and Yellen 1990). Therefore, shocks to profits such as an increase in tax liabilities will lead to adjustments in wages.¹⁶ The degree to which firms are able to adjust their wages in response to a tax rate increase depends on the labor supply elasticity, i.e., on the degree to which labor supply declines if wages are cut. In case of a less elastic labor supply, a cut in wages lead to a smaller decline in labor supply than in case of a more elastic labor supply. Thus, there is a smaller decline in the firm's surplus and a larger incidence on employees.

H3: Tax elasticities of capital are lower for firms that shift the tax incidence to their consumers or employees.

3. Institutional Background and Data

3.1 Institutional Background: Local business taxes in Germany

In Germany, the corporate tax burden for corporations comprises of a corporate income tax and a solidarity surcharge (5.5% of corporate income tax burden) that are levied at the federal

have maximized his profits before the change). However, the application of the profit maximizing approach has been questioned due to a lack of information on the marginal revenue function in reality where firms seem to maintain a target ratio of profits to sales (for a survey see e.g., Hall and Hitch 1939). In that case, price adjustments in response to a change in after-tax profits are possible (see also Goode 1945). Another reason for prices below the profit-maximizing optimum is that firms refrain from price increases because they are afraid that the price increase is not followed (see e.g., Goode 1945, Gordon 1967). Increases in tax rates could be understood as industry-wide signals that induces all firms to increase their prices (see Gordon 1967).

¹⁵ This is in line with e.g., Gordon (1967), p. 731.

¹⁶ For an extensive discussion of the different models that explain wage adjustments in response to tax rate changes see e.g., Fuest, Peichl, and Sieglöcher (2015).

level and a local business tax that is levied at municipality level. The legal framework for the computation of the taxable base for local business tax is set at the federal level and follows the computation of the taxable income for corporate income tax purposes. Some additions and deductions apply such as a limited deductibility of financing costs.¹⁷ The local business rate is computed as the product of a basic federal rate (*Steuermesszahl*) that is set at the federal level and a multiplier (*Hebesatz*) that is set by the council of each municipality during the budgeting process in the last three months of the previous period (see Fuest, Peichl, and Siegloch 2015). Multipliers range between 200% (legal minimum since 2004) and 530%, with an average of 400% in my sample which leads to local business tax rates between 7% and 19.7%.

The German Business Tax Reform Act of 2008 reduced the corporate income tax from 25% to 15% as well as the federal rate for local business tax from 5% to 3.5%. Moreover, it repealed the deductibility of local business tax from its own base and from corporate income tax. An example for the computation of the local business tax as well as the overall corporate tax rate before and after the reform is provided in Appendix C.

On average about 30 municipalities, Germany's smallest administrative unit, make up one of the 295 counties (*Kreise*) which represents the next larger administrative unit. Municipalities with more than 100,000 inhabitants (about 1% of all municipalities) usually make up their own county. The highest regional jurisdictions are the 16 federal states (*Bundesländer*).

3.2 Tax Rate Data

I exploit variation in local business tax rates across municipalities and over time. Figure 1 and Figure 2 provide an overview of the averages and changes in multipliers over time and across municipalities.¹⁸

[Insert Figure 1 and Figure 2 about here]

Figure 1 indicates that there is an increase in local business tax multipliers after 2009. While most of the changes represent tax rate increases, about 4% of all changes represent a cut in the multiplier.¹⁹ Table 1 gives an overview of the number of observations and tax changes per state.

[Insert Table 1 about here]

¹⁷ See Paragraph 8 and 9 of the Local Business Tax Act (GewStG).

¹⁸ The map shows that local business tax multipliers are especially high in Nordrhein-Westfalia. This is due to the fiscal equalization scheme that compensates municipalities for losses in tax revenues. The minimum multiplier that a municipality has to levy in order to receive compensation for a loss in tax revenue is the highest in this state. For details see e.g. Buettner (2006).

¹⁹ Tax competition with respect to local business tax rates is less strong due to fiscal equalization scheme that compensates municipalities for losses in tax revenues. See e.g. Buettner (2006).

While the frequency of tax rate changes is high (37% of the firms in the sample experience at least once a change in the multiplier), the size of the tax rate changes is rather small. The average increase in the multiplier amounts to 20 percentage points which translates into an increase in the overall corporate tax rate of 0.7 percentage points for periods after 2007. This is equal to 2.4% of the average corporate income tax rate for that period. The average reduction in the local business tax multiplier amounts to 18 percentage points.

In general, local business tax rates are higher in urban regions with high economic development such as Frankfurt (460% in 2014), Hamburg (470% in 2014) or Munich (490% in 2014). This relation can also be observed in the data. Panel A of Figure 3 shows that counties in the lowest quartile of GDP per capita also levy the lowest multipliers on average.

[Insert Figure 3 about here]

However, changes in economic conditions are not correlated with changes in local business tax rates. Panel B of Figure 3 suggests that the number of increases in local business tax multipliers is independent of local GDP growth (measured at county level). While I observe slightly more increases in local business taxes for the lowest quartile of GDP growth regions in 2009 and slightly less increases in 2011, the overall number of increases between the different quartiles of GDP growth follow a common trend over the observations period. This is in line with prior literature on German local business tax which suggests that tax rates are usually not changed in response to local business cycle shocks (see e.g. Fuest, Peichl, and Siegloch 2015).²⁰ Foremny and Riedel (2014) provide evidence that local business tax rates vary with changes in the political environment, such as the election cycle. Moreover, changes in the fiscal equalization scheme, which is set at the state level and which requires municipalities to levy a minimum multiplier in order to receive compensation for a loss in tax revenues, could induce changes in multipliers (see e.g., Buettner 2006). This reduces concerns that tax policy changes are accompanied by structural changes in the economy which could lead to biased parameter estimates for the tax rate effect because estimates would also reflect firm responses to the change in the economic conditions (e.g. higher investments in response to an increase in investment opportunities). I will further address these concerns in my empirical model by limiting counterfactuals to firm-years from the same county and year.

Throughout the study I will use changes in the overall statutory corporate tax rate (sum of corporate income tax, solidarity surcharge and local business tax) to identify capital responses to tax rate changes. This provides cleaner estimates for the tax rate elasticity of capital than

²⁰ In particular, they show that neither unemployment nor GDP or fiscal surplus change prior to changes in local business tax rates.

using changes in local business tax multipliers that have different effects on the overall corporate tax rate before and after 2008. Changes in the overall statutory tax rate are all induced by changes in local tax rates. Moreover the overall statutory tax rate declined in 2008 due to the corporate tax reform that reduced both, the federal corporate income tax rate as well as the basic federal rate for the local business tax. In addition, the repeal of the deductibility of the local business tax from its own base as well as from the corporate income tax base had an effect on the overall statutory tax rate. While year fixed effects eliminate the average change in the overall statutory tax rate for all observations, firms are affected heterogeneously depending on their location, i.e., their local business tax burden.

3.3 *Firm-level Data*

Firm-level data (financial statements and ownership information) are provided by the Amadeus database. Financial statement and income statement information is available for a sample of 624,425 firm-years from 2004–2014. I exclude financial and utility firms (123,541 observations) because they are subject to different regulatory and reporting requirements that could cause different investment behavior. I can merge information on local business tax rates for 457,611 firm-years.²¹ I exclude sole proprietorships and partnerships with an individual as the major shareholder (30,722 firm-years) for two reasons. First, there is no reliable estimate for the overall statutory tax rate that the firm faces because profits will be subject to the owner's personal income tax rate which depends on other income of the individual owner. Second, I expect these firms to be less responsive to local business tax changes because local business tax can be (partly) credited against the personal income tax.²² Moreover, I exclude observations for which I do not have data on all variables (fixed assets, sales growth, age, wage expense, sales, cash holdings, liabilities, EBIT, local business tax rate, local property tax rate). My regression design with firm fixed effects requires at least two observations per firm. Since fixed effects subtract the mean of each variable, the coefficient on the tax rate would not be identified otherwise. The final sample covers 111,392 firm-years from 3,897 different municipalities during 2005–2014. Table 2 provides descriptive statistics of the sample.

[Insert Table 2 about here]

²¹ Missing tax information is often due to several area reforms.

²² Before 2008, local business tax could be credited up to a multiplier of 180%. Starting in 2008, local business tax can be credited up to 380%.

3.4 Multi-plant firms

One potential concern of my research design is related to firms with plants in multiple jurisdictions because I can only observe the municipality in which the firm is registered. There is no information on the amount and location of other production plants. However, a production plant usually represents a permanent establishment and is thereby subject to the local business tax rate that is levied in its location. Thus, firms with multiple plants in different jurisdictions could potentially downward bias my estimates because if a firm undertakes parts of its activity in permanent establishments outside the headquarter's municipality, I will observe lower investment elasticities to tax rate changes at the headquarter location. However, the amount of firms that have multiple establishments appears to be small. According to the Monthly Survey of Plants in Manufacturing and Mining (*Monatsbericht für Betriebe im Verarbeitenden Gewerbe sowie Bergbau und Gewinnung von Steinen und Erden*), the majority of manufacturing firms with more than 20 employees are single-plant firms (see also Becker, Egger, and Merlo 2012). Moreover, the Statistical Report on the German Local Business Tax 2010 (*Gewerbsteuerstatistik*) states that out of 3.3 million only 161,315 businesses (5%) had more than one permanent establishment.²³

4. Empirical approach

To study the effect of taxes on a firm's capital stock, I compare a firm's fixed assets before and after changes in local business taxes to the development of capital of other firms in the same county and year that did not face a tax rate change. $\ln(\text{Fixed Assets})_{i,t} = \alpha_0 + \beta_1 \ln(\text{Tax Rate})_{m,t} + \beta_2 \ln(\text{Property Tax})_{m,t} +$

$$\sigma \chi_{i,t-1} + \alpha_{t,n} + \alpha_i + \varepsilon_{i,t}. \quad (1)$$

where i , m , n , and t index firms, municipalities, counties and years. *Fixed Assets* include tangible and intangible assets and other fixed assets such as long-term investments, shares and participations, or pension funds. *Tax Rate* represents the overall statutory tax rate (sum of corporate income tax, solidarity surcharge and local business tax) that varies across municipalities and over time.²⁴ I include the logarithm of the tax rate to compute direct elasticity estimates. I also include the logarithm of a municipality's property tax rate to control for changes in capital that are due to (simultaneous) changes in the property tax rate.

²³ See https://www.destatis.de/DE/Publikationen/Thematisch/FinanzenSteuern/Steuern/Gewerbsteuer/Gewerbsteuer2141020109004.pdf?__blob=publicationFile, p.35.

²⁴ For the computation of the corporate tax rate see Appendix C.

χ is a vector of control variables that comprises of controls for firm-level investment determinants (*Start-Up*, *Sales growth*, $\ln(\text{Sales})$, $\ln(\text{Wage})$, and in some specifications also $\ln(\text{EBIT})$, $\ln(\text{Cash})$, $\ln(\text{Liabilities})$). I include the lagged values of $\ln(\text{Sales})$, $\ln(\text{Wage})$, $\ln(\text{EBIT})$, $\ln(\text{Cash})$, and $\ln(\text{Liabilities})$ because contemporaneous values could be affected by tax rate changes. Higher levels of sales and wage in the proceeding period are associated with higher capital in year t . Therefore, I expect positive coefficients on $\ln(\text{Sales})$ and $\ln(\text{Wage})$. *Start-Up* is an indicator variable equal to one if the firm was registered for less than five years and *Sales growth* is measured as the average percentage change in sales and captures investment opportunities. While I expect a negative sign for *Start-Up* (young firms have less capital than mature firms), I expect a positive sign for the coefficient on sales growth since increases in sales (investment opportunities) lead to more capital expenditures. To control for the availability of internal funds, I include the lagged logarithm of *Cash*, *EBIT*, and *Liabilities* respectively and expect the coefficients to be positively associated with a firm's capital.

In addition to controls for observable firm characteristics, I include firm fixed effect (α_i) that remove all unobservable firm specific factors that affect investment decisions over all sample years. With this, I compare the average capital stock of a firm before a tax rate change to the average capital stock after the reform.²⁵ By including county-year fixed effects ($\alpha_{n,t}$), I restrict my counterfactuals only to firm-years of the same county.²⁶ This addresses concerns of differences in regional economic developments that are correlated with tax rate changes and could also reduce concerns that tax enforcement varies across regions.²⁷ I cluster standard errors at the municipality which allows correlation of standard errors across time and firms within municipalities.

5. Results

5.1 Baseline results

Column 1 of Table 3 reports coefficient estimates for regressions of the logarithm of fixed assets on the logarithm of the overall statutory tax rate without any firm controls. Consistent

²⁵ While multiple tax rate changes per firm may prevent clean estimates for the tax rate effect on capital, I note that my results are robust if I exclude firms with multiple tax rate changes.

²⁶ Note that in this case, the identification of the tax rate variable stems only from those municipalities that do not make up their own county (i.e. municipalities with no more than 100,000 inhabitants). My results are robust to using state-year (industry-year) fixed effects, i.e. to limiting counterfactuals to firms of the same state (industry) and year.

²⁷ This holds if firms in the same county are audited by the same tax office. This would not be the case e.g., in larger cities which usually have more than one tax office. However, if one assumes that the level of enforcement follows a general policy set at the state level, county-year fixed effects can mitigate concerns of different levels of tax enforcement.

with prior literature, I find a negative effect of tax rates on a firm's capital stock. Increases in the tax rate by 1% lead to a decline in capital stock relative to firms operating in the same county equal to 0.97% in the long-term.

[Insert Table 3 about here]

At a first glance, this effect seems very high. A 1% increase in the tax rate (increase by 0.31 percentage points for the median firm) will lead to an increase in the tax bill of about 1,289 € (taking EBIT as a proxy for a firm's taxable income). Results suggest that this would lead to a decline in fixed assets equal 8,467 € (0.0097*873,000 €) for the median firm relative to firms operating in the same county. However, with my model, I do not only capture the decline in fixed assets in the following period but the average decline in fixed assets for all periods following the tax rate change. Thus, if the firm cuts its capital expenditures each year by the amount of additional tax payments, the decline in fixed assets will be larger than the short-term investment effect of tax rate changes.

Including controls for the lagged logarithm of a firm's wage expense and sales as well as sales growth to capture for investment opportunities and a dummy variable for start-up firms (registered for less than five years) in column (2) leads to slightly lower coefficients. Further including lagged controls for a firm's availability of internal funds reduces the tax rate coefficient to 0.91 (column 3). While the sign of all control variables is in line with prior literature, most control variables show very high correlations which makes the interpretation of the size of the control variables more difficult. While firm and county-year fixed effects lead to very high adjusted R² values (0.95) in all specifications, the within R² increases from 0.0002 to 0.068 when including additional firm controls.

To see how fixed capital responds to tax changes over time, I estimate the following dynamic specification of equation (1) in a five-year window around the tax change.

$$\Delta \ln(\text{Fixed Assets})_{i,t} = \alpha_0 + \sum_{i=-2}^2 \beta_i \Delta \ln(\text{Tax Rate})_{m,t+i} + \beta_{2,t} \ln(\text{Property Tax})_{m,t} + \alpha_{t,n} + \alpha_i + \varepsilon_{i,t}. \quad (2)$$

As opposed to the baseline model with firm fixed effects, I estimate this specification using first-differences to better identify the timing of the capital response. The results are reported in Table 4. While Panel A includes firm fixed effects that control for the firm's average change in fixed assets over the observation period, Panel B presents regression results of the first-difference estimation without firm fixed effects.

Both estimations reveal that most of the capital adjustments to tax rate changes occur in the period before the actual tax change. This could be explained by anticipation effects because local business tax rates are usually set during the budgeting process in the last three months of the previous period (see Fuest, Peichl, and Siegloch 2015). If firms learn about the tax change before the fiscal year end of the previous year, it is very likely that this affects their investment decisions in that period. The coefficients in year t and $t-1$ reveal that there are no reversals of the investment response. Moreover, the findings support the parallel trends assumption which requires similar trends in the outcome variable between treatment and control group in the absence of the treatment effect.

[Insert Table 4 about here]

I next run a placebo test to corroborate the validity of my baseline approach by showing no or lower capital responses of firm for which I expect no or lower effects. I expect lower sensitivities for loss firms because they are not paying taxes in the current period and in the following periods where loss carryforwards shield the firm's profits from taxation.²⁸ Since after-tax cash flows and thereby net present values of investment projects of loss firms are less affected, their capital expenditures are expected to be less dependent on taxes. To test this, I construct a dummy variable (*Loss*) equal to one for firms that report negative EBIT in year t and I interact *Loss* with $\ln(\text{Tax Rate})$. I include both variables in my baseline regression and in line with my expectations, I find a positive coefficient for the interaction between *Loss* and *Tax Rate*. That is, I find a weaker relation between tax rates and capital stock for loss firms. The fact that loss firms show tax rate elasticities different from zero could be explained by a change in the net present value of long-term investment projects. If the loss firm expects to return to profitability during the investment period and to use up all its loss carryforward, the higher tax rate will reduce future after-tax cash flows and thereby the net present value of investment projects.

[Insert Table 5 about here]

5.2 *Robustness of Baseline results*

Robustness of the baseline results to different specifications are reported in Table A.2. Panel A shows robustness of the results to including the tax rate in levels instead of logs. Since a one percentage point increase in the tax rate equals an increase of about 3% of the average tax rate

²⁸ At least up to profits of 1 million €. Only 60% of profits exceeding 1 million € can be offset with loss carryforwards according to the German loss offset provisions, see Paragraph 10a Local Business Tax Act (GewStG).

(32%), I expect the size to be about three times the size of the coefficient of Table 3. Results are in line with this notion and suggest that a one percentage point increase in the tax rate leads to a decline in capital stock equal to 2.9–3.3%.

The inclusion of county-year fixed effects excludes tax rate changes that occur in municipalities with more than 100,000 inhabitants that usually form their own county (“*Kreisfreie Städte*”). I therefore test the robustness of my results to the inclusion of state-year instead of county-year fixed effects in Panel B of Table A.2. With this approach I broaden the control group to firms that operate in the same state (*Bundesland*). I include the unemployment rate at the county-level to control for regional differences in economic conditions. With this approach, the elasticity estimates range between 0.73% and 0.8%.²⁹ This suggests long-term declines in fixed assets of up to 6.984 € for the median firm following a tax rate increase of 1%.

In Panel C of Table A.2 I estimate the baseline model with industry-year instead of county-year fixed effects. With this approach, changes in capital stock of firms that experienced a tax rate change are compared to the change in capital stock of firms that operate in the same industry (using Fama & French 48 industry classifications) and year. I control for changes in differences in regional economic conditions by including additional state-level (logarithm of GDP and GDP growth) and county-level (unemployment rate) control variables. With this approach, elasticity estimates range between 0.58% and 0.69%, which suggests long-run capital declines of up to 6,023 € for the median firm after a tax rate increase by 1%.

Table A.3 shows regression results when using the logarithm of investments (change in fixed assets before depreciation) as the dependent variable. The size of the effect is smaller than in previous regressions. The tax rate elasticity of investments of 0.9 (column 3) suggests that an increase in the tax rate by 1% decreases investments by 0.9% in the long run. Thus, a tax rate increase by 0.31 percentage points (higher tax payments of 1,289 €) will lead to an average decline in capital expenditures equal to 878 € ($97,601 \cdot 0.009$) in the following periods. Put differently, each additional euro of tax payments will lead to a decline in capital expenditures relative to other firms operating in the same industry equal to 68 cents.

5.3 *Financial constraints*

In this section I test for heterogeneity in capital response to tax rate changes. Following my initial hypothesis, I expect stronger elasticities for financially constrained firms. There are numerous measures to capture financial constraints such as the dividend payer status (Fazzari,

²⁹ Results are very similar when controlling for state-industry-year fixed effects instead.

Hubbard, and Petersen 1988), the KZ Index (Kaplan and Zingales 1997), or the WW Index (Whited and Wu 2006) in the literature. While my data does not allow me to construct most of these variables and while their validity has been questioned in the recent literature (e.g., Farre-Mensa and Ljungqvist 2016), I focus on an indirect measure that relies purely on size and age, two characteristics that are less endogenous than other sorting factors such as leverage or cash holdings (Hadlock and Pierce 2010). However, the suitability of the parameter estimates of the SA Index for my private firm data is questionable because their estimations are based on a sample of U.S. listed firms.³⁰ Therefore, I construct a dummy variable, *FC*, equal to one for firms that are in the lowest tertile of total assets and age. With this definition I identify about 18% of the sample firms as being financially constrained. I exclude loss firms because they are likely to be identified as being financially constrained.³¹ This is because, as discussed above, I expect weaker elasticities for loss firms because they are not paying taxes. Table 6 provides evidence for stronger elasticities of capital to tax rates for financially constrained firms. The results suggest that elasticities of financially constrained firms are about half times larger than that of unconstrained firms.³² Thus, the results suggest that potential higher levels of tax avoidance of financially constrained firms (see e.g., Law and Mills 2015, Edwards, Schwab, and Shevlin 2016) that would lead to a lower responsiveness do not outweigh the stronger responsiveness due to higher investment- cash flow sensitivities.

[Insert Table 6 about here]

5.4 Tax avoidance

I next examine the role of tax avoidance in the relation between tax rates and capital stock. I expect larger elasticities of firms that operate in only one taxing jurisdiction (single-jurisdictional firms) because they have less tax avoidance possibilities and therefore higher effective tax rates. To test this, I set the indicator variable *SingleJuris* equal to one for firms that are either stand-alone (75%) or belong to a corporate group that operates in only one municipality (25%) and I interact *SingleJuris* with the logarithm of *Tax Rate*. I exclude firms for which no ownership information is available from this regression. In line with my expectations, I find stronger elasticities of firms that operate in only one taxing jurisdiction which supports the notion that this is due to better tax avoidance possibilities of multi-jurisdictional firms. In fact, capital elasticities of single-jurisdictional firms appear to be about

³⁰ For similar concerns regarding the suitability see e.g., Erel, Jang, and Weisbach (2015).

³¹ However, results are robust to the inclusion of loss firms.

³² The results are robust if I run this test only for multi-jurisdictional firms to address concerns that Table 5 and Table 6 capture the same effect.

half times larger compared to that of multi-jurisdictional firms.³³ Thus, while multi-jurisdictional firms may relocate their investments in response to tax rate changes which would result in higher tax rate elasticities, lower responsiveness due to better tax avoidance opportunities outweigh this effect. This could be explained with higher cost of relocating investments relative to tax planning. Moreover, the tax rate elasticity for the response of single-jurisdictional firms can be interpreted as an estimate for the change in a firm's scale of investments in response to tax rate changes as the effect cannot be explained with capital relocations for these firms.

[Insert Table 7 about here]

My findings are in line with e.g., Simmler (2015) and Dobbins and Jacob (2016) who provide evidence for lower investment responses of multinational than domestic group firms to a tax rate cut in Germany. Moreover, my results support findings by Fuest, Peichl, and Siegloch (2015) who show that plants of a multi-plant firm show less wage adjustments in response to local tax rate changes because they have better tax avoidance possibilities.

Given the stronger effects for small and young firms (Table 6) and the fact that single-jurisdictional firms are on average smaller than multi-jurisdictional firms, one concern could be that I capture the size difference between single-jurisdictional and multi-jurisdictional firms with this test and that my findings could thus be explained with the difference in financial constraints.³⁴ While I control for differences in size (and other time-varying observable firm characteristics) across single-jurisdictional and multi-jurisdictional firms parametrically in columns 2 and 3, I further address this concern with a matching approach that reweights observations according to their comparability with firms of the other group or restricts my sample to similar firms. Results are reported in Table A.4. In Panel A, I use entropy balancing to assign weights to single-jurisdictional and multi-jurisdictional firms based on their comparability to the other group with respect to observable firm characteristics (all firm controls used in column 3) in each year. I rerun the regression from Table 7 by weighting each observation according to its comparability with observations of the other group. In Panel B, I use propensity score matching in each industry to match a firm that belongs to a multi-jurisdictional group to a single-jurisdictional firm with similar observable firm characteristics. I do the matching for 2010 based on all firm control variables of column 3 and then use every

³³ Results are robust if I exclude loss firms to address concerns that I observe stronger responses of single-jurisdictional firms because they are more likely to incur losses.

³⁴ I note that this test does not address the concern that stand-alone firms generally face higher financial constraints relative to group firms with access to intercompany financing (see e.g., Hoshi, Kashyap, and Scharfstein 1990).

observation for a matched firm in 2010 also in other years.³⁵ I rerun the regression of Table 7 with this smaller sample. Both approaches lead to results that are very similar to the main results in Table 7.

I further examine whether there are differences in tax elasticities of capital stock between domestic and multinational group firms. Following the argumentation above, I would expect stronger responses of domestic group firms to local tax rate changes because multinational firms can additionally reduce their tax burden via profit shifting between countries. While the coefficient on the interaction between *Domestic* (indicator variable equal to one for firms that belong to a corporate group that has operations in different municipalities in Germany but no foreign operations) and the logarithm of *Tax Rate* indicates stronger responses of domestic group firms, I do not find joint significance of the sum of the logarithm of the tax rate and the interaction (see Online Appendix Table A.5).

5.5 *Tax incidence*

I next examine the role of tax incidence in the relation between taxes and capital. Unfortunately, I can only rely on indirect proxies to measure the extent to which firms transfer the additional tax burden to their consumers or employees because I do not observe prices and individual wages per worker.³⁶ Therefore, I follow prior literature and use profit margins as a proxy for a firm's ability to transfer the tax incidence to its stakeholders. Following e.g., Lerner (1934), Kubick et al. (2015), Jacob, Michaely, and Müller (2016) and Jacob and Müller (2016) I assume that firms with high profit margins have more market power which suggests that they face a less elastic demand. Thus, a price increase will lead to lower declines in demand relative to other firms. Moreover, Fuest, Peichl, and Siegloch (2015) show that firms with high profit margins transfer more of the additional tax burden to their employees. This follows the reasoning of the fair wage models that assumes wages to be a function of inter alia the firm's profits (see e.g., Akerlof and Yellen 1990). Therefore, shocks to profits such as increases in tax liabilities will lead to stronger wage adjustments in profitable firms. To test this, I exclude loss firms ($EBIT < 0$) and then construct an indicator variable, *High Margin*, equal to one for firms that report profit margins (earnings before interest, tax, depreciation, and wages relative to sales) in the highest tertile of their industry-year group. I include *High Margin* and an

³⁵ The drawback of this approach is that I may include an observation in the sample in years in which I have no observation for the matching partner of 2010. However, as opposed to a matching approach that matches firms in each industry-year, this approach ensures that I have sufficient time-series data for each firm.

³⁶ I have data on the wage expense of the firm and the number of employees. However, changes in the wage per employee could as well be due to changes in working hours or the replacement of blue collar with white collar workers.

interaction of *High Margin* with $\ln(\text{Tax Rate})$ in my baseline regression. Results are reported in Table 8. In line with my hypothesis, I find a weaker relation between tax rates and capital for firms with higher profitability.³⁷ Capital elasticities of firms with high profit margins equal about two thirds of capital elasticities of other firms. To address concerns that high profit margins negatively correlate with financing constraints, I test the robustness of my results for a sample excluding firms that I defined as financially constrained in section 5.2 (firms with total assets and age in the lowest tertile) and find very similar results.

Thus, my findings are in line with the notion that firms with higher profitability are better able to shift the additional tax burden to either their consumers or employees and therefore show lower capital elasticities to tax rate changes.

[Insert Table 8 about here]

In additional tests, I examine the tax incidence on employees in more detail. As suggested in my hypothesis development, I expect lower tax rate elasticities in case of an inelastic labor supply because in that case firms are better able to shift the tax burden to their employees via an adjustment in wages. Following Jacob and Müller (2016), I measure a firm's labor supply elasticity with the share of blue collar workers. Fuest, Peichl, and Siegloch (2015) show that firms are more likely to cut wages of blue collar workers because they are less mobile, i.e. show lower labor supply elasticities than white collar workers who are better able to find employment in another firm and therefore have more negotiation power in the wage setting process. Therefore, I would expect lower capital elasticities for firms operating in industries with low average wages. To test this, I construct an indicator variable equal to one for firms that operate in an industry with a median wage-to-sales ratio in the lowest tertile.³⁸ I aggregate the data at the industry level because I assume that the ratio of blue collar to white collar workers depends mostly on the industry. The drawback of this measure is that it may not only capture firms with blue-collar (low wage) workers, but also captures firms operating in industries with a lower ratio of labor input to capital input. However, for example for manufacturing firms this coincides with a higher degree of blue collar workers. Alternatively I use the median wage-to-employee ratio as a proxy for a firm's average wage per employee. The drawback of this measure is that it does not take different working hours into account. The higher the number of employees with less than a full position, the more likely it is that the firm is falsely identified

³⁷ These findings could as well be explained by higher tax avoidance of firms with high market power (high profit margins) as suggested by Kubick et al. (2015) because these firms have more persistent profitability resulting from their product market power. However, Jacob and Müller (2016) find less tax avoidance of firms with high profit margins suggesting that they are better able to transfer the economic tax burden.

³⁸ Results are robust to using means instead of medians.

as a low wage firms. Moreover, the number of employees appears to be rather imprecise (rounded) because the variable is clustered around numbers ending on 5 or 10. Results reported in Table 9 indicate lower capital responses of firms operating in industries with lower wage expense. While the results are very significant when using the wage-to-sales ratio to sort firms into low and high wage firms (Panel A), results are weaker for the wage-per-employee ratio (Panel B), which could be explained with the imprecision of this measure as explained above. Overall, the result are in line with the notion that firms show lower capital responses because they shift part of the economic tax burden to their employees.

[Insert Table 9 about here]

6. Conclusion

This study sheds light on the heterogeneity in tax rate elasticities of capital of private firms. The strength of studying local business tax reforms to analyze investment responses lies in the high internal validity of this approach. It allows me to disentangle tax rate and tax base effects and to compare similar firms within the same geographic region which are likely to face the same economic and legal conditions. Assuming similar trends in investments behavior in the absence of a tax rate change, this allows causal inferences about the relation between tax rates and investments.

My results suggest that a tax increase by 1% translates into a long run decline in fixed assets by up to 0.97%. In line with prior literature that shows larger investment-cash flow sensitivities of financially constrained firms, the results suggest that tax-induced changes in capital are up to half times larger for financially constrained (small and young) firms relative to unconstrained firms. Thus, potential higher levels of tax avoidance of financially constrained firms (see e.g., Law and Mills 2015, Edwards, Schwab, and Shevlin 2016) that would lead to a lower responsiveness do not outweigh the stronger responsiveness due to higher investment-cash flow sensitivities.

Moreover, firms with more tax avoidance possibilities (multi-jurisdictional firms) show lower capital elasticities to tax rate changes. That is, capital elasticities of single-jurisdictional firms are about half times larger than that of multi-jurisdictional firms. While capital declines of multi-jurisdictional firms could be explained with a relocation of capital to lower tax jurisdictions, lower investments of single-jurisdictional firms usually represent a decline in a firm's operations. While both outcomes lead to a loss in capital investments for each taxing jurisdictions, a decline in a firms overall operations represents a loss in overall corporate investments for the economy as a whole.

Finally, I find a weaker relation between taxes and capital stock for firms with high market power and for firms operating in industries with low wage expense which suggests that these firms may transfer the additional tax burden to their consumers via an increase in prices or to their employees via a cut in wages following tax rate increases. While my findings are in line with the notion that firms with a better ability to shift the tax burden to either their consumers or employees actually do so and therefore show lower tax rate elasticities of capital, I note that my analysis is limited to very indirect measures and should therefore be interpreted with caution. Finding more exogenous settings to test this relation could be an interesting path for future research.

My results have important policy implications because they can help policy makers to understand cross-sectional differences in the responsiveness of corporate investments to changes in tax policy. My findings imply that a tax rate cut, as suggested by the U.S. president in 2016 will especially foster investment activity of small and young firms as well as investments of single-jurisdictional firms, i.e., firms with less tax avoidance possibilities and firms with less market power. However, as pointed out by Ljungqvist and Smolyansky (2014), I acknowledge that the external validity of my study could be limited to the extent to which there are interactions between federal tax policy and other economic conditions that are held constant in the local setting. The authors suggest that a federal tax reform could induce central banks to change their monetary policy which changes interest rates and inflation expectations that affect investment decisions of different firm types differently. Developing a structural model to control for these interactions goes beyond the scope of this study and is therefore left to future research.

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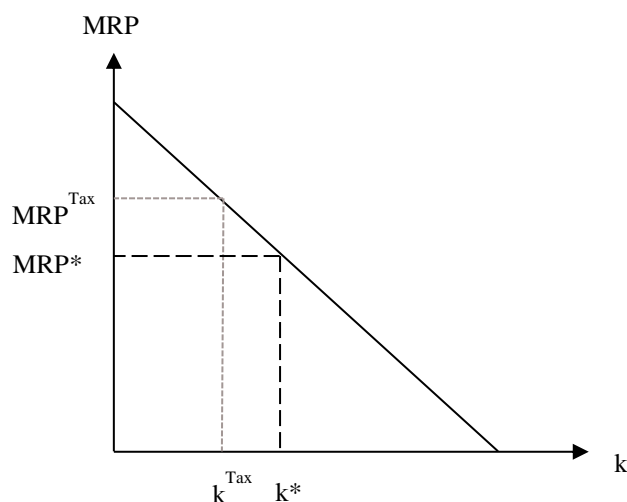
APPENDIX A³⁹

In this section, I provide more formal evidence for

- (i) the negative effect of tax rates on the required marginal product of capital, and
- (ii) the mitigating role of consumer demand elasticity in the relation between taxes and the required marginal product of capital.

Choosing the optimal level of capital

According to standard neoclassical investment theory (Jorgenson 1963, 1967; Hall and Jorgenson 1967) firms choose their optimal level of capital (k^*) where the marginal revenue product (MRP) of capital equals the user cost of capital (required rate of return) (r). The marginal revenue product represents the product of the output price (p) and the firm's marginal product of capital (MP). Taxes increase the required return for each additional unit of capital.



(i) Marginal product of capital and income taxes

Let us assume a producer with market power who can influence the market price (p) with his output $Y(k, l)$. He pays a wage (w) for each unit of labor (l) and r for each unit of capital (k). An income tax is levied on revenues net of wage expense and capital costs. Capital costs are deductible at a rate $1 - \alpha$.

Demand for capital stock (k) is determined to maximize profits (Π):

$$\Pi = \underbrace{p(Y(k, l)) \times Y(k, l)}_{\text{Revenue}} - \underbrace{wl - rk}_{\text{Labor and capital costs}} - \underbrace{t [p(Y(k, l)) * Y(k, l) - wl - (1 - \alpha)rk]}_{\text{Tax expense}}$$

³⁹ I am thankful to Michael Devereux who helped developing this section.

$$\frac{\partial \Pi}{\partial k} = \frac{\partial p}{\partial Y} Y_k Y + p Y_k - r - t \left[\frac{\partial p}{\partial Y} Y_k Y - (1 - \alpha)r \right] = 0$$

Rearranging for the profit maximizing marginal product of capital (Y_k) yields:

$$\Leftrightarrow (1 - t) \left[Y_k \left(p + Y \frac{\partial p}{\partial Y} \right) - r[(1 - t)(1 - \alpha)] \right] = 0 \mid \varepsilon = -\frac{Y}{p} \frac{\partial p}{\partial Y}$$

$$\Leftrightarrow (1 - t) p Y_k (1 - \varepsilon) - r[1 - t(1 - \alpha)] = 0$$

$$\Leftrightarrow Y_k = \frac{r(1 - t(1 - \alpha))}{(1 - t) p (1 - \varepsilon)} > 0$$

With $0 > r < 1$, $0 > \varepsilon < 1$, $0 > t < 1$, $0 > \alpha < 1$, and $p > 0$ the marginal product of capital is increasing with corporate income tax. Thus, increasing corporate tax rates, increases the marginal revenue (the marginal product) that each additional unit of capital must yield in order to equal marginal costs. If the marginal product of capital increases, the optimal level of capital (k) decreases.

(ii) The role of demand elasticity in the relation between the marginal product of capital and taxes

To examine the role of demand elasticity (ε) in the relation between taxes and the marginal product of capital, I further differentiate Y_k with respect to t .

$$\frac{\partial Y_k}{\partial t} = \frac{-r(1 - \alpha)}{(1 - t) p (1 - \varepsilon)} + \frac{r(1 - t)(1 - \alpha)}{p(1 - \varepsilon)(1 - t)^2}$$

$$\frac{\partial Y_k}{\partial t} = \frac{-r(1 - t(1 - \alpha)) - r(1 - \alpha)(1 - t)}{p(1 - \varepsilon)(1 - t)^2}$$

$$\frac{\partial Y_k}{\partial t} = \frac{\alpha r}{p(1 - \varepsilon)(1 - t)^2} > 0$$

With $0 > r < 1$, $0 > \varepsilon < 1$, $0 > t < 1$, $0 > \alpha < 1$, and $p > 0$, the effect of corporate income tax (t) on the marginal product of capital is increasing with the demand elasticity. Thus, the more elastic the consumer demand (the more of the tax incidence falls on the producer), the stronger is the effect of a change in tax policy on the marginal product of capital and thereby the level of optimal capital stock.

APPENDIX B

Variable Descriptions

Variable	Definition
Firm-level variables	
<i>Age</i>	Age of firm measured as the time period between t and the date of incorporation.
<i>Cash</i>	Cash holdings.
<i>Domestic</i>	Firm belongs to a domestic corporate group that operates in more than one municipality.
<i>EBIT</i>	Earnings before interest and taxes.
<i>Fixed Assets</i>	Fixed assets include tangible and intangible assets and other fixed assets such as long term investments, shares and participations, or pension funds.
<i>Liabilities</i>	Long-term and short-term liabilities.
<i>MNE</i>	Firm belongs to a multinational corporate group.
<i>Profit margin</i>	Earnings before interest, tax, depreciation, and wages relative to sales.
<i>Sales growth</i>	Average percentage change in sales, winsorized at 1% and 99%.
<i>SingleJuris</i>	Firm is either stand-alone or belongs to a domestic group that operates in only one municipality.
<i>Start-Up</i>	Dummy variable equal to one if the firm was registered for less than five years.
<i>Wage</i>	Wage expense.
Country- and industry-level variables	
<i>GDP growth</i>	Annual percentage change in <i>GDP</i> .
<i>Ln(GDP)</i>	Logarithm of the <i>GDP</i> measured at state level in year 2010 real euros (in billions).
<i>Local Property Tax</i>	Multiplier for local property taxes that is set at municipality level.
<i>Tax Rate</i>	Overall statutory corporate tax rate including corporate income tax (“Koerperschaftssteuer”), solidarity surcharge (“Solidaritaetszuschlag”), and local business tax (“Gewerbsteuer”).
<i>Unemployment</i>	Unemployment rate at county (“Kreis”) level.

APPENDIX C

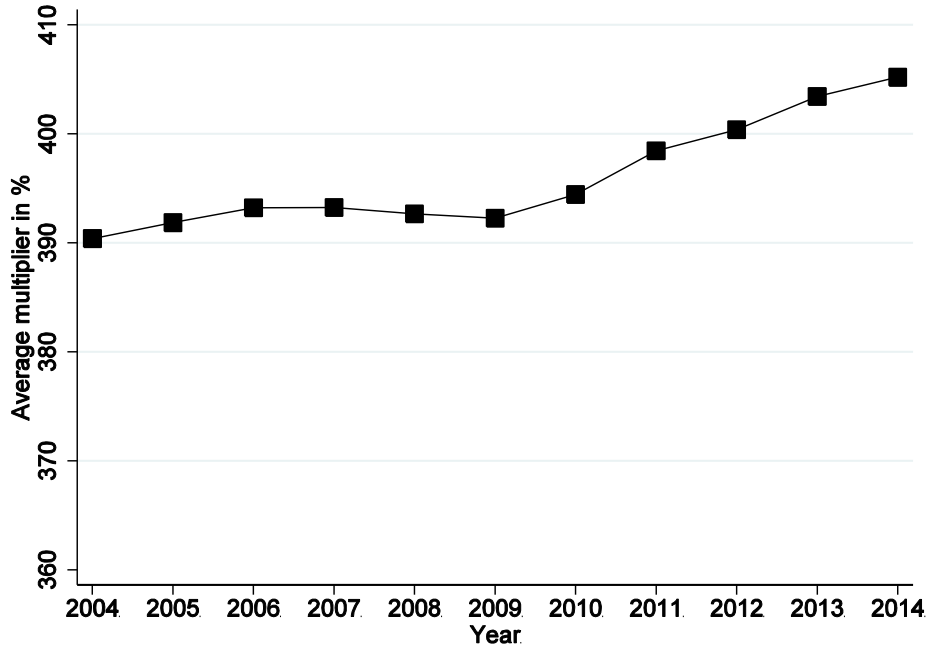
The following table gives an overview of the computation of the local business tax and overall corporate income tax burden before and after the 2008 Business Tax Reform.

Before	After
<i>Computation of the Local Business Tax (LBT):</i>	
$\frac{\text{Multiplier} * 5\%}{1 + (\text{Multiplier} * 5\%)}$	$\text{Multiplier} * 3.5\%$
<i>Computation of the Overall Statutory Tax Rate:</i>	
$25\% \times (1 - \text{LBT}) \times (1 + 5.5\%) + \text{LBT}$	$15\% \times (1 + 5.5\%) + \text{LBT}$

Figure 1: Local Business Tax Multiplier over time

This figure plots the average local business tax multiplier for all firms of the sample from 2005–2014 (Panel A). Panel B plots the number of changes in the multiplier from 2005–2014.

Panel A: Average Multiplier



Panel B: Changes in Local Business Tax multiplier (frequency)

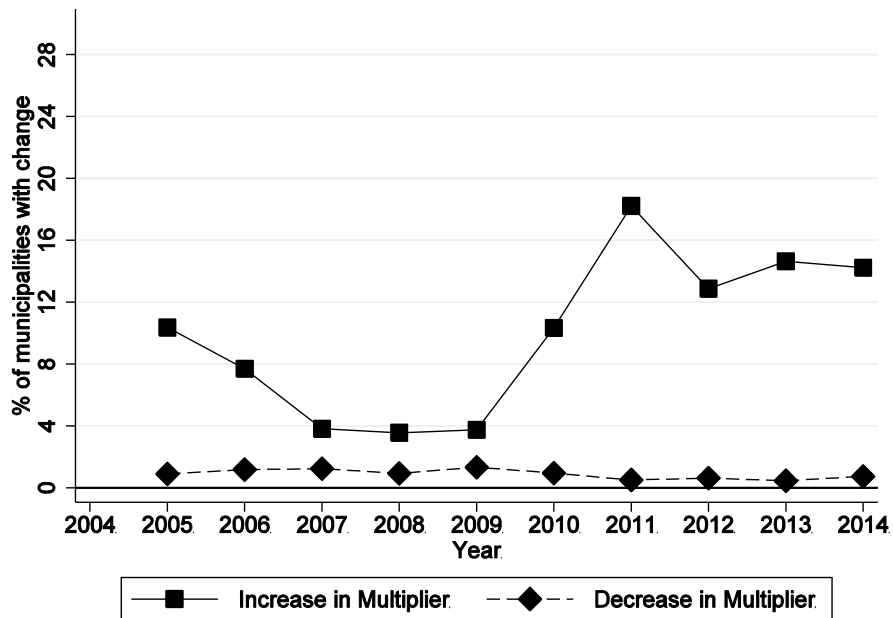
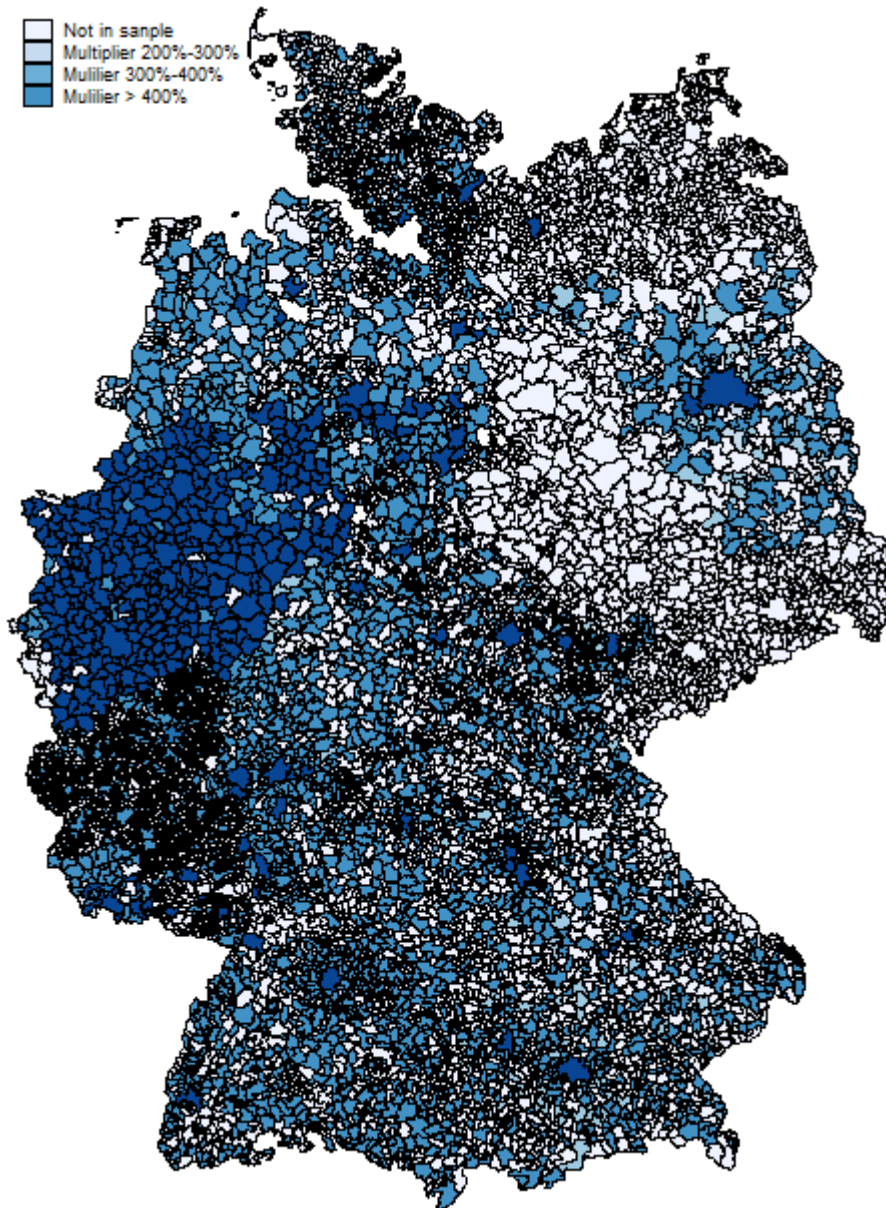


Figure 2: Local Business Tax Multipliers across municipalities

Panel A: Multipliers across municipalities

This map shows the average multiplier of each municipality that is part of the sample from 2005–2014.



Panel B: Changes in multipliers

This map shows changes in the *Multiplier* of each municipality that is part of the sample from 2005-2014.

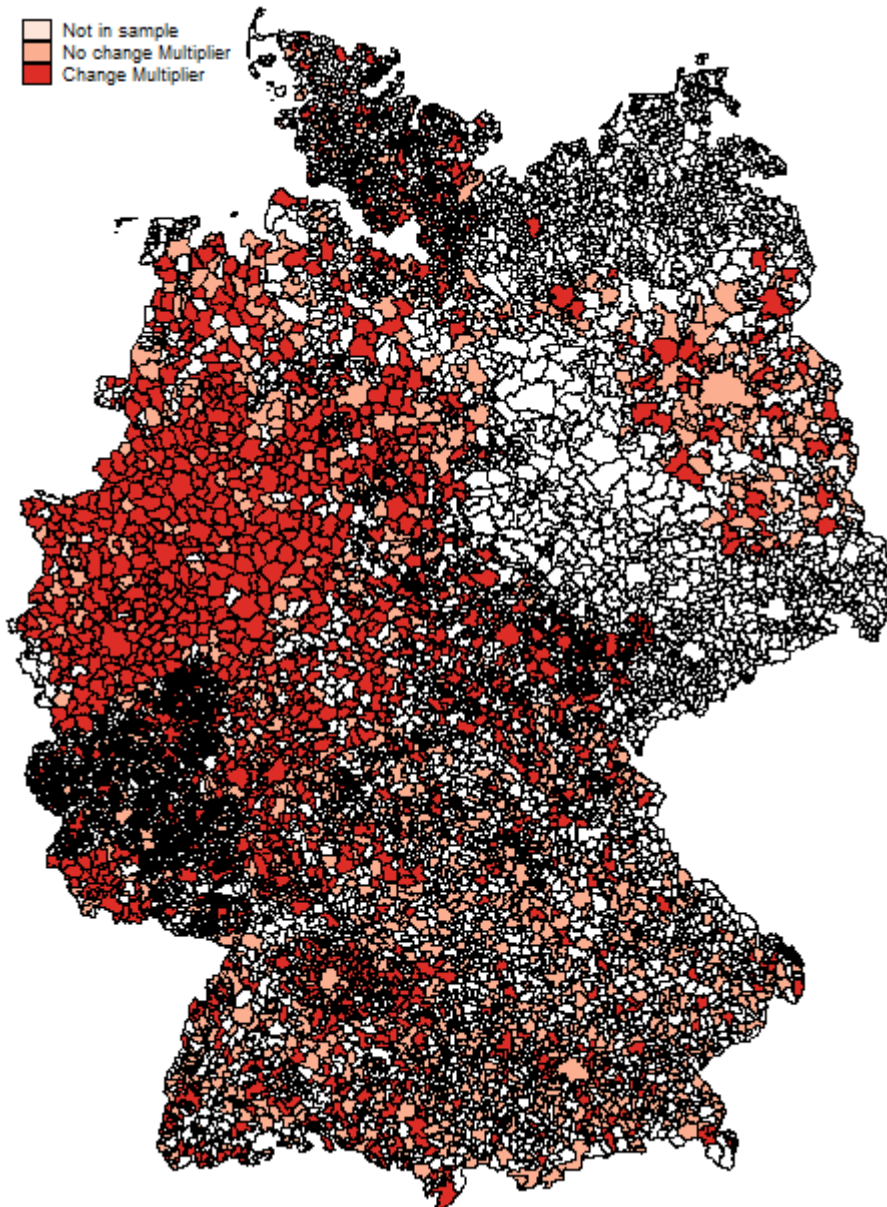
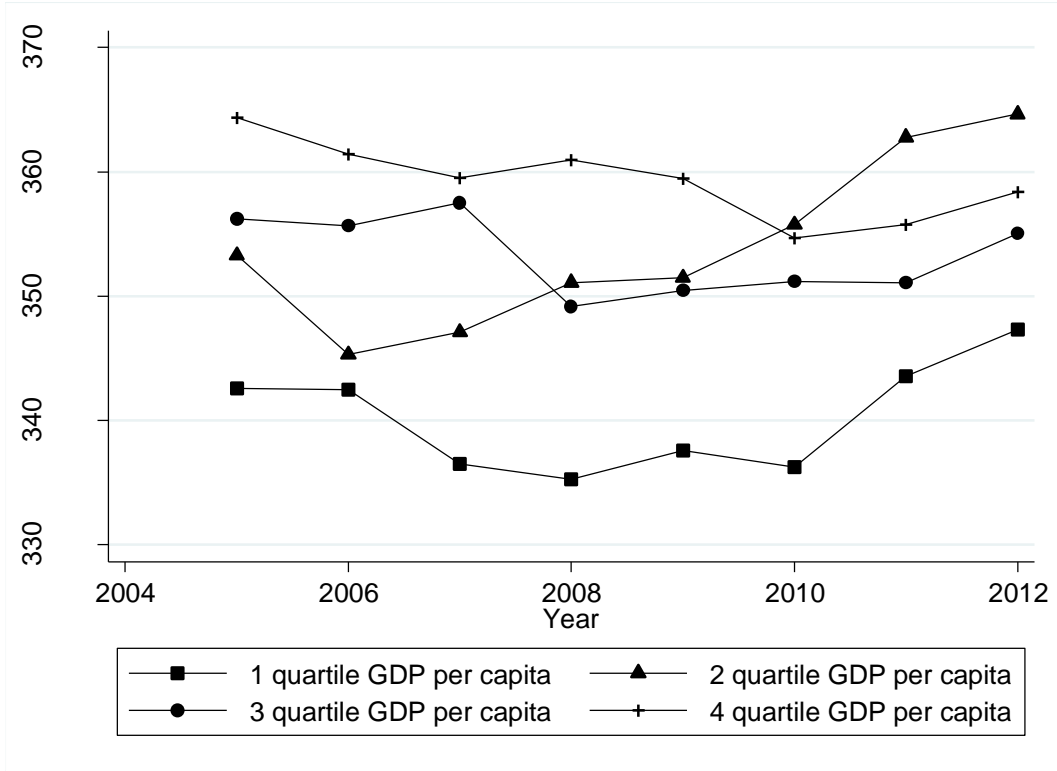


Figure 3: Local economic environment and tax rates

Panel A plots the average local business tax multiplier in each quartile of the GDP per capita (measured at the county level). Panel B plots the average multiplier relative to the average GDP growth per county.

Panel A: Multipliers and GDP per capita



Panel B: Multipliers and GDP growth

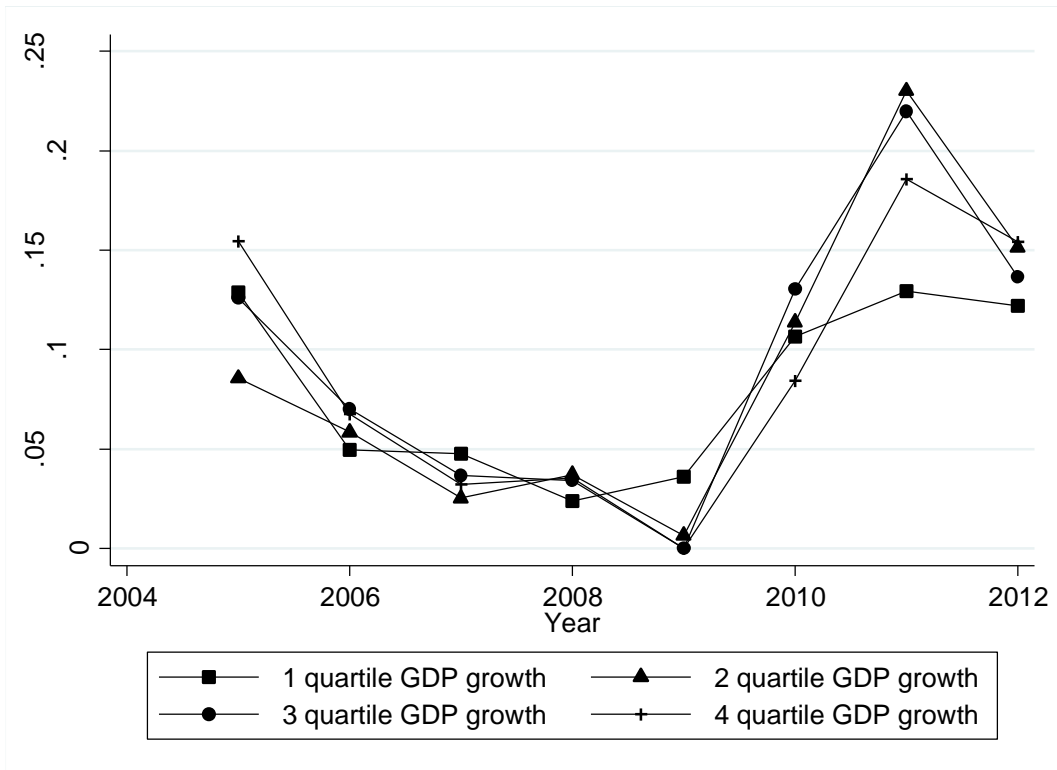


Table 1: Tax reforms per state

This table presents the number of observations and tax changes per state during the sample period.

Sate	Change in Multiplier	% of increases	Total
Baden-Württemberg	970	96.6%	12,970
Bayern	696	54.5%	15,674
Berlin	0	-	4,792
Brandenburg	246	94.7%	2,584
Bremen	58	100.0%	910
Hamburg	0	-	3,800
Hessen	1,192	67.4%	11,344
Mecklenburg-Vorpommern	257	94.9%	1,820
Niedersachsen	1,260	98.3%	10,527
Nordrhein-Westfalen	5,643	86.7%	30,706
Rheinland-Pfalz	460	92.0%	3,994
Saarland	317	81.7%	1,867
Sachsen	261	82.4%	2,226
Sachsen-Anhalt	111	39.6%	446
Schleswig-Holstein	499	97.6%	3,618
Thüringen	949	92.8%	4,114
Total	12,919	85.3%	111,392

Table 2: Descriptive Statistics

This table presents descriptive statistics of our main variables from 2005–2014. All variables are defined in Appendix B.

Variable	N	Mean	Standard deviation	25th percentile	50th percentile	75th percentile
<i>Fixed Assets</i> (in T €)	111,392	18,800	344,000	141	873	5,367
<i>Investment</i> (in T €)	111,392	1,428	128,000	11	98	627
<i>Tax Rate</i>	111,392	31.93	4.17	28.60	30.88	32.98
<i>Local Property Tax</i>	111,392	420.35	118.83	339.00	400.00	490.00
<i>Wage</i> _{<i>t-1</i>} (in T €)	111,392	9,255	88,000	571	2,112	7,168
<i>Sales</i> _{<i>t-1</i>} (in T €)	111,392	68,000	765,000	2,831	12,100	41,300
<i>Start-Up</i>	111,392	26.97	29.48	10.00	18.00	32.00
<i>Sales growth</i>	111,392	0.06	0.28	-0.06	0.02	0.12
<i>EBIT</i> _{<i>t-1</i>} (in T €)	111,392	3,537	38,400	97	416	1,737
<i>Cash</i> _{<i>t-1</i>} (in T €)	111,392	2,573	37,300	30	229	1,344
<i>Liabilities</i> _{<i>t-1</i>} (in T €)	111,392	26,400	302,000	796	3,480	12,500
<i>Loss</i>	111,392	0.08	0.27	0.00	0.00	0.00
<i>Corporation</i>	111,392	0.86	0.35	1.00	1.00	1.00
<i>Profit Margin</i>	110,982	0.10	1.18	0.03	0.06	0.12
<i>SingleJuris</i>	85,952	0.28	0.45	0.00	0.00	1.00
<i>Domestic</i>	85,952	0.33	0.47	0.00	0.00	1.00
<i>MNE</i>	85,952	0.39	0.49	0.00	0.00	1.00

Table 3: Baseline Results

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

	$\ln(\text{Fixed Assets})_{i,t}$		
Ln(Tax Rate)	-0.9726***	-0.9276***	-0.9127***
	(0.3512)	(0.3347)	(0.3272)
Ln (Local property Tax)	0.0934	0.1145	0.1118
	(0.0865)	(0.0833)	(0.0802)
Ln (Wage) _{t-1}		0.1453***	0.1252***
		(0.0202)	(0.0187)
Ln (Sales) _{t-1}		0.3294***	0.1538***
		(0.0273)	(0.0238)
Start-Up		-0.0656***	-0.0542**
		(0.0220)	(0.0221)
Sales Growth		0.2732***	0.2382***
		(0.0154)	(0.0151)
Ln (EBIT) _{t-1}			0.0330***
			(0.0038)
Ln (Cash) _{t-1}			0.0041
			(0.0025)
Ln (Liabilities) _{t-1}			0.2358***
			(0.0162)
Firm & County-Year FE	Yes	Yes	Yes
Observations	111,392	111,392	111,392
Adj R-squared	0.951	0.953	0.954
Within R-squared	0.0002	0.0455	0.0677

Table 4: Timing

The dependent variable is the change in the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. I rerun the same regression as in column (1) of Table 3 using lead, lag, and contemporaneous values of the tax rate as alternative explanatory variables. I include firm and county-year fixed effects in Panel A and county-year FE in Panel B. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Including Firm FE

	$\Delta \ln(\text{Fixed Assets})_{i,t}$		
$\Delta \ln(\text{Tax Rate})_{t-2}$	0.2846 (0.5900)	0.0903 (0.8983)	0.8131 (0.7370)
$\Delta \ln(\text{Tax Rate})_{t-1}$	-0.5715 (0.3898)	-0.7005 (0.4892)	-0.4965 (0.5587)
$\Delta \ln(\text{Tax Rate})_t$	-0.4475 (0.4318)	-0.7508 (0.4796)	-0.6221 (0.5007)
$\Delta \ln(\text{Tax Rate})_{t+1}$	-1.2415*** (0.3759)	-1.1994** (0.5778)	-1.1120* (0.6426)
$\Delta \ln(\text{Tax Rate})_{t+2}$	-0.3174 (0.4065)	-0.1506 (0.5684)	-0.6522 (0.5055)
$\Delta \ln(\text{Local property Tax})$	-0.0426 (0.0923)	-0.0235 (0.1210)	-0.1984 (0.1292)
Firm & County-Year FE	Yes	Yes	Yes
Observations	30,673	23,066	15,587
Within R-squared	0.0005	0.0004	0.0007

Panel B: Without Firm FE

	$\Delta \ln(\text{Fixed Assets})_{i,t}$		
$\Delta \ln(\text{Tax Rate})_{t-2}$	-0.0416 (0.4443)	0.0595 (0.6073)	0.8115 (0.6274)
$\Delta \ln(\text{Tax Rate})_{t-1}$	-0.4585* (0.2783)	-0.4686 (0.3410)	-0.4191 (0.4052)
$\Delta \ln(\text{Tax Rate})_t$	-0.2491 (0.3415)	-0.4733 (0.3521)	-0.7357* (0.4212)
$\Delta \ln(\text{Tax Rate})_{t+1}$	-0.7284** (0.3078)	-0.7404 (0.4574)	-0.9570* (0.5098)
$\Delta \ln(\text{Tax Rate})_{t+2}$	0.1856 (0.2833)	-0.1941 (0.3740)	-0.4724 (0.4495)
$\Delta \ln(\text{Local property Tax})$	-0.0215 (0.0832)	-0.0241 (0.1077)	0.0112 (0.1345)
County-Year FE	Yes	Yes	Yes
Observations	30,673	23,066	15,587
Within R-squared	0.0005	0.0002	0.0001

Table 5: Loss Split

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. *Loss* is an indicator variable equal to one if the firm reports negative EBIT. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

	$\ln(\text{Fixed Assets})_{i,t}$		
$\ln(\text{Tax Rate})$	-0.9991*** (0.3505)	-0.9420*** (0.3340)	-0.9263*** (0.3266)
$\ln(\text{Tax Rate}) \times \text{Loss}$	0.3484*** (0.0986)	0.2181** (0.0929)	0.2219** (0.0918)
<i>Loss</i>	-1.1910*** (0.3405)	-0.7120** (0.3203)	-0.7160** (0.3160)
$\ln(\text{Local property Tax})$	0.0928 (0.0863)	0.1153 (0.0831)	0.1129 (0.0801)
$\ln(\text{Wage})_{t-1}$		0.1441*** (0.0202)	0.1239*** (0.0187)
$\ln(\text{Sales})_{t-1}$		0.3320*** (0.0273)	0.1557*** (0.0237)
<i>Start-Up</i>		-0.0666*** (0.0219)	-0.0551** (0.0220)
<i>Sales Growth</i>		0.2793*** (0.0153)	0.2462*** (0.0151)
$\ln(\text{EBIT})_{t-1}$			0.0347*** (0.0038)
$\ln(\text{Cash})_{t-1}$			0.0041 (0.0025)
$\ln(\text{Liabilities})_{t-1}$			0.2356*** (0.0162)
Joint significance $\ln(\text{Tax Rate}) + \ln(\text{Tax Rate}) \times \text{Loss}$	-0.6507* (0.3647)	-0.7239** (0.3479)	-0.7044** (0.3395)
Firm & County-Year FE	Yes	Yes	Yes
Observations	111,392	111,392	111,392
Adj R-squared	0.951	0.953	0.954
Within R-squared	0.0006	0.0460	0.0682

Table 6: Financial constraints

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. *FC* is equal to one for firms that are in the lowest tertile of total assets and age. Loss firms are excluded. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-0.7443** (0.3658)	-0.7131** (0.3474)	-0.6975** (0.3385)
<i>Ln (Tax Rate) x FC</i>	-0.4363*** (0.1123)	-0.2859*** (0.1077)	-0.2478** (0.1043)
<i>FC</i>	1.2372*** (0.3905)	0.7795** (0.3752)	0.6607* (0.3638)
<i>Local property Tax</i>	0.0750 (0.0863)	0.1000 (0.0835)	0.0973 (0.0799)
<i>Ln (Wage)_{t-1}</i>		0.1387*** (0.0226)	0.1177*** (0.0208)
<i>Ln (Sales)_{t-1}</i>		0.3179*** (0.0310)	0.1411*** (0.0262)
<i>Sales Growth</i>		0.2514*** (0.0171)	0.2213*** (0.0164)
<i>Ln (EBIT)_{t-1}</i>			0.0392*** (0.0044)
<i>Ln (Cash)_{t-1}</i>			0.0045* (0.0025)
<i>Ln (Liabilities)_{t-1}</i>			0.2303*** (0.0168)
Joint significance <i>Ln (Tax Rate) + Ln (Tax Rate) x FC</i>	-1.1806*** (0.3851)	-0.9990*** (0.3665)	-0.9453*** (0.3578)
Firm & County-Year FE	Yes	Yes	Yes
Observations	100,302	100,302	100,302
Adj R-squared	0.952	0.954	0.955
Within R-squared	0.0065	0.0468	0.0689

Table 7: Single-jurisdictional firms vs. multi-jurisdictional firms

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. *SingleJuris* is equal to one for firms that are either standalone or belong to a corporate group that operates in only one municipality. I exclude firms for which I have no ownership information from my sample. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-0.8529** (0.4200)	-0.7922** (0.3929)	-0.7767** (0.3827)
<i>Ln (Tax Rate) x SingleJuris</i>	-0.3773*** (0.1026)	-0.3526*** (0.0962)	-0.3951*** (0.0929)
<i>Ln (Local property Tax)</i>	0.0745 (0.1008)	0.1051 (0.0975)	0.1025 (0.0941)
<i>Ln (Wage) t-1</i>		0.1633*** (0.0227)	0.1437*** (0.0213)
<i>Ln (Sales) t-1</i>		0.3173*** (0.0313)	0.1378*** (0.0250)
<i>Start-Up</i>		-0.0595** (0.0241)	-0.0528** (0.0240)
<i>Sales Growth</i>		0.2759*** (0.0173)	0.2398*** (0.0171)
<i>Ln (EBIT) t-1</i>			0.0302*** (0.0044)
<i>Ln (Cash) t-1</i>			0.0031 (0.0030)
<i>Ln (Liabilities) t-1</i>			0.2370*** (0.0184)
Joint significance <i>Ln (Tax Rate)</i> + <i>Ln (Tax Rate) x SingleJuris</i>	-1.2302*** (0.4218)	-1.1448*** (0.3954)	-1.1718*** (0.3848)
Firm & County-Year FE	Yes	Yes	Yes
Observations	85,914	85,914	85,914
Adj R-squared	0.950	0.952	0.953
Within R-squared	0.0009	0.0469	0.0683

Table 8: High profit margins

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. *High Margin* is an indicator variable equal to one for firms that report profit margins in the highest tertile of its industry-year group. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-0.9127*** (0.3225)	-0.8766*** (0.3062)	-0.8522*** (0.2970)
<i>Ln (Tax Rate) x High Margin</i>	0.2321*** (0.0675)	0.2097*** (0.0654)	0.2017*** (0.0635)
<i>High Margin</i>	-0.7833*** (0.2320)	-0.6649*** (0.2250)	-0.6416*** (0.2188)
<i>Ln (Local property Tax)</i>	0.0700 (0.0751)	0.0965 (0.0725)	0.0935 (0.0695)
<i>Ln (Wage)_{t-1}</i>		0.1372*** (0.0211)	0.1107*** (0.0191)
<i>Ln (Sales)_{t-1}</i>		0.3305*** (0.0265)	0.1863*** (0.0225)
<i>Start-Up</i>		-0.0648*** (0.0211)	-0.0593*** (0.0211)
<i>Sales Growth</i>		0.2658*** (0.0147)	0.2282*** (0.0140)
<i>Ln (Cash)_{t-1}</i>			0.0075*** (0.0023)
<i>Ln (Liabilities)_{t-1}</i>			0.2331*** (0.0145)
Joint significance <i>Ln (Tax Rate) +</i> <i>Ln (Tax Rate) x High Margin</i>	-0.6806** (0.3730)	-0.6679** (0.3128)	-0.6504** (0.3041)
Firm & County-Year FE	Yes	Yes	Yes
Observations	99,613	99,613	99,613
Adj R-squared	0.952	0.954	0.955
Within R-squared	0.0006	0.0437	0.0642

Table 9: Low wages

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. *Low Wages* is an indicator variable equal to one for firms that operate in an industry with a median wage-to-sales ratio (wage-to employees ratio) in the lowest tertile in Panel A (Panel B). I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Wage-to-Sales Ratio			
	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-1.0663*** (0.3078)	-0.9968*** (0.2923)	-0.9840*** (0.2850)
<i>Ln (Tax Rate) x Low Wages</i>	0.2046*** (0.0669)	0.1513** (0.0641)	0.1367** (0.0623)
<i>Low Wages</i>	-0.7093*** (0.2294)	-0.5323** (0.2201)	-0.4836** (0.2142)
Joint significance <i>Ln (Tax Rate) + Ln (Tax Rate) x High Margin</i>	-0.8617*** (0.3084)	-0.8455*** (0.2946)	-0.8473*** (0.2883)
Firm & County-Year FE	Yes	Yes	Yes
Observations	111,392	111,392	111,392
Adj R-squared	0.950	0.953	0.954
Within R-squared	0.0005	0.0457	0.0660
Panel B: Wage-to-Employees Ratio			
	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-0.9990*** (0.3050)	-0.9555*** (0.2902)	-0.9517*** (0.2832)
<i>Ln (Tax Rate) x Low Wages</i>	0.0962 (0.0608)	0.1031* (0.0621)	0.1106* (0.0596)
<i>Low Wages</i>	-0.3162 (0.2119)	-0.3369 (0.2163)	-0.3630* (0.2078)
Joint significance <i>Ln (Tax Rate) + Ln (Tax Rate) x High Margin</i>	-0.9028*** (0.3093)	-0.8524*** (0.2955)	-0.8411*** (0.2886)
Firm & County-Year FE	Yes	Yes	Yes
Observations	111,392	111,392	111,392
Adj R-squared	0.950	0.953	0.954
Within R-squared	0.0003	0.0457	0.0660

ONLINE APPENDIX

Table A.1: Descriptive Statistics

This table presents descriptive statistics of our main variables over the sample period for domestic and multinational group firms in Panel A and single-jurisdictional firms in Panel B. All variables are defined in Appendix B.

Panel A: Domestic Groups and MNE

Variable	N	Mean	Standard deviation	25th percentile	50th percentile	75th percentile
<i>Fixed Assets</i> (in T €)		23,300	381,000	232	1,485	7,718
<i>Tax Rate</i>	87,357	32	4	29	31	33
<i>Local Property Tax</i>	87,357	422	118	340	400	490
<i>Wage</i> $t-1$ (in T €)	87,357	11,200	98,400	877	3,011	9,245
<i>Sales</i> $t-1$ (in T €)	87,357	82,600	857,000	4,764	17,400	51,200
<i>Age</i>	87,357	28	31	10	18	33
<i>Sales growth</i>	87,357	0.05	0.27	-0.06	0.02	0.12
<i>EBIT</i> $t-1$ (in T €)	87,357	4,306	41,900	152	625	2,281
<i>Cash</i> $t-1$ (in T €)	87,357	3,076	42,000	46	343	1,855
<i>Liabilities</i> $t-1$ (in T €)	87,357	32,400	325,000	1,311	5,110	16,300
<i>Loss</i>	87,357	0.08	0.27	0.00	0.00	0.00
<i>Corporation</i>	87,357	0.84	0.36	1.00	1.00	1.00
<i>Profit Margin</i>	87,006	0.10	1.33	0.03	0.06	0.12
<i>Local competition</i>	87,357	0.02	0.15	0.00	0.00	0.00

Panel B: Single-jurisdictional firms

Variable	N	Mean	Standard deviation	25th percentile	50th percentile	75th percentile
<i>Fixed Assets</i> (in T €)	24,035	2,546	145,000	47	181	755
<i>Tax Rate</i>	24,035	32	4	28	31	35
<i>Local Property Tax</i>	24,035	414	121	330	390	470
<i>Wage</i> $t-1$ (in T €)	24,035	2,126	25,800	235	602	1,581
<i>Sales</i> $t-1$ (in T €)	24,035	14,600	197,000	1,076	2,905	9,105
<i>Age</i>	24,035	23	24	9	16	28
<i>Sales growth</i>	24,035	0.08	0.31	-0.07	0.03	0.16
<i>EBIT</i> $t-1$ (in T €)	24,035	741	21,100	36	104	329
<i>Cash</i> $t-1$ (in T €)	24,035	747	3,711	10	61	281
<i>Liabilities</i> $t-1$ (in T €)	24,035	4,721	199,000	290	833	2,540
<i>Loss</i>	24,035	0.08	0.27	0.00	0.00	0.00
<i>Corporation</i>	24,035	0.92	0.27	1.00	1.00	1.00
<i>Profit Margin</i>	23,976	0.08	0.21	0.03	0.05	0.10
<i>Local competition</i>	24,035	0.02	0.12	0.00	0.00	0.00

Table A.2: Baseline – Semi elasticities

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. Columns 1 to 3 include the same firm control variables as in Table 3. I include firm fixed effects in all specifications. In Panel A, I include county-year fixed effect. In Panel B and C, I include state-year and industry-year fixed effects, respectively. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Semi-elasticities			
	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Tax Rate</i>	-0.0330** (0.0129)	-0.0302** (0.0123)	-0.0290** (0.0121)
<i>Local property Tax</i>	0.0003 (0.0002)	0.0003 (0.0002)	0.0003 (0.0002)
Firm & County-Year FE	Yes	Yes	Yes
Observations	111,392	111,392	111,392
Adj R-squared	0.951	0.953	0.954
Within R-squared	0.0002	0.0455	0.0676
Panel B: State-year FE			
	$\ln(\text{Fixed Assets})_{i,t}$		
Ln(<i>Tax Rate</i>)	-0.8010*** (0.2936)	-0.7294** (0.3042)	-0.7629** (0.3069)
<i>Unemployment Rate</i>	-0.0084 (0.0075)	-0.0050 (0.0076)	-0.0051 (0.0077)
Ln (<i>Local property Tax</i>)	0.0660 (0.0950)	0.0689 (0.0914)	0.0679 (0.0883)
Firm & State-Year FE	Yes	Yes	Yes
Observations	111,392	111,392	111,392
Adj R-squared	0.950	0.953	0.954
Within R-squared	0.0003	0.0462	0.0691
Panel C: Industry-year FE			
	$\ln(\text{Fixed Assets})_{i,t}$		
Ln(<i>Tax Rate</i>)	-0.6895*** (0.2560)	-0.5831** (0.2460)	-0.5861** (0.2409)
Ln (<i>GDP</i>)	0.7901** (0.3438)	0.6457* (0.3383)	0.6296* (0.3327)
<i>GDP growth</i>	-0.5327** (0.2392)	-0.5234** (0.2347)	-0.4693** (0.2317)
<i>Unemployment rate</i>	0.0011 (0.0061)	0.0033 (0.0060)	0.0029 (0.0060)
Ln(<i>Local property Tax</i>)	0.0417 (0.0769)	0.0403 (0.0748)	0.0410 (0.0725)
Firm & Ind-Year FE	Yes	Yes	Yes
Observations	111,391	111,391	111,391
Adj R-squared	0.950	0.953	0.954
Within R-squared	0.0007	0.0466	0.0693

Table A.3: Investment

The dependent variable is the logarithm of *Investment* which is defined as the change in fixed assets before depreciation. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. I include firm and industry-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Industry-year FE			
	$\ln(Investment)_{i,t}$		
Ln(Tax Rate)	-1.0850*** (0.3520)	-0.9518*** (0.3427)	-0.9037*** (0.3412)
<i>Ln (GDP)</i>	0.9478*** (0.3326)	0.7170** (0.3232)	0.6155* (0.3245)
<i>GDP growth</i>	-0.7244 (0.5146)	-0.8422* (0.4971)	-0.8698* (0.4930)
<i>Unemployment rate</i>	-0.0111 (0.0081)	-0.0093 (0.0079)	-0.0076 (0.0078)
<i>Ln(Local property Tax)</i>	0.1396 (0.0898)	0.1290 (0.0870)	0.1229 (0.0861)
<i>Ln (Wage)_{t-1}</i>		-0.0477* (0.0251)	-0.0245 (0.0249)
<i>Ln (Sales)_{t-1}</i>		0.5468*** (0.0403)	0.5179*** (0.0419)
<i>Start-Up</i>		-0.0401 (0.0268)	-0.0385 (0.0269)
<i>Sales Growth</i>		0.7775*** (0.0281)	0.8073*** (0.0284)
<i>Ln (EBIT)_{t-1}</i>			0.1026*** (0.0073)
<i>Ln (Cash)_{t-1}</i>			0.0388*** (0.0035)
<i>Ln (Liabilities)_{t-1}</i>			-0.1533*** (0.0164)
Firm & Ind-Year FE	Yes	Yes	Yes
Observations	93,094	93,094	93,094
Adj R-squared	0.766	0.771	0.773
Within R-squared	0.0004	0.0216	0.0296
Panel B: State-year FE			
	$\ln(Investment)_{i,t}$		
Ln(Tax Rate)	-1.0920*** (0.3997)	-1.0426*** (0.3959)	-0.9982** (0.3965)
Firm & State-Year FE	Yes	Yes	Yes
Observations	93,095	93,095	93,095
Adj R-squared	0.766	0.771	0.772
Within R-squared	0.0003	0.0216	0.0297

Table A.4: Single-jurisdictional firms vs. multi-jurisdictional firms - Matching

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Entropy Balancing			
	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-0.9112* (0.5531)	-0.9331* (0.5362)	-0.9105* (0.5270)
<i>Ln (Tax Rate) x SingleJuris</i>	-0.4288*** (0.1163)	-0.4270*** (0.1122)	-0.4533*** (0.1105)
Joint significance <i>Ln (Tax Rate)</i> + <i>Ln (Tax Rate) x SingleJuris</i>	-1.3401** (0.5553)	-1.3600** (0.5375)	-1.3639*** (0.5284)
Firm & County-Year FE	Yes	Yes	Yes
Observations	85,914	85,914	85,914
Adj R-squared	0.935	0.938	0.939
Within R-squared	0.0013	0.0430	0.0562
Panel B: Propensity Score Matching			
	$\ln(\text{Fixed Assets})_{i,t}$		
<i>Ln (Tax Rate)</i>	-1.1548 (0.7754)	-1.3377* (0.7322)	-1.1571 (0.7121)
<i>Ln (Tax Rate) x SingleJuris</i>	-0.5528** (0.2241)	-0.4527** (0.2145)	-0.4646** (0.2126)
Joint significance <i>Ln (Tax Rate)</i> + <i>Ln (Tax Rate) x SingleJuris</i>	-1.7076** (0.77859)	-1.7904** (0.7314)	-1.6217** (0.7137)
Firm & County-Year FE	Yes	Yes	Yes
Observations	12,974	12,974	12,974
Adj R-squared	0.945	0.947	0.948
Within R-squared	0.0022	0.0449	0.0535

Table A.5: Domestic group firms vs. multinational group firms

The dependent variable is the logarithm of *Fixed Assets*. *Tax Rate* represents the overall statutory tax rate including corporate income tax, local business tax and solidarity surcharge. I exclude firms that operate in a single municipality (single jurisdictional firms) and firms for which I have no ownership information from my sample. I include firm and county-year fixed effects in all specifications. Standard errors are clustered at the municipality level and reported in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.

	$\ln(\text{Fixed Assets})_{i,t}$		
$\ln(\text{Tax Rate})$	-0.5109 (0.5174)	-0.4290 (0.4763)	-0.4435 (0.4580)
$\ln(\text{Tax Rate}) \times \text{Domestic}$	-0.3057*** (0.0937)	-0.2619*** (0.0871)	-0.2650*** (0.0839)
$\ln(\text{Local property Tax})$	-0.0131 (0.1214)	0.0070 (0.1176)	0.0150 (0.1130)
$\ln(\text{Wage})_{t-1}$		0.1664*** (0.0253)	0.1436*** (0.0234)
$\ln(\text{Sales})_{t-1}$		0.2937*** (0.0337)	0.1173*** (0.0266)
<i>Start-Up</i>		-0.0361 (0.0268)	-0.0336 (0.0267)
<i>Sales Growth</i>		0.2862*** (0.0215)	0.2460*** (0.0206)
$\ln(\text{EBIT})_{t-1}$			0.0219*** (0.0046)
$\ln(\text{Cash})_{t-1}$			-0.0028 (0.0036)
$\ln(\text{Liabilities})_{t-1}$			0.2564*** (0.0211)
Joint significance $\ln(\text{Tax Rate}) + \ln(\text{Tax Rate}) \times \text{Domestic}$	-0.8166 (0.5165)	-0.6909 (0.4761)	-0.7085 (0.4578)
Firm & County-Year FE	Yes	Yes	Yes
Observations	61,796	61,796	61,796
Adj R-squared	0.945	0.947	0.949
Within R-squared	0.0008	0.0456	0.0704