

# Large and Influential: Firm Size and Governments' Corporate Tax Rate Choice\*

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## Abstract

Theory suggests that large firms are more likely to engage in lobbying behaviour and are geographically more mobile than smaller entities. Conditional on jurisdiction size, policy choices are thus predicted to depend on the shape of a jurisdiction's firm size distribution, with more business-oriented policies being enacted if jurisdictions host large firms. The paper empirically tests this prediction using local business taxation in Germany as a testing ground. Exploiting rich and exogenous variation in municipalities' firm size structures, we find evidence for an inverse relationship between the size of hosted entities and municipalities' local business tax choices. The effect is statistically significant and quantitatively relevant, suggesting that the rising importance of large businesses may trigger shifts towards a more business-friendly design of (tax) policies.

**Keywords:** Firm size, corporation tax, political economy

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# 1 Introduction

The importance of large corporations has steadily grown over recent decades (e.g. UNCTAD (2002), Cefis et al. (2009), Poschke (2014)). Many observers eye this development with scepticism and have raised concerns that the increasing fraction of economic activity concentrated in big businesses may foster the corporate sector’s influence over government policies (e.g. Crouch (2004), Roach (2007), Barth (2011), Cave and Rowell (2014)). The purpose of our paper is to empirically assess the importance of these concerns. Using tax policy as a testing ground, we investigate whether jurisdictions’ firm size structures determine their governments’ business tax choices.

The paper starts out with a brief discussion of theoretical mechanisms that establish a link between firm size and jurisdiction policy.<sup>1</sup> Firstly, an increase in the size of hosted entities may, conditional on aggregate jurisdiction size, raise overall corporate lobby spending as more firms take the size threshold to participate in lobbying in the presence of fixed costs.<sup>2</sup> Secondly, theory predicts that large firms are geographically more mobile than smaller entities - among others, because fixed costs of relocating corporate activity can be spread over a larger asset base. For both reasons, jurisdictions may, conditional on their aggregate size, opt for a more business-oriented (tax) policy design if they host large firms.

In the main part of the paper, we empirically test for a link between jurisdictions’ firm size structures and their corporate tax rate choices. Our analysis relies on data for the German local business tax, which is set autonomously by German municipalities. The setting is unique and ideal to assess the question of interest. Firstly, tax issues belong to the most pressing policy concerns of the corporate sector (see e.g. the lobbying statistics of the US NGO *Open Secrets*). Secondly, using subnational data offers the advantage that our sample municipalities, while autonomously choosing the local business tax rate, operate in an otherwise homogenous institutional setting. The business tax furthermore significantly contributes to the tax burden on corporations in Germany, making up around 40% of corporate tax payments on average. The focus on policy choices of subnational government tiers finally allows us to construct consistent measures for the firm size structure of jurisdictions based on administrative micro-data for Germany.<sup>3</sup>

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<sup>1</sup>Note that we focus on *jurisdictions’* firm size structures, as opposed to firm size distributions within *industries* or *spatial* firm concentration.

<sup>2</sup>Decentralized corporate lobbying for business-friendly common government policies exerts a positive externality on other firms in the jurisdiction which is not internalized by the individual firm.

<sup>3</sup>Consistent data on the firm size structures of countries is to the best of our knowledge not available.

Exploiting rich cross-sectional and longitudinal variation in firm size structures across more than 3800 sample municipalities and eight sample years (2000-2007), we find evidence for a statistically significant and economically relevant link between the size of hosted firms and municipalities' local business tax choices. The empirical models control for socio-economic and budgetary characteristics of municipalities as well as political preferences and include a full set of county-year and municipality fixed effects respectively. Remaining endogeneity concerns are addressed by a Batrik style instrumental variable strategy that exploits a large number of industry shocks to model shifts in municipalities' firm size structures. To do so, we predict changes in the size of individual firms in a given municipality based on average 4-digit industry size growth rates. Motivated by our theoretical considerations to come, our main empirical analysis tests for an effect of average firm size on municipalities' local business tax choices.<sup>4</sup> Quantitatively, our estimates suggests that doubling the average size of firms lowers municipalities' local business tax rates by 9% on average. In robustness checks, we, moreover, test whether increases in average firm size have a stronger negative impact on local business tax rates in smaller municipalities, which is rejected by the data, however.

To assess the relative importance of lobbying and firm mobility in driving this effect, we construct firm-level measures for corporate mobility, namely indicators for firm affiliation with a multinational and national group respectively and a variable capturing the tax sensitivity of business activities.<sup>5</sup> Aggregating these measures to the municipality-level and adding them to the set of control variables in the main specifications reduces the estimate for the firm-size coefficient by around 90%. The findings hence suggest that mobility differences are a main driver of the observed link between business size and local business tax choices. Complementary, we assess the 'lobbying channel' by rerunning the baseline regressions with control variables for the fraction of firms per municipality that engage in lobbying behaviour. Firms are coded as lobby-active if they donate significant funds to German political parties or spend time interacting with politicians and bureaucrats, where the latter is proxied by interactions with policy-makers at the national and supra-national level since according data for the local level is unavailable. Aggregating these measures to the municipality level and adding them as regressors to our main model reduces the firm size effect of

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<sup>4</sup> Including regressors for the absolute size of hosted firms follows the theoretical notion that only firms above a given size threshold participate in lobbying or relocate corporate investments in space.

<sup>5</sup>Specifically, we determine the sensitivity of fixed asset investment to changes in the business tax rate based on firm-level data, where the tax effect is allowed to vary across narrowly defined subgroups of firms. Potential reverse causality concerns are addressed in the analysis, cf. Section 5.

interest - suggesting that lobbying contributes to the link between firm size and local business tax choices. Quantitatively, the importance of the channel is indicated to be limited though. Note, however, that mobility and lobbying controls are unlikely to capture all differences in mobility and lobbying behaviour across firms, implying that the sketched strategy yields bounds for the importance of firm mobility and lobbying as drivers of the 'firm size-business tax' link (with at least 90% of the effect being assigned to the mobility channel and up to 10% to the lobbying channel).<sup>6</sup>

To the best of our knowledge, our paper is the first to establish a causal link between jurisdictions' firm size distributions and corporate tax policy choices.<sup>7</sup> It contributes to a flourishing literature on the determinants of tax setting behaviour. In recent years, studies mainly focused on strategic interaction in corporate tax rate choices of neighbouring jurisdictions, presenting some evidence in favour of inter-jurisdictional tax competition and a race-to-the-bottom of corporate tax rates (see e.g. Devereux et al. (2008), Overesch and Rincke (2011)). A recent strand of the literature qualifies this race-to-the-bottom prediction, suggesting that corporate tax competition may be mitigated by agglomeration rents, with larger jurisdictions choosing higher corporate tax rates (see e.g. Ludema and Wooton (2000), Baldwin and Krugman (2004), Jofre-Monseny and Solé-Ollé (2012), Jofre-Monseny (2013), Koh et al. (2013), Brühlhart et al. (2012), Luthi and Schmidheiny (2014), Brühlhart and Simpson (2018)).<sup>8</sup> Our paper adds to this literature by highlighting that, beyond effects related to the aggregate size of a jurisdiction's corporate activity, intra-jurisdictional firm size heterogeneity impacts on business tax choices.

As firm size structures vary significantly across countries and sub-national government tiers (see e.g. Garcia-Santana and Ramos (2012)), our findings help to explain observed differences in governments' corporate tax policy choices. The results moreover suggest that recent decades' merger and acquisition waves and the trend towards more concentration of economic activity (particularly in emerging markets and the develop-

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<sup>6</sup>The relative importance of firm mobility and lobbying in driving the link between firm size and business tax choices must not necessarily correspond to the relative importance of the two channels in directly affecting local business taxes. See Section 5 for details.

<sup>7</sup>After finalizing the first version of our paper, we became aware of Bischoff and Krabel (2017) who also report a negative correlation between firm size and local business tax choices for the German state of Hesse. Their empirical analysis, however, does not allow for a causal interpretation of the effect and the authors also do not assess potential mechanisms that link firm size and policy choices.

<sup>8</sup>Brühlhart and Simpson (2018) study how industry-level agglomeration affects government policy using data on firm subsidies in Great Britain. They find that only the assignment of grants administered by central government agencies conforms with the predictions of economic geography models.

ing world, see e.g. Poschke (2014)) affect governments' tax policies and may trigger shifts towards more favourable tax conditions for the corporate sector. Insights from the analysis may furthermore extend to other policy areas and administrative practices, including the provision of public goods and services, the assignment of grants or product market regulation - suggesting that firm size may play a role in explaining regulatory capture and public fund allocation in these fields.

The remainder of the paper is structured as follows: in Section 2, we present theoretical considerations to motivate our empirical analysis. Section 3 describes the institutional background and data for our empirical analysis. Sections 4 and 5 present the identification strategy and estimation results. Section 6 concludes.

## 2 Theoretical Considerations

While the economic literature provides comprehensive evidence that the *aggregate* size of economic activity affects jurisdictions' corporate (tax) policy choices, it largely ignores the possibility that firm size *heterogeneity* drives governmental (tax) policy setting. As sketched in the Introduction, empirically testing for the latter relationship in the context of the German local business tax is the core aim of our paper. A theoretical link between jurisdictions' firm size structures and corporate (tax) policy may be established by two mechanisms.

### *Corporate Lobbying*

The first relates to corporate lobbying activities and thus to the direct attempt of the corporate sector to influence government policy. The effect of lobbying on government behaviour has been analysed extensively in the economic literature (see e.g. Olson (1965) and Grossman and Helpman (2001)) and growing empirical evidence confirms the effectiveness of lobbying activities in influencing policy choices (see, among others, Goldberg and Maggi (1999) for trade protection, Facchini et al. (2011) for immigration policy, Blau et al. (2013) for bank bailouts and Salamon and Siegfried (1977) and Richter et al. (2009) for tax policy choices).

While most papers link aggregate lobby spending to the size of interest groups, Bombardini (2008) emphasizes the role of firm heterogeneity in driving lobby formation and aggregate lobby spending. In particular, she argues that in the presence of a fixed cost of making political contributions, i.e. initial expenses necessary to play an active role in lobbying activities, only the largest firms participate in lobby formation since

the initial fixed costs of organising for political activity may be spread over a larger asset base. Firm size, on top, also positively correlates with corporate productivity and profitability, and hence with the size of the corporate tax base, implying that large firms have higher incentives to lobby for low business tax rates than smaller entities. It consequently follows that, conditional on the aggregate size of the jurisdiction<sup>9</sup>, corporate lobby spending becomes larger if a jurisdiction hosts large firms.

An analogous prediction derives from the observation that firms benefit from favorable common business policies enforced by the lobbying of other corporates. Lobby involvement is thus affected by free-riding incentives (e.g. Olson (1965)), making aggregate lobby spending inefficiently small from the perspective of the corporate sector. If a jurisdiction's economic activity becomes more concentrated, the positive lobbying externality on other firms is partly internalized, lowering the free-rider problem and enhancing overall corporate lobbying and hence influence over government policy.<sup>10</sup>

#### *Firm Mobility*

On top, a link between firm size structures and corporate (tax) policy choices may be established by differences in the inter-jurisdictional mobility of large and small firms. Precisely, if relocating corporate activity involves fixed costs, mobility rates increase in the size of the business, reflecting that big firms can spread the fixed relocation costs over a large asset base (see e.g. Dharmapala (2014) or the literature on selection into outsourcing building on Melitz et al. (2004)). Firm size, moreover, positively correlates with corporate profitability, as described above, implying that large firms have higher incentives to hedge business investments from taxation by relocating to low-tax jurisdictions (see e.g. Baldwin and Okubo (2009)). Optimal (tax) policy choices

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<sup>9</sup>Contrary to lobbying for *private* or *industry-specific* public policies, we are interested in lobbying for policies that affect *all* firms located in a jurisdiction. Note that, if given the choice, firms would prefer to lobby for private benefits (instead of favourable common policies at the industry or jurisdiction level) as this avoids free rider problems (see next paragraph of the main text) and may provide advantages over competitors. Governments, however, can hardly differentiate policy design at the firm or industry level due to administrative and legal constraints (the European non-discrimination law e.g. prohibits state aid for specific firms (Articles 101 and 107, Treaty on the Functioning of the EU)), hence creating a role for aggregate corporate sector lobbying.

<sup>10</sup>To see this, consider a jurisdiction that hosts two firms, which employ a fraction of the jurisdiction's workers and earn a fraction of the aggregate profits each. Lobbying for lower local business tax rates incurs costs, but reduces the tax payments for both firms. When deciding on the optimal level of lobby spending, each firm does not take into account that its lobby spending also lowers the tax payments of the other firm. If the two firms merge, the respective externality is internalized and the lobby spending of the new firm is larger than the sum of the lobby spending of the two firms before.

account for these mobility differences, with governments opting for more business-oriented policies if they host large and mobile businesses and vice versa.

Firm mobility may, however, also link jurisdictions' firm size structures to their (tax) policy choices in the absence of mobility differences between small and large entities. To see this, consider a scenario where corporate location decisions are a function of governments' policy choices and idiosyncratic location preferences. If firms obtain shocks to their location preferences each period, communities may lose and win firms that relocate across borders. In such a setting, welfare costs of firm turnover are plausibly higher if communities lose relatively large entities as the lost economic activity and jobs may not be compensated in the short run by the attraction or foundation of new firms, causing unemployment and related welfare losses. Even if communities can make up for the lost economic activity, search frictions in the labor market may induce high welfare losses (in the short-run) when large employers relocate. If communities (e.g. for historic reasons) depend on large firms, they may hence be more inclined to implement business-friendly (tax) policies.

### *Implications for the Empirical Strategy*

The aim of this paper is to empirically assess the proposed link between jurisdictions' firm size structures and government policies using the German local business tax as a testing ground. In the main part of the empirical analysis, we test whether the average size of firms impacts on jurisdictions' local business tax choices. This derives from the theoretical notion that absolute firm size matters: The larger a firm's tax base, the higher is the propensity that it engages in lobbying or relocates across borders in the presence of fixed costs. Note, however, that relative firm size may be important as well. If average firm size in a jurisdiction increases by a given value (conditional on aggregate jurisdiction size), smaller jurisdictions become more dependent on big employers and business taxpayers than larger jurisdictions and their local business tax response may, therefore, be stronger. Our empirical analysis will account for potential effect heterogeneity along these lines.

Note, moreover, that our theoretical considerations suggests drawing on corporate taxable income or employment as measures for firm size in the empirical analysis.<sup>11</sup> Since our administrative micro data lacks information on taxable income, but includes

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<sup>11</sup>If firm mobility involved fixed costs, it is large firms that are more mobile. Here, the theoretically relevant firm size measure is the firm's *expected taxable income*: the higher this income, the larger the business gains from locating/relocating in/to a low-tax jurisdiction; analogously, if lobbying involved fixed costs, it is large firms that engage in lobbying. Again, the theoretically relevant firm size measure is the firm's *expected taxable income* as firms benefit more from lobbying the larger this taxable income;

data on firms' employment (see below), we proxy average firm size by firms' average employment in the empirical analysis. As company-level data generally suggests that employment highly correlates with corporate taxable income (as well as other size proxies like assets), using other firm size proxies would likely yield similar results to the ones that are reported in this paper.<sup>12</sup>

### 3 Institutional Background and Data

We study the link between firm size and local business tax choices using the German local business tax as a testing ground. The following section describes the institutional background and the data used for the empirical analysis.

#### *Local Business Taxation in Germany: Institutional Background*

German municipalities autonomously set the local business tax rate, while the definition of the business tax base is determined by federal law and is thus homogenous across municipalities. The tax is levied on business earnings of incorporated and non-incorporated firms located within a municipality's borders. It significantly contributes to the tax burden on businesses in Germany and is also the most important revenue instrument at German municipalities' own discretion.<sup>13</sup> Municipalities set a tax mul-

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if lobbying exerts a positive externality on other firms in the jurisdiction, the relevant firm size measure is again the firm's *expected taxable income*: the positive externality on other firms is larger, the larger this income; finally, jurisdictions may choose lower local business tax rates when they host large firms - relative to their size - because they depend on these large employers and large local business tax payers. If such firms relocated from a jurisdiction, this might severely hit local labor markets and come with negative welfare consequences. Here, the theoretically relevant measure is the firm's employment or the firm's taxable income.

<sup>12</sup>Corporate accounting data for Germany (from the AMADEUS database, see the description below) shows a positive and statistically significant correlation of the log of firms' employment with the log of firms' pre-tax profits of 0.48 and a positive and significant correlation with the log of fixed assets of 0.74. Note that a positive correlation between inputs and profits is also expected on theoretical grounds: Conditional on productivity, higher inputs translate into higher profits; on top of that, firm size tends to correlate positively with productivity and profitability (see e.g. Serrasqueiro and Nunes (2008), Akbas and Karaduman (2012), Lee (2009)).

<sup>13</sup>Liberal professions and non-profit organisations are exempted from local business taxation. Furthermore note that a major fraction of municipalities' revenues comes from state grants and redistributed tax revenues. German municipalities moreover autonomously set the local property tax rate, which, however, is a less important revenue source relative to the local business tax. The majority of local business tax revenues moreover remains directly with the municipalities; only a small share is transferred to the central and regional level as an element of the German federal equalisation scheme,



tiplier, which is measured in business tax points and is multiplied by a base rate ('Messzahl') chosen at the federal level when calculating a firm's tax levy. In our sample period, a proportional base rate of 5% applied for corporations (and for non-incorporated firms on income above EUR 48,000 (Par. 11 Local Business Tax Act)). To ease interpretation, the empirical analysis to come will approximate the local business tax rate in percentage points as the product of a locality's tax multiplier and the base rate of 5%. In our estimation sample (see below), the average municipality set a tax multiplier of 340 business tax points, which corresponds to a tax rate of 17% (cf. Table 1).<sup>14</sup>

Furthermore note that, in all German municipalities, a change in the local business tax rate is enacted by a simple majority of votes in the local council. German municipalities moreover have exactly the same fiscal policy tools at hand and also face the same main responsibilities, including the construction and maintenance of roads, sewerage, kindergartens and primary schools as well as the provision of certain social benefits to the unemployed and the poor. Other responsibilities, such as the maintenance of cultural or sport facilities, tourism, and public transport are optional.

### *Sample Definition and Variable Construction*

The empirical analysis to come draws on a sample of West German municipalities between 2000 and 2007.<sup>15</sup> The analysis disregards small municipalities with (on average over our sample period) less than 2000 inhabitants as anecdotal evidence suggest that small municipalities lack room for strategic policy-making. In line with that notion, we obtain qualitatively comparable, but quantitatively smaller, results to the ones presented below when this restriction is dropped (cf. an earlier working paper version Böhm et al. (2016)).<sup>16</sup> Our main estimation sample comprises 3,835 municipalities and 30,680 municipality-year observations.

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see e.g. Büttner (2003) and Foremny and Riedel (2014).

<sup>14</sup>Note that the results are robust to using an effective local business tax measure, which additionally takes into account that the local business tax was deductible from its own base until 2007.

<sup>15</sup>The sample restriction to West German municipalities and to the years 2000-2007 is data-driven and reflects that the plant data provided by the German Employment Agency (see below), which we use to calculate the firm concentration indices, is available to us for the indicated time period only. East German municipalities are moreover omitted from the analysis as East Germany saw major municipality boundary reforms within our sample frame.

<sup>16</sup>Specifically, it is mostly larger German municipalities which, besides their mandatory spending obligations, provide significant amounts of public goods and services - reflecting prohibitively high per capita provision costs in smaller municipalities (see e.g. Alesina and Spolaore (1997)). As municipalities, moreover, have limited options to take on debt, many small municipalities are reported to only adjust their local business tax rate to balance their mandatory spending.

The sub-national setting furthermore allows us to construct consistent measures for municipalities' firm size patterns. The latter are calculated from the universe of German plants provided by the German Employment Agency (GEA) for 2000 to 2007. The data comprises more than 2 million plants per year and includes information on the host municipality and the number of employees subject to social security contributions (see also Koh and Riedel (2014)). In the following, we use this information to construct the average size  $A_{i,t}$  of firms hosted in municipality  $i$  at time  $t$  as a measure for the absolute size of businesses.

The data is furthermore augmented by rich information on the socio-economic, budgetary and political characteristics of our sample municipalities. We account for the size of economic activity as measured by the municipality's population and number of employees, the economic conditions/fiscal performance of municipalities as measured by the municipalities' unemployment rate and (ln) total revenue as well as (ln) local business tax revenue. The data is moreover augmented by information on public good preferences and financing needs as indicated by the fraction of the municipality's population aged below 15 and above 65 respectively. On top, we include information on the seat shares of the political parties in the municipal council and variables capturing the municipalities' industry structure, namely a proxy for corporate rents from spatial firm concentration.<sup>17</sup> Table 1 presents information on variable definition, data sources and descriptive statistics.

Finally, we add firm-level data from Bureau van Dijk's AMADEUS database, which comprises rich accounting and ownership information on firms in Europe. The subset of the data on German firms is linked to our sample municipalities via post code

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<sup>17</sup>All controls vary at the municipality level. Note, moreover, that information on total revenue and local business tax revenue is obtained from the cashflow statements of municipalities (and have been used in prior work, see e.g. Buettner (2006)). Total revenue includes own tax revenues, income tax and VAT revenues allocated to the municipality as well as grants from the state. The information on local business tax revenues captures actual business tax payments received by municipalities (i.e. pre-payments for the tax are captured at the time when they accrue as are refunds in the case that tax pre-payments exceed firms' actual tax levy). For multi-plant firms, a formula apportionment system applies, implying that the tax base is consolidated at the German federal level and apportioned to municipalities based on plants' payroll shares. Related tax payments are included in the local business tax revenues of each locality (cf. Riedel (2010)). Information on spatial agglomeration rents at the industry level is obtained from prior work (Koh et al. (2013),  $\text{Log } L_{i,t}^{\text{aggl}}$  defined therein). In a previous version of the paper, we also controlled for the income per capita and debt per capita as well as the fraction of non-incorporated firms. Since these variables are only available at the county-level, they are not longer identified in the regressions as we control now in all specifications for county-year fixed effects to absorb common shocks of municipalities located in the same region.

information and is used to construct control variables.<sup>18</sup> For Germany, Bureau van Dijk’s main data source is the German registrar of companies. From the mid 2000s onwards, the data covers nearly all companies with limited liability in Germany. As will be described in the next section, we moreover rely on AMADEUS data for Germany, France and Italy to construct instrumental variables (cf. Section 4 for details).

## 4 Empirical Strategy

As spelled out in Section 2, the aim of our empirical analysis is to assess the impact of the average firm size,  $A_{i,t}$ , on the local business tax choice  $b_{i,r,t}$  in municipality  $i$  of region  $r$  at time  $t$ . We estimate a model of the following form

$$b_{i,r,t} = \alpha_1 + \alpha_2 A_{i,t} + \alpha'_3 X_{i,t} + \rho_{r,t} + \mu_i + u_{i,r,t}. \quad (1)$$

The theoretical considerations predict that a rise in the average size of firms is associated with lower local business tax choices and hence  $\alpha_2 < 0$ . Equation (1) controls for unobserved heterogeneity along two dimensions: First, we include in all specifications municipality fixed effects to absorb time-constant unobserved heterogeneity across sample municipalities. Second, we include in all specifications county-year fixed effects. These absorb common shocks to municipalities in the same county. In particular, they largely absorb - as we will show in a robustness test - spatial interaction between neighboring municipalities.

Moreover, our estimation model controls for the rich set of municipality characteristics described in the previous section (subsumed in the vector  $X_{i,r,t}$ ), thus acknowledging that firm size changes - irrespective of their source - might correlate with changes in jurisdictions’ aggregate economic activity and other socio-economic and budgetary determinants of the local business tax choice. To account for the fact that several control variables might be endogenous (employees, population, share of population < 65 years, share of population > 15 years, unemployment rate as well total revenue), we use their 3-year lagged values in our main specification and assess the sensitivity of this strategy in a robustness test. Note, moreover, that on top of linear models, we run specifications with flexible functional forms of control variables by adding higher order polynomials and interaction terms between regressors.

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<sup>18</sup>On top, we retrieve information from Bureau van Dijk’s DAFNE database, which coincides with the AMADEUS sub-data for Germany but includes additional information, most importantly allows us to identify company relocations within our sample period.

Next to controlling for observed and unobserved heterogeneity, we moreover pursue an instrumental variable strategy to hedge against results that are driven by potential firm size responses to changes in jurisdictions' tax policies - where the direction of the OLS-bias is a priori unclear: low business taxes may attract firms of above average size (biasing the  $\alpha_2$ -estimate upwards in absolute terms) but may simultaneously also foster entrepreneurship and the foundation of new (and, in consequence, small) companies (biasing the  $\alpha_2$ -estimate downwards in absolute terms). Our instrumental variable strategy employs a Bartik-style instrument. In particular, we use a large number of exogenous industry shocks as driver of individual firm size (see Bertrand et al. (2002) and Dharmapala and Riedel (2013) for similar approaches) to model changes in municipalities' aggregate firm size structures. The validity of our excluded instrument relies on two assumptions. First, the tax rate choice in a particular jurisdiction must have no impact on the industry growth rates that are used to predict the change in individual firm sizes in this jurisdiction. Second, the industry-growth rates must affect - conditional on our set of control variables - jurisdictions' tax rate choices only by changing the locality's firm size structure. Since the validity of the first assumption is related to the construction of the instrument, we will discuss both assumptions after describing the construction of the instrument.

Our instrumental variable approach models individual firm size  $\tilde{S}_{k,i,t}$  of entity  $k$  located in municipality  $i$  in year  $t$  as  $\tilde{S}_{k,i,t} = \tilde{S}_{k,i,t-1} \cdot (1 + \tilde{g}_{k,i,t})$ , where  $\tilde{S}_{k,i,t-1}$  stands for  $k$ 's predicted size in period  $t - 1$  and  $\tilde{g}_{k,i,t}$  depicts the predicted size growth of firm  $k$  calculated from common firm size shocks to all other entities  $j$  that are part of the same industry ( $k \neq j$ ). Note that  $\tilde{g}_{k,i,t}$  captures different sources of common firm size variation within industries, among others, shocks to consumer demand, industry regulation, production technology or cost structures. We construct  $\tilde{g}_{k,i,t}$  as a function  $F$  of the average growth rate of other firms in the same industry,  $\tilde{g}_{k,i,t} = F(\sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{(|I_\ell| - 1)})$ , with  $|I_\ell|$  denoting the cardinality of the set of firms  $I_\ell$  in industry  $\ell$  ( $k, j \in I_\ell$ ). The function  $F$  is specified further below, and essentially allows the effect of the average size growth at the industry level on individual firm size growth to differ across firms in different size classes. Based on  $\tilde{g}_{k,i,t}$ , we then determine the size of each firm in our data,  $\tilde{S}_{k,i,t}$ . Note that, as our sample municipalities host firms from many different 4-digit industries (which, moreover, belong to different size classes), firms within one and the same locality may be subject to very different industry shocks. Aggregation of the predicted firm size values  $\tilde{S}_{k,i,t}$  to the jurisdiction level then yields instruments for the average size of entities  $\tilde{A}_{i,t} = \sum_k \tilde{S}_{k,i,t} / K_{i,t}$  in our sample municipalities.

The construction of the instruments draws on Bureau van Dijk's AMADEUS data

(cf. Section 4).<sup>19</sup> We calculate  $S_{k,i,t}$  for all German firms in AMADEUS that were active during our sample period 2000-2007 (derived based on firms' year of incorporation and, if applicable, year of company closure). To avoid inflicting the instrument with endogenous variation in firms' initial size, we assign a uniform size value for all considered entities in 2000 ( $\tilde{S}_{k,i,2000} = \tilde{S}_{2000}$  for all  $k$  and  $i$ ).<sup>20</sup> This ensures that any cross-sectional and longitudinal difference in predicted firm size values relates to variation in  $\tilde{g}_{k,i,t}$ .

The industry growth rate  $\tilde{g}_{k,i,t}$  is constructed based on different samples. Specifically, we draw on balanced samples of French firms, Italian firms and German firms in AMADEUS respectively, for the years between 2000 and 2007. We focus on a balanced panel to avoid that the industry-level growth rates capture any variation related to AMADEUS's increasing firm coverage over time. Moreover, since employment coverage is poor in financial statements data, we use changes in fixed assets to construct the industry shocks. Using German firms is a priori desirable as their size changes reflect European-specific as well as German-specific shocks. The coverage of accounting data for German firms is, however, low in AMADEUS in the early 2000s, implying that the construction of the industry shocks relies on a rather small sample of firms with balanced size information only (around 6000).<sup>21</sup> This implies that industry shocks can be calculated at the 2-digit-NACE level only. In turn, drawing on French or Italian firms for the construction of  $\tilde{g}_{k,i,t}$  allows for a construction at the 4-digit NACE level, reflecting that sample coverage was good in both countries throughout our sample period (for France, we observe 390,000 firms and for Italy 110,000 firms). Both economies are, moreover, comparable to Germany in terms of their geographic location, economic structures, institutional settings and industry composition, making them a suitable

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<sup>19</sup>Note that we cannot draw on the GEA data to calculate  $\tilde{S}_{k,i,t}$  as regulations for researchers' access to the GEA data were tightened over the past years, implying that we can exploit firm size structure variables calculated from the GEA data in prior research (cf. our discussion in Section 4) but cannot use the data for the construction of the instrumental variables. Moreover, note that we observe approx. 400,000 German firms in AMADEUS that were active between 2000 and 2007. While the number of German firms with non-missing balance sheet information in that time frame is limited (see below), the set of 400,000 companies includes firms with missing balance sheet data in some or all of our sample years, as the simulation of  $S_{k,i,t}$  requires information on firms' industry affiliation but not on balance sheet items.

<sup>20</sup>Specifically, we assign a size value of 100 thsd. US Dollars in 2000, where results are insensitive to the particular choice of this starting value. Furthermore note in this context that we measure firm size by corporate fixed assets when calculating size measures based on AMADEUS as the variable is better covered than alternative measures like firm employment (see below).

<sup>21</sup>To avoid obvious endogeneity problems, we disregard firms that are located in the same municipality as the firm under consideration, when constructing  $\tilde{g}_{k,i,t}$  from German firms.

base to calculate  $\tilde{g}_{k,i,t}$ .<sup>22</sup>

Our data also suggests that the described industry-shocks are more strongly correlated with the size development of large firms relative to the size development of smaller entities (see the Online Appendix A for details). This may firstly relate to potential differences in the exposure of small and large firms to industry shocks. On top, the difference may root in the calculation of  $\tilde{g}_{k,i,t}$ , which draws on firms with balanced firm size data between 2000 and 2007. As these entities have above average size, the pattern may relate to the higher underlying similarity of large firms within the same industry and a higher proneness to be subject to the same shocks. To maximise the relevance of our instrumental variable, we account for this heterogeneity when calculating  $\tilde{g}_{k,i,t}$  and estimate a (time-constant industry-independent) parameter  $\gamma_q$  which captures the transmission rate with which the (average) industry growth rate translates into changes in the size growth of firm  $k$  in size class-decile  $q \in \{1, \dots, 10\}$  and write  $\tilde{g}_{k,i,t} = F(\sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{(|I_\ell|-1)}) = \sum_q I_{qk} \cdot \gamma_q \cdot \sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{|I_\ell|-1}$ , with  $I_{qk}$  indicating whether firm  $k$  belongs to size class  $q$ . A more detailed description of the estimation strategy and the results is provided in the Online Appendix A.<sup>23</sup>

Given the construction of our instrument, we believe our instrument to be valid. Firstly, reverse causality is ruled out by construction (even when relying on German firms for the construction of  $\tilde{g}_{k,i,t}$  as we disregard entities in the same municipality as the firm under consideration). Second, we believe that the industry-growth rates affect jurisdictions' tax rate choice only via changes in jurisdictions' firm size structure. This is the case as the consistency of our instrumental variable estimator does not rely on the assumption of exogenous industry shares as we focus on a large number of industry shocks (since we construct them on the 4-digit NACE level) which are uncorrelated with a potential bias from the industry shares. Thus, any bias from the industry shares averages out due to the large number of shocks (see, Kolesar et al. (2015) and Borusyak et al. (2018)). Moreover, our control variables absorb other potential channels how firm size changes may impact a jurisdictions' tax rate choice, namely changes in firm profitability and thus municipality revenue and changes in the state of the labor market (namely the actual and expected unemployment rate, see the Online Appendix B for details on the construction of the forward looking unemployment rate).

To assess the exogeneity of our instruments directly, we, moreover, employ a test of overidentifying restrictions using the instrument calculated based on French and the

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<sup>22</sup>Note that industry shocks are winsorized at the top and bottom 1% level.

<sup>23</sup>The parameters  $\gamma_q$  are estimated with Bureau van Dijk's AMADEUS data for Germany, see the Online Appendix A for details on estimation strategy and results.

instrument calculated based on Italian firms. To assess whether the two instruments rely on different sources of variation, we follow Goldsmith-Pinkham et al. (2018), and construct Rotemberg weights for the two instruments and test for the rank correlation in the top 10, 20 and 50 industries with the largest changes over time (in absolute terms).<sup>24</sup> The French and the Italian firm instruments have different top 10 industries, and only three industries out of the top 20 are the same (p-value of Spearman’s rank correlation test is 0.00). When considering the top 50 industries, we also find that the two instruments rely on different sources of variation (p-value of Spearman’s rank correlation test is 0.74). This suggests that the test of overidentification restrictions will be informative.

## 5 Results

The results are presented in Tables 2. Heteroscedasticity robust standard errors that account for clustering at the municipality level are depicted in brackets below the coefficient estimates. In Specification (1), we estimate the OLS and in Specification (2) the instrumental variable model outlined above using French firms for the construction of the industry shock. The specifications include a full set of municipality and a full set of year fixed effects. The point estimates for the average firm size variable are negative and statistically significant. The instrumental variable point estimate is, however, substantially larger in absolute terms compared to the OLS estimate suggesting a bias in the OLS estimate due to endogenous firm size. Based on the results in Specification (2), we find that a doubling of the average firm size is suggested to lower the business tax rate by 1.6 percentage points or around 9%, evaluated at the sample mean, cf. Table 1. This finding is corroborated in models that augment the vector of regressors by a full set of county-year fixed effects (Specification (3)) and by the controls sketched in Section 3 (cf. Specification (4)). The first stage estimates and test statistics are presented at the bottom of Table 2 and confirm the relevance of the instrument. Similar results are, moreover, derived when we use Italian or German firms to construct the industry shocks for the instrument (cf. Specifications (5) and (6) of Table 2).

To assess whether our excluded instruments are indeed exogenous, we employ a test for overidentifying restrictions in a specification with two instruments (the one

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<sup>24</sup>The Rotemberg weights are the changes in the predicted size of firms in a particular industry between 2000 and 2007. Thus, we construct first the change in the size of firms in a particular 4-digit NACE industry (which vary due to the industry shocks as well as the number of firms in a particular industry), in a second step we calculated the average of the change.

constructed based on French firms and the one constructed based on Italian firms). The F-statistic at the first stage of this model is 11.66, confirming the relevance of the instruments. The Hansen-test, moreover, suggests that the instruments are valid (p-value: 0.61). Given that both instruments rely on different sources of variation as shown above, this supports the notion that our instrumental variable strategy is valid.

Table B1 in the online appendix reports the coefficient estimates for the control variables in Specifications (4)-(6) of Table 2. The point estimates are largely insignificant, except for (ln) employees, industry concentration and the unemployment rate. The estimates suggest that more urban municipalities (log employees) have higher tax rates and that jurisdictions tax industry-related agglomeration rents. Both result are consistent with prior literature. Furthermore, the results imply that municipalities that are hit by an economic shock (unemployment rate) have lower tax rates. This is consistent with countercyclical public tax policy choices.

We run several robustness checks (see Table B2-B5 in the Online Appendix B). First, we reestimate the baseline model but account for clustering of errors at the level of commuting areas (cf. Column (1) in Table B2). Second, we include all control variables squared as well as interacted with municipality size and add a forward looking unemployment rate to the set of regressors (cf. Column (2) in Table B2).<sup>25</sup> Third, we include the tax rate of neighboring jurisdictions (within a 15 kilometer distance radius based on municipality centroids, inverse distance-weighted) as an additional regressor to account for potential spatial policy interactions among jurisdictions (cf. Column (3) in Table B2). In all these specifications, the point estimate for the average firm size and the precision of the estimate is largely unchanged. Next, we rerun our baseline model without municipality fixed effects (but with the full set of county-year fixed effects). This implies that we can use richer variation for empirical identification but it comes at the cost that unobserved heterogeneity across sample municipalities is not absorbed. The results are presented in Columns (4) to (7) of Table B2. Column (4) shows the OLS estimate and Column (5) to (7) report the results based on instrumental variables calculated from industry shocks modelled by French, Italian and German firms respectively. While the instrumental variable point estimates are somewhat lower (around -1.4), they are within the confidence intervals of the results of our main model specifications. Note, moreover, that similar results are derived when we, additionally, instrument the control variable for jurisdiction size with municipalities' population and infrastructure around 1900 (see Table B5 of the Online Appendix).

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<sup>25</sup>See Online Appendix B for details on the construction of the forward looking unemployment rate.



Table B3 of the Online Appendix, moreover, shows that our results remain largely unchanged when we add current-period control characteristics of the sample municipalities (instead of three-year lags). Finally, following our theoretical notion in Section 2, Table B4 in the Online Appendix runs specifications, where the effect of average firm size on jurisdiction’s local business tax rate choices is allowed to vary with jurisdiction size. The results reject the theoretical notion that the firm size-tax link might be larger in smaller jurisdictions.<sup>26</sup>

### *Discussion*

Concluding, our results provide strong evidence for a negative effect of average firm size on local business tax choices. The effect is not only statistically significant but also quantitatively highly relevant: Doubling the average firm size decreases municipalities’ local business tax rate by 9% on average. German cities like Wolfsburg, Ingolstadt and Ludwigshafen, which host the headquarters of the world leading car and chemical manufacturers Volkswagen, Audi and BASF, are for example predicted to would have chosen significantly higher local business tax rates under the counterfactual that these firms were absent: if average business size dropped to the level of other German cities of similar aggregate size, local business tax rates are, *ceteris paribus*, predicted to rise by 27%, 16% and 18% respectively.<sup>27</sup>

Furthermore note that the identified link between firm size and business tax rate choices likely serves as a lower bound for the importance of firm-size-effects on business-related policy choices given that similar effects may emerge in other policy instruments suited to accommodate the corporate sector. In the context of German municipalities, this may e.g. relate to the provision of local public goods and services; at higher government tiers, it may, among others, affect the setting of the federal corporate tax rate and

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<sup>26</sup>Note that in prior working paper versions of this paper, we showed that characteristics of the jurisdiction’s relative firm size structure, like the Herfindahl index or the employment share of the largest firm, yield no significant effect on local business tax choices, once average firm size is included.

<sup>27</sup>The log-difference in average firm size between the city of Wolfsburg (hosting around 122 thousand inhabitants during our sample period) and other cities of comparable size (with an average population between 100 and 200 thsd. inhabitants during our sample period) is 3.23. A corresponding decrease in average firm size is predicted to raise Wolfsburg’s local business tax by 4.8 percentage points or 27%, evaluated at Wolfsburg’s average business tax during our sample period (=18%). The relative adjustments for Ingolstadt and Ludwigshafen are calculated accordingly. Furthermore note, that in line with our theoretical considerations, all three cities levy local business tax rates that are significantly lower than the ones of other cities of comparable size (18.78% vs. 21.27%). On top of that, note that similar findings emerged in a complementary analysis which exploits municipality amalgamations in East Germany for empirical identification (cf. Böhm et al. (2016)).

the tax base definition as well as the assignment of public grants and regulatory provisions.<sup>28</sup> Note that empirically identifying firm-size-effects in other policy instruments may be difficult though - thus underlining the suitability of our testing ground. Firstly, at higher government tiers, the wide and complex set of policy instruments available to accommodate the corporate sector may imply that benefits granted to businesses are spread out across different policy measures, thus making it challenging to identify firm-size-effects for individual instruments. Studying business taxation furthermore offers the benefit that business tax reductions/increases can be directly interpreted as 'business-(un)-friendly' policies, contrary to other policy areas, like government spending, where public information is not available at a sufficiently disaggregated level to identify business-friendly and business-unfriendly shifts in jurisdictions' policy choices.

### *Transmission Channel*

Our discussion in Section 2 identified lobbying and firm mobility as potential theoretical drivers of the 'firm size-tax choice' link. The aim of this sub-section is to assess the relative importance of the two transmission channels. This is of particular interest as efficiency consequences starkly differ between the mechanisms.<sup>29</sup> Precisely, if business lobbies spend resources to deviate corporate tax policies in their favour and away from the social optimum, welfare is harmed. On the contrary, corporate tax adjustments in response to differences in the underlying mobility of hosted entities or in response to implicit or explicit relocation threats of large employers are, from the perspective of the individual jurisdiction, in line with welfare maximizing behavior.<sup>30</sup>

To assess the importance of firm mobility as a driver of our results, we make use of Bureau van Dijk's data for Germany to construct three firm-level mobility measures<sup>31</sup>: Firstly, we define an indicator for the affiliation of firms with a multinational and national group respectively. Precisely, firms are coded to be affiliated with a multinational group if one of their majority-owned affiliates or one of their parent firms

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<sup>28</sup>Which instrument is used (and which policy adjustments firms lobby for) thereby depends on the benefit of given policy adjustments for the businesses involved and the welfare costs associated with that change (see e.g. Grossman and Helpman (1994)).

<sup>29</sup>Distributive predictions coincide, with both mechanisms suggesting that increases in firm size go along with a reduction in corporate tax rates (at the expense of other agents in the economy).

<sup>30</sup>From an international perspective, decentralised corporate tax setting behaviour may exert externalities on foreign jurisdictions, which may render decentralised policy choices inefficient.

<sup>31</sup>Specifically, we make use of a version of the so-called DAFNE data, which coincides with the AMADEUS information for Germany, but offers the advantage that ownership changes and firm relocations are accounted for in our data version and information on postal codes allows to identify the host municipality of the identified firms.

(owning at least 50% of ownership stakes) is located in a foreign country. Analogously, firms are defined to belong to a national group if one of their majority-owned subsidiaries or a parent (owning at least 50% of ownership stakes) is located in another German municipality. To further model the mobility of individual firms, we determine the elasticity with which businesses' fixed asset investments expand in response to corporate tax decreases, estimated based on Bureau van Dijk's AMADEUS data for narrowly defined subsets of firms. Specifically, tax elasticities are allowed to vary with observed mobility correlates, namely firm size (cf. Section 2), industry affiliation (capturing differences related to the (in)tangible nature of main production factors) and the size of a firm's host jurisdiction (capturing differences related to mobility-reducing agglomeration rents). On top, we allow for unobserved mobility drivers by letting tax elasticities vary between high, medium and low-tax jurisdictions. This follows the theoretical notion that hosting high-mobility firms (irrespective of the source of the mobility-advantage) goes along with low local business tax choices of municipalities. In total, we derive tax elasticities for 543 subsets of firms (that vary in all four 'heterogeneity dimensions' and are estimated based on around 2.5 million firm-year observations). See the Online Appendix C for further details on the estimation strategy and results.

We estimate the described tax elasticities based on tax variation that stems from a *federal* corporate tax reform in 2008, which, firstly, lowered incorporated firms' federal corporate tax rate by 10 percentage points, while leaving the tax burden of unincorporated entities (taxed on a pass-through basis) unchanged and, secondly, abolished the deductibility of the local business tax from its own tax base and from the corporate tax base and altered the base rate ('Messzahl'), with which the local business tax multipliers set by municipalities are multiplied when calculating the local business tax levy, see Section 4 and the Online Appendix C for details.<sup>32</sup> All described changes affect the tax burden on businesses in Germany and are exploited for empirical identification. The model is estimated based on Bureau van Dijk's AMADEUS data for Germany between 2004 and 2010. Note that, if differences in firm mobility are indeed a significant driver of the 'firm size-tax choice' link, we expect mobile firms - proxied by multinational and national group affiliation and high tax-elasticities - to have above average size and simultaneously face low local business taxes in their host jurisdiction. The online appendix confirms a positive link of firm size with the absolute assigned

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<sup>32</sup>In unreported robustness checks, we additionally estimate tax elasticities based on variation in municipalities' local business tax multipliers. Results are basically unchanged and available upon request from the authors.

tax elasticities.

Additionally, we assess the importance of lobbying as a driver of our results. Research on corporate sector influence on policy-making faces the challenge that systematic information on firms' lobbying effort is hard to come by. Recent studies for the US draw on entities' direct monetary contributions to candidates running for political office, provided by the Federal Election Commission. Information on indirect lobby efforts, e.g. related to the time spent by firm representatives in meetings with politicians or bureaucrats often remains unacknowledged though. In the following, we account for both means of political influence by coding firms as lobby-active if they either make significant monetary contributions to German political parties or spend time engaging with politicians and bureaucrats. Precisely, we make use of data on donations to German political parties exceeding the threshold value of 50,000 Euros, which have to be published by German law (Par. 25 Parteiengesetz). The data is available from 2002 onwards and is linked to the AMADEUS database by name matching procedures.<sup>33</sup> This information is complemented by data on interactions of firms with political representatives. As such data is missing for the local level, we turn to information on corporate interactions with political representatives at the national and supranational level. At the German national level, we rely on a list of entities holding permanent access passes to the premises of the German parliament. The list was published by the German parliament following a decision by the higher administrative court of Berlin-Brandenburg in 2015 ruling that the parliament must disclose holders of access passes to its premises as well as the parliamentary group which granted the access pass. The published list comprises more than 1100 representatives which held such passes between 2013 and 2015. Complementary, we draw on the European Union's Transparency Register, which is jointly operated by the European Parliament and the European Commission, and lists entities that engage in activities designed to influence decision-making in EU institutions. The register was initially founded by the EU Commission in 2008 and was expanded in 2011, when the parliament joined the initiative. Signing up with the registry is voluntary but there are several incentives for entities to register: Among others, registration is required for meetings with EU representatives or participation in expert groups as well as for access to the premises of the European Parliament; registered entities moreover receive automatic information on public consultations or Commission activities and initiatives. In total, around 11,000 entities registered with the registry

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<sup>33</sup>Note that we link firm names as well as the names of individual owners of German companies. Firms owned by individuals donating money to political parties are coded as politically active. In total, the database comprises 450 donations between 2002 and today.

to date.

In the following, firms are coded as lobby active if they make significant party donations or appear on the access-pass list of the German parliament or in the EU's Transparency Register. Beyond the lobbying entities identified, all affiliated companies (i.e. majority-owned subsidiaries or parent firms holding more than 50% of ownership stakes) are included in the definition of lobbying firms. In total, 4,887 firms are coded as lobby-active. The derived lobbying indicator serves as a proxy for lobbying behaviour at the local level under a number of assumptions. Firstly, the construction presumes an underlying general propensity of firms to engage in lobbying, i.e. a positive correlation between lobbying at higher and lower government tiers. Secondly, we assume time-constant political engagement as firms are coded as lobby-active if they are observed to engage in lobbying in any sample-year or post-sample year. This follows the notion that influence on political decision-making relies on (potentially unobserved) constant relationship building and constant communication with political decision makers.<sup>34</sup> Finally note that the lobbying variable is aggregated to the municipality-level by calculating asset-weighted firm-averages.

The results for the channel analysis are reported in Table 3. Column (1) shows the baseline model without municipality fixed effects (cf. also Table B2 in the Online Appendix).<sup>35</sup> Specification (2) includes our first mobility proxy, the average tax elasticity of hosted entities estimated based on tax variation induced by the federal corporate tax reform in 2008.<sup>36</sup> In Specification (3), we, furthermore, add the fraction of firms per municipality that are part of a multinational and domestic group respectively as additional firm mobility controls. The result of these two specifications supports the

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<sup>34</sup>The EU Transparency Register and the access pass-list of the German parliament comprise information from our post-sample period only, implying that firms that were lobby-active between 2000 and 2007 but closed-down or ceased their lobby-behaviour after 2007 are not captured in our analysis.

<sup>35</sup>Note that this section relies on models without municipality fixed effects (which yield similar coefficient estimates for the average firm size variable as the models with municipality fixed effects) since our mobility and lobbying controls do not exhibit time-series variation. Moreover, we rely on the instrument calculated based on industry shocks to German firms, which is somewhat stronger on the first stage than the instruments calculated based on French and Italian firms (but yields similar point estimates, cf. Table B2 of the Online Appendix).

<sup>36</sup>Note that we winsorized the 543 derived elasticities at the 5% level before assigning them back to individual firms and before taking municipality-averages (see the online appendix for details). Results are unchanged if we do not winsorize or only winsorize at the 1% level. Results are also very similar when we do not only use the federal corporate tax reform in 2008 to identify the tax elasticities but also variation in local business tax rates. See a prior working paper version of this paper for details and results (Riedel and Simmler (2018)).

notion that municipalities choose lower local business tax rates when they host mobile firms. Precisely, the coefficient estimate for the MNE-variable turns out negative (although only marginally statistically significant, p-value: 0.103), while the coefficient estimate for the average corporate tax elasticity is positive and significant (- note that an increase in the *negative* average tax elasticity of firms per jurisdiction corresponds to an absolute decrease in the variable). Adding the mobility controls to the estimation model, moreover, significantly reduces the absolute coefficient estimate for the firm size variable (by more than 90%), suggesting that the firm mobility channel is an important driver of the effect of interest. Specification (4) reruns the baseline model in Specification (1) of Table 3 but includes the lobbying control in the set of regressors. Specification (5), moreover, includes both, the lobbying controls and the mobility controls at the same time. While the lobbying control turns out negative, the point estimate for the average firm size variable is almost unchanged. Note that these results are robust to different sensitivity checks. First, in a prior working paper version (Riedel and Simmler (2018)), we show that comparable findings are derived when we use predicted lobby propensities of firms (based on observed characteristics) instead of the actual lobbying activity as in the main analysis. Second, similar results emerge when we do not instrument average firm size and when we instrument additionally jurisdiction size with long lagged population and infrastructure information (drawn from Koh et al. (2013)), see Table B5 in the Online Appendix.

Concluding, the estimates assign about 90% of the effect to the mobility channel. The lobbying channel is suggested to be largely irrelevant. Note, however, that these estimates yield lower bounds for the true importance of firm mobility and lobbying as drivers of our results since mobility and lobbying controls are unlikely to capture all differences in the mobility characteristics and lobbying behaviour across firms.<sup>37</sup> The analysis hence yields bounds for the relative importance of the two mechanisms, with at least 90% of the effect being assigned to the mobility channel and up to 10% to the lobbying channel.<sup>38</sup>

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<sup>37</sup>In line with these considerations, the coefficient estimate for the average firm size variable is still negative (albeit quantitatively small and statistically insignificant) when both, the mobility and the lobbying control variables are included (cf. Specification (5) of Table 3).

<sup>38</sup>Note that the importance of the mobility and lobbying channel in establishing a link between firm size and local business tax choices must not necessarily correspond to the relative importance of the direct effects of firm mobility and lobbying on local business tax choices. From a theoretical perspective, the importance of the two mechanisms for the 'firm size-tax' link depends on the structure of corporate mobility and lobbying costs. If fixed costs to engage in lobbying at the local level are e.g. small, firms may engage in significant lobbying activities irrespective of their size, which - if effective - result in low local business tax rates. The lobby-driven correlation between firm size and

## 6 Summary and Conclusion

The paper presents evidence for a systematic link between jurisdictions' firm size structure and government policies. Using the German local business tax as a testing ground, we provide evidence for an inverse relationship between the average firm size in German municipalities and their local business tax choices. The effect is statistically significant and quantitatively relevant and prevails in various sensitivity checks.

The findings suggest that differences in firm size structures across jurisdictions add to explaining observed heterogeneity in governments' tax policy choices. Recent decades' merger and acquisition waves and the trend towards more concentration of economic activity (especially in emerging markets and the developing world) may thus not be neutral in terms of governments' tax policy choices and may lead to more favourable tax conditions for the corporate sector. Finally note that our findings may also extend to other policy areas, including, among others, the provision of public goods and services, the assignment of public grants or product and labor market regulations - suggesting that firm size structures may also play a role in explaining regulatory capture and public fund allocation in these fields.

## References

- Akbas, H. E. and Karaduman, H. A. (2012). The effect of firm size on profitability: An empirical investigation on turkish manufacturing companies. *European Journal of Economics, Finance and Administrative Sciences*, 55:21–27.
- Alesina, A. and Spolaore, E. (1997). On the number and size of nations. *The Quarterly Journal of Economics*, 112(4):1027–1056.
- Baldwin, R. and Okubo, T. (2009). Tax reform, delocation, and heterogeneous firms. *The Scandinavian Journal of Economics*, 111(4):741–764.
- Baldwin, R. E. and Krugman, P. (2004). Agglomeration, integration and tax harmonisation. *European Economic Review*, 48(1):1 – 23.

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local business tax choices would nevertheless be small in such a scenario. Analogously, moderate fixed relocation costs would imply high mobility rates among small and large firms, potentially resulting in low local business tax choices, while the mobility-driven correlation between firm size structures and local business tax choices would nevertheless be small.

- Barth, C. (2011). 29 companies that paid millions for lobbying (and didn't pay taxes). *Forbes*, December 14, 2011.
- Bertrand, M., Mehta, P., and Mullainathan, S. (2002). Ferreting out tunneling: An application to indian business groups. *The Quarterly Journal of Economics*, 117(1):121–148.
- Bischoff, I. and Krabel, S. (2017). Local taxes and political influence: evidence from locally dominant firms in german municipalities. *International Tax and Public Finance*, 24(2):313–337.
- Blau, B. M., Brough, T. J., and Thomas, D. W. (2013). Corporate lobbying, political connections, and the bailout of banks. *Journal of Banking and Finance*, 37(8):3007 – 3017.
- Böhm, T., Riedel, N., and Simmler, M. (2016). Large and influential: firm size and governments' corporate tax rate choice? *Oxford University Centre for Business Taxation*, Working Paper(16/05).
- Bombardini, M. (2008). Firm heterogeneity and lobby participation. *Journal of International Economics*, 75(2):329 – 348.
- Borusyak, K., Hull, P., and Jaravel, X. (2018). Quasi-experimental shift-share designs. Working Paper.
- Brühlhart, M., Jametti, M., and Schmidheiny, K. (2012). Do agglomeration economies reduce the sensitivity of firm location to tax differentials? *The Economic Journal*, 122(563):1069–1093.
- Brühlhart, M. and Simpson, H. (2018). Agglomeration economies, taxable rents and government capture: evidence from a place-based policy. *Journal of Economic Geography*, 18(2):319–353.
- Büttner, T. (2003). Tax base effects and fiscal externalities of local capital taxation: evidence from a panel of german jurisdictions. *Journal of Urban Economics*, 54(1):110 – 128.
- Cave, T. and Rowell, A. (2014). The truth about lobbying: 10 ways big business controls government. *The Guardian*, March 12, 2014.
- Cefis, E., Marsili, O., and Schenk, H. (2009). The effects of mergers and acquisitions on the firm size distribution. *Journal of Evolutionary Economics*, 19(1):1–20.



- Crouch, C. (2004). *Post-Democracy*. John Wiley and Sons, New York.
- Devereux, M. P., Lockwood, B., and Redoano, M. (2008). Do countries compete over corporate tax rates? *Journal of Public Economics*, 92(5):1210 – 1235.
- Dharmapala, D. (2014). What do we know about base erosion and profit shifting? a review of the empirical literature. *Fiscal Studies*, 35(2):421–448.
- Dharmapala, D. and Riedel, N. (2013). Earnings shocks and tax-motivated income-shifting: Evidence from european multinationals. *Journal of Public Economics*, 97(2):95–107.
- Facchini, G., Mayda, A. M., and Mishra, P. (2011). Do interest groups affect us immigration policy? *Journal of International Economics*, 85(1):114 – 128.
- Foremny, D. and Riedel, N. (2014). Business taxes and the electoral cycle. *Journal of Public Economics*, 115(Supplement C):48 – 61.
- Garcia-Santana, M. and Ramos, R. (2012). Dissecting the size distribution of establishments across countries. *CEMFI Working Paper*, (No. 1204).
- Goldberg, P. K. and Maggi, G. (1999). Protection for Sale: An Empirical Investigation. *American Economic Review*, 89(5):1135–1155.
- Goldsmith-Pinkham, P., Sorkin, I., and Swift, H. (2018). Bartik instruments: What, when, why, and how. Working Paper 24408, National Bureau of Economic Research.
- Grossman, G. and Helpman, E. (2001). *Special Interest Politics*. MIT Press.
- Grossman, G. M. and Helpman, E. (1994). Protection for sale. *American Economic Review*, 84(4):833–850.
- Jofre-Monseny, J. (2013). Is agglomeration taxable? *Journal of Economic Geography*, 13(1):177–201.
- Jofre-Monseny, J. and Solé-Ollé, A. (2012). Which communities should be afraid of mobility? the effects of agglomeration economies on the sensitivity of employment location to local taxes. *Regional Science and Urban Economics*, 42(1):257 – 268.
- Koh, H.-J. and Riedel, N. (2014). Assessing the Localization Pattern of German Manufacturing and Service Industries: A Distance-based Approach. *Regional Studies*, 48(5):823–843.

- Koh, H.-J., Riedel, N., and Böhm, T. (2013). Do governments tax agglomeration rents? *Journal of Urban Economics*, 75(Supplement C):92 – 106.
- Kolesar, M., Chetty, R., Friedman, J., Glaeser, E., and Imbens, G. W. (2015). Identification and inference with many invalid instruments. *Journal of Business & Economic Statistics*, 33(4):474–484.
- Lee, J. (2009). Does size matter in firm performance? evidence from us public firms. *International Journal of the Economics of Business*, 16(2):189–203.
- Ludema, R. D. and Wooton, I. (2000). Economic geography and the fiscal effects of regional integration. *Journal of International Economics*, 52(2):331 – 357.
- Luthi, E. and Schmidheiny, K. (2014). The effect of agglomeration size on local taxes. *Journal of Economic Geography*, 14(2):265–287.
- Melitz, M., Helpman, E., and Yeaple, S. (2004). Export versus fdi with heterogeneous firms. *The American Economic Review*, 94(1):300–316.
- Olson, M. (1965). *The logic of collective action : public goods and the theory of groups / Mancur Olson*. Harvard economic studies: 124. Cambridge [u.a.] Harvard Univ. Press 1965.
- Overesch, M. and Rincke, J. (2011). What drives corporate tax rates down? a reassessment of globalization, tax competition, and dynamic adjustment to shocks. *The Scandinavian Journal of Economics*, 113(3):579–602.
- Poschke, M. (2014). The firm size distribution across countries and skill-biased change in entrepreneurial technology. *mimeo*.
- Richter, B. K., Samphantharak, K., and Timmons, J. F. (2009). Lobbying and taxes. *American Journal of Political Science*, 53(4):893–909.
- Riedel, N. and Simmler, M. (2018). Large and influential: Firm size and governments’ corporate tax rate choice. *CESifo Working Paper Series*, 6904.
- Roach, B. (2007). Corporate power in a global economy. *Global Development and Environment Institute, Tufts University*.
- Salamon, L. M. and Siegfried, J. J. (1977). Economic power and political influence: The impact of industry structure on public policy. *American Political Science Review*, 71(3):1026–043.

Serrasqueiro, Z. and Nunes, P. (2008). Performance and size: Empirical evidence from portuguese smes. *Small Business Economics*, 31(2):195 ? 217.

UNCTAD (2002). *World Investment Report 2002, Transnational Corporations and Export Competitiveness*. UNCTAD/WIR/2002. United Nations, New York and Geneva.

## 7 Tables

**Table 1: Descriptive Statistics for 2000 to 2007**

Variable	No. of Obs.	Mean	Std. Dev.	Min	Max
Local Business Tax	30,680	17.004	1.711	10	25
Log Average Firm Size	30,680	2.196	0.454	0.794	4.393
Population	30,680	14,675	42,929	1,861	1,302,067
Population Share > 65	30,680	0.176	0.031	0.056	0.392
Population Share < 15	30,680	0.166	0.021	0.057	0.256
Employees	30,680	5,023	21,216	57	695,650
Unemployment Rate	30,680	0.031	0.012	0	0.107
Revenue (in thsd. Euros)	30,680	27,459	133,420	2	5,775,026
Share Conservative Party (CDU/CSU)	30,680	0.368	0.192	0	1
Share Social Democrats (SPD)	30,680	0.241	0.166	0	1
Share Green Party	30,680	0.026	0.043	0	.375
Share Farleft Parties	30,680	0.000	0.003	0	0.069
Share Farright Parties	30,680	0.001	0.007	0	0.226
Industry Concentration	30,680	0.244	0.600	0	6.300
Tax Sensitivity	30,680	-1.231	0.110	-1.625	-0.520
Share Multinational Firms	30,680	0.066	0.082	0	0.332
Share Domestic Group	30,680	0.212	0.071	0	0.333
Share Lobby Firms	30,680	0.017	0.088	0	0.992

Notes: The table presents descriptive statistics for the sample years 2000-2007. 'Local Business Tax' depicts municipalities' local business tax in percentage points. 'Log Average Firm Size' is the natural logarithm of the average size of firms hosted in a municipality in a given year (uniformly weighted), calculated based on data from the German Employment Agency. 'Population' depicts a municipality's number of inhabitants (obtained from German Federal Statistical Offices and their publication "Statistik Lokal"), 'Population Share > 65' and 'Population Share < 15' indicate the share of a locality's inhabitants older than 65 and younger than 15. 'Employees' is the number of employees and unemployment rate the share of unemployed people in the considered municipality (obtained from the Federal Employment Agency). 'Revenue' stands for total revenue. 'Share Conservative Party (CDU/CSU)', 'Share Social Democrats (SPD)', 'Share Liberals (FDP)', 'Share Farleft Parties', 'Share Farright Parties' indicate the seat shares in the local councils for the respective parties and party groups. Note that the shares do not sum up to one as a significant fraction of local council seats is held by civil parties that are difficult to classify in the traditional left-right-spectrum. The described control variables were obtained from the Federal Statistical Offices in Germany. Industry concentration stems from Koh et al (2013). 'Tax Sensitivity' is the average semi-elasticity of fixed asset investment w.r.t. the changes in business taxation for firms in a given host jurisdiction. These semi-elasticities are determined for different sub-sets of firms, defined based on firm size, industry affiliation and the host jurisdiction's population size and business tax rate (see Section 5 and the online appendix for details). 'Share Multinational Firms' is the asset-weighted fraction of firms in a given jurisdiction that operate internationally, defined by ownership links to parent firms (owning at least 50% of ownership shares) and majority-owned subsidiaries. Analogously, 'Share Domestic Groups' depicts the share of firms that are affiliated with domestic groups in the sense that they have parent firms (owning at least 50% of ownership shares) or majority-owned subsidiaries that operate in another German municipality. 'Share Lobby Firms' depicts the asset-weighted share of firms within a municipality that are identified as lobbyists (cf. Section 5 for details).

<b>Table 2: Baseline Results</b>						
	(1)	(2)	(3)	(4)	(5)	(6)
Log Average Firm Size	-0.1470*** (0.0542)	-1.5776** (0.7692)	-1.5182** (0.7532)	-1.6740* (0.8726)	-1.8215** (0.9125)	-1.5749** (0.7554)
Observations	30,680	30,680	30,680	30,680	30,680	30,680
Municipality FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	no	no	no	no
County-year FE	no	no	yes	yes	yes	yes
Controls	no	no	no	yes	yes	yes
IV (countries)		France	France	France	Italy	Germany
F statistic		26.78	22.70	22.42	22.23	29.96
Under-Identification p-value		0.00	0.00	0.00	0.00	0.00
First Stage: Point Estimate						
Excl. Instrument		1.7295*** (0.3342)	1.6455*** (0.3454)	1.4059*** (0.2969)	1.2381*** (0.2626)	2.9614*** (0.5410)

Notes: Robust standard errors that account for clustering at the municipality level in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. See the notes to Table 1 for a definition of variables.

<b>Table 3: Channel Analysis</b>					
	(1)	(2)	(3)	(4)	(5)
Log Average Firm Size	-1.4180*** (0.4621)	-0.2867 (0.4311)	-0.1304 (0.4977)	-1.4142*** (0.4632)	-0.1514 (0.4940)
Tax Sensitivity		2.7084*** (0.1799)	2.7237*** (0.1814)		2.7262*** (0.1813)
Share Multinational Firms			-0.4218 (0.2586)		-0.3388 (0.2517)
Share Domestic Groups			0.0215 (0.1782)		0.0174 (0.2517)
Share Lobby Firms				-0.1938 (0.2026)	-0.3751* (0.2051)
Observations	30,680	30,680	30,680	30,680	30,680
Municipality FE	no	no	no	no	no
County-year FE	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes
IV (countries)	Germany	Germany	Germany	Germany	Germany
F statistic	71.16	64.54	50.36	70.69	50.99
Under-Identification p-value	0.00	0.00	0.00	0.00	0.00
First Stage: Point Estimate					
Excl. Instrument	8.3817*** (0.9936)	8.0683*** (1.0043)	6.9919*** (0.9852)	8.3554*** (0.9937)	7.0333*** (0.9849)

Notes: Robust standard errors that account for clustering at the municipality level in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. See the notes to Table 1 for a definition of variables.

# Online Appendix

## Appendix A: Construction of the Instrumental Variable

Table A1 presents results for the estimation of  $\gamma_q$ . As described in the main text,  $\gamma_q$  captures how corporate fixed assets of German firms in size decile  $q$  respond to 'industry shocks', i.e. to fixed asset changes of other firms in the same industry.  $\gamma_q$  is then used to construct the instrumental variables for our sample frame: namely, industry-shock-driven changes in individual firm size are modelled as  $\tilde{S}_{k,i,t} = \tilde{S}_{k,i,t-1}(1 + \tilde{g}_{k,i,t})$ , with  $\tilde{g}_{k,i,t} = \sum_q I_{qk} \cdot \gamma_q \cdot \sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{|I_\ell| - 1}$ . See Section 4 for further details.

$\gamma_q$  hence needs to be estimated for firms located in Germany and being assigned to different size deciles  $q$ . Since accounting information for German entities is often missing before the mid 2000s (when registrar information became available within AMADEUS/DAFNE), cf. Section 4, we determine  $\gamma_q$  drawing on data for German firms between 2006 and 2010 and estimate a model of the following form:

$$\text{Log } FA_{k,t} = a_k + \rho_t + \sum_{q=1}^{10} I_{qk} \cdot \gamma_q \cdot \text{Log } \overline{FA}_{k,t} + \mu_{k,t} \quad (2)$$

where  $\text{Log } FA_{k,t}$  describes the natural logarithm of the fixed assets of firm  $k$  at time  $t$  and  $\text{Log } \overline{FA}_{k,t}$  describes the natural logarithm of the average fixed assets of other firms in the same 4-digit industry as firm  $k$  at time  $t$ .  $I_{qk}$  is a dummy variable indicating if firm  $k$  belongs to size decile  $q$ . All specifications furthermore include a full set of firm fixed effects and year fixed effects. The sample comprises German firms with balanced fixed asset information between 2006 and 2010. Analogously,  $\text{Log } \overline{FA}_{k,t}$  is calculated based on firms with balanced asset information (to avoid that  $\text{Log } \overline{FA}_{k,t}$  captures variation related to changing firm coverage in AMADEUS over time, see also our argumentation in the main text).

<b>Table A1: Estimation of <math>\gamma_q</math></b>		
	(1)	(2)
Log Avg. Fixed Assets	-0.0435*** (0.0026)	-0.0382*** (0.0026)
Log Avg. Fixed Assets X Decile 2	0.0081*** (0.0019)	0.0086*** (0.0019)
Log Avg. Fixed Assets X Decile 3	0.0068*** (0.0019)	0.0074*** (0.0019)
Log Avg. Fixed Assets X Decile 4	0.0190*** (0.0019)	0.0191*** (0.0019)
Log Avg. Fixed Assets X Decile 5	0.0177*** (0.0019)	0.0175*** (0.0020)
Log Avg. Fixed Assets X Decile 6	0.0298*** (0.0020)	0.0293*** (0.0020)
Log Avg. Fixed Assets X Decile 7	0.0555*** (0.0022)	0.0542*** (0.0022)
Log Avg. Fixed Assets X Decile 8	0.0903*** (0.0024)	0.0876*** (0.0025)
Log Avg. Fixed Assets X Decile 9	0.1410*** (0.0031)	0.1358*** (0.0032)
Log Avg. Fixed Assets X Decile 10	0.2116*** (0.0055)	0.2012*** (0.0057)
Observations	2,537,194	2,537,194
R-squared	0.8529	0.8536
Municipality FE	yes	yes
Year FE	year	year+size

Note: Robust standard errors that account for clustering at the municipality level in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. The definition of the 10 groups corresponds to the deciles of the fixed asset distribution, namely Decile 1: firms with fixed assets of less than 4 thsd. US Dollars, Decile 2: firms with fixed assets of more than 4 thsd. US Dollars and less than 13 thsd. US Dollars, Decile 3: firms with fixed assets of more than 13 thsd. US Dollars and less than 26 thsd. US Dollars, Decile 4: firms with fixed assets of more than 26 thsd. US Dollars and less than 43 thsd. US Dollars, Decile 5: firms with fixed assets of more than 43 thsd. US dollars and less than 75 thsd. US dollars, Decile 6: firms with fixed assets of more than 75 thsd. US Dollars and less than 138 thsd. US Dollars, Decile 7: firms with fixed assets of more than 138 thsd. US Dollars and less than 289 thsd. US Dollars, Decile 8: firms with fixed assets of more than 289 thsd. US dollars and less than 724 thsd. US dollars, Decile 9: firms with fixed assets of more than 724 thsd. US Dollars and less than 2713 thsd. US Dollars, Decile 10: firms with fixed assets of more than 2713 thsd. US dollars. Specification (1) includes municipality plus year fixed effects, Specification (2) furthermore allows year effects to vary across size classes.

Note moreover that the construction of  $\text{Log } \overline{FA_{k,t}}$  corresponds to the construction of  $\sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{|I_\ell|-1}$  in the sense that the same country-set of firms is used to model the industry shock. If, e.g., firms from France are used to construct  $\sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{|I_\ell|-1}$ , then the same country-set of firms is used to construct  $\text{Log } \overline{FA_{k,t}}$  for the estimation of  $\gamma_q$ . On top, when calculating  $\text{Log } \overline{FA_{k,t}}$ , firms are reweighted such that their size distribution corresponds to the size distribution of firms used to calculate  $\sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{|I_\ell|-1}$ .<sup>39</sup>

<sup>39</sup>As described in the main text,  $\sum_{j \in I_\ell, j \neq k} \frac{g_{j,t}}{|I_\ell|-1}$  is calculated based on firms with balanced



The results are presented in Table A1 and show that the firm size development of small firms is not or even moderately negatively correlated with the size development of others firms in the same industry. For large firms, especially firms in the top size decile, this correlation turns positive and is quantitatively relevant. As described in the main text, the observed response-heterogeneity may, firstly, reflect different exposure of large and small firms to industry shocks and, secondly, root in the fact that large firms are overrepresented in the calculation of the industry shocks as described above. From the estimated  $\gamma_q$  and the calculated industry shocks  $(\tilde{g}_{i,k,t})$ , we simulate the average firm size  $\tilde{A}_{it}$  and  $\tilde{H}_{it}$ , as described above and in the main text.

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asset information between 2000-2007. Depending on the country-set used, this implies that the industry-shocks are calculated from firms with above average size. Reweighting firms when calculating  $\text{Log } \overline{FA_{k,t}}$  to match this size distribution ensures that  $\gamma_q$  analogously captures transmission rates for shocks calculated based on firms with above average size.

## Appendix B: Additional Tables

Table B1 presents the coefficient estimates for the control variables in Specifications (4) to (6) of Table 2 in the main text.

<b>Table B1: Control Variables, Specifications (4) to (6), Table 2</b>			
	(4)	(5)	(6)
L3.Log Employees	0.5010 (0.3085)	0.5524* (0.3218)	0.4666* (0.2685)
L3.Log Population	2.3111 (3.8076)	2.1205 (3.8588)	2.4392 (3.7513)
L3.Log Population, sqrd.	-0.1681 (0.2216)	-0.1581 (0.2243)	-0.1747 (0.2189)
L3.Log Revenue	0.0016 (0.0253)	0.0008 (0.0257)	0.0021 (0.0250)
Industry Concentration	0.1666* (0.0990)	0.1805* (0.1017)	0.1573* (0.0896)
L3.Population Share > 65	0.5196 (1.4307)	0.5016 (1.4456)	0.5316 (1.4196)
L3.Population Share < 15	-0.2707 (1.3398)	-0.2817 (1.3596)	-0.2633 (1.3273)
L3.Unemployment Rate	-4.2013** (1.7731)	-4.2549** (1.7916)	-4.1652** (1.7462)
Share Concervative Party (CDU/CSU)	-0.0758 (0.0821)	-0.0795 (0.0832)	-0.0732 (0.0807)
Share Social Democrats (SPD)	-0.1729 (0.1106)	-0.1745 (0.1113)	-0.1718 (0.1099)
Share Liberals (FDP)	0.2647 (0.3605)	0.2543 (0.3617)	0.2718 (0.3571)
Share Green Party	0.0750 (0.3100)	0.0882 (0.3132)	0.0661 (0.3064)
Share Farleft Parties	-2.8855* (1.6853)	-2.8985* (1.6979)	-2.8767* (1.6778)
Share Farright Parties	-0.2095 (0.7121)	-0.2480 (0.7180)	-0.1836 (0.6992)

Notes: Robust standard errors that account for clustering at the municipality level in brackets. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. Please see the notes to Table 1 for a definition of the variables.

Table B2 presents a first set of robustness test. Specification (1) reestimates our baseline model but accounts for clustering of errors at the level of commuting zones (instead of municipalities as in the baseline analysis). The coefficient estimate for the average firm size variable remains statistically significant. In Column (2), we expand our set of control variables and include also all control variables squared as well as interacted with the size of municipalities (measured by log population). Moreover, we include a forward looking unemployment rate. The forward looking local unemployment rates is constructed in two steps: Firstly, we use data on aggregate employment numbers at

the 2-digit industry level in Germany drawn from EUROSTAT for the years 2000 to 2008 to determine unemployment rates per two-digit-industry and sample year.<sup>40</sup> The industry-shock-driven unemployment rate in our sample municipalities is then calculated as a weighted average, using municipalities' firm numbers per industry in 2000 as weights (for all sample years). The results in Column (2) are comforting as the inclusion of the additional control variables leaves the point estimate for the average firm size variable largely unchanged. Specification (3), moreover, reestimates our baseline model with an additional control variable for the average local business tax of neighboring jurisdictions (calculated as an inverse distance weighted average of the local business tax rates of neighbors within a 15 kilometer distance radius) to absorb potential effects of spatial policy interactions. While the point estimate for the spatial interaction variable is positive and significant, our effect of interest is largely unchanged. Columns (4) to (7), moreover, present results in models without municipality fixed effects (but with county-year fixed effects and the full set of control variables being included). Column (4) shows the OLS and in Column (5) to (7) the average firm size is, moreover, instrumented following the strategy described in the main text. This yields results that are qualitatively and quantitatively comparable to our baseline estimates with municipality fixed effects. Note, moreover, that additionally instrumenting jurisdiction size with long-lagged population density in 1910 and the number of railway connections (drawn from Koh et al. (2013)) yields similar results (cf. Specifications (4) and (5) of Table B5).

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<sup>40</sup>As our data includes employment but no unemployment numbers per 2-digit industry, we assume that unemployment rates in all 2-digit industries correspond to the average unemployment rate in Germany in 2000 (7.9%). Based on this, unemployment numbers per industry in 2000 are determined. This stock of unemployed individuals is then transferred to later sample years and any reduction/increase in the observed number of employees per 2-digit industry is assumed to increase/reduce the number of unemployed persons in that 2-digit industry on a 1:1 basis.

<b>Table B2: Robustness Checks Baseline Results I</b>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log Average Firm Size	-1.5749*** (0.5485)	-1.5003** (0.7398)	-1.5504** (0.7510)	-0.2329*** (0.0697)	-1.1949** (0.6017)	-1.3542** (0.5840)	-1.4180*** (0.4621)
Unemployment Rate (Industry Shock), Forward		3.8485 (2.6595)					
Neighbor Local Business Tax			0.0771** (0.0361)				
Observations	30,680	30,680	30,680	30,680	30,680	30,680	30,680
Municipality FE	yes	yes	yes	no	no	no	no
County-year FE	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes
Controls, sqrd.	no	yes	no	no	no	no	no
Controls * size	no	yes	no	no	no	no	no
IV (countries)	Germany	Germany	Germany		France	Italy	Germany
F statistic	29.89	30.37	29.99		36.46	42.93	71.16
Under-Identification p-value	0.00	0.00	0.00		0.00	0.00	0.00
First Stage: Point Estimate							
Excl. Instrument	2.9614*** (0.5417)	3.0057*** (0.5454)	2.9633*** (0.5411)		3.4166*** (0.5658)	3.1649*** (0.4830)	8.3817*** (0.9936)

Robust standard errors that account for clustering at the municipality level are reported in parentheses (apart from Specification (1) which accounts for clustering of errors at the level of commuting areas). \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. Please see the notes to Table 1 for a definition of the variables.

In Table B3, we assess the sensitivity of our results to using three-year lagged values for some of the control variables. Specifically, in Column (1) we exclude log employees from the set of control variables, which slightly decreases the point estimates to -1.3, in absolute terms, but is still within the confidence intervals of the results of our baseline specification. In Column (2), we use (ln) current population instead of three-year lagged (ln) population. In Column (3), we use current unemployment rate instead of three-year lagged unemployment rate. In Column (4), we do the same with (ln) revenue. In Column (5), we use instead of current (ln) revenue, current revenue per capita (winsorized at top and bottom 1%). In Column (6), we use instead of (ln) revenue the (ln) local business tax base and in Column (7) the local business tax base per capita. The results in all these additional specifications are similar to the results of our baseline specification.

<b>Table B3: Robustness Checks Baseline Results II</b>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log Average Firm Size	-1.3110** (0.6037)	-1.5892** (0.7543)	-1.4925** (0.7205)	-1.5877** (0.7609)	-1.5857** (0.7619)	-1.5715** (0.7570)	-1.4732* (0.8076)
Log Population		0.2574 (2.8825)					
Log Population, sqrd.		-0.0344 (0.1687)					
Unemployment Rate			-3.5856** (1.7300)				
Log Revenue				0.0184 (0.0192)			
Revenue pC					0.0000 (0.0000)		
Log Tax Base						-0.0070 (0.0077)	
Tax Base pC							-0.0003* (0.0002)
Observations	30,680	30,680	30,680	30,680	30,680	30,680	30,680
Municipality FE	yes	yes	yes	yes	yes	yes	yes
County-year FE	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes
W/o log employees	yes	no	no	no	no	no	no
IV (countries)	Germany	Germany	Germany	Germany	Germany	Germany	Germany
F statistic	35.39	30.20	32.69	29.43	29.31	29.73	25.24
Under-Identification p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Robust standard errors that account for clustering at the municipality level in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. See the notes to Table 1 for a description of the variables.

Table B4, moreover, assesses the theoretical notion that the effect of average firm size on local business tax choices may be larger in small municipalities. This may, e.g., relate to the fact that the relocation of large firms relative to aggregate jurisdiction size may exert a significant effect on local labor markets and municipalities may choose low local business tax rates for this reason. If firms are big relative to jurisdiction size, this, moreover, corresponds to a situation where economic activity in a jurisdiction is more concentrated, which might lead to higher aggregate lobby spending and hence lower local business tax rates, reflecting that free riding incentives on the lobbying on other firms are reduced (see also Footnote 10 in the main text). Columns (1) and (2) report the estimates when the sample is split at the median of population size. Specification (3) allows the coefficient estimate for the average firm size to vary across tertiles of the jurisdiction's population distribution. The results do not support the sketched notion that response-behaviour to average firm size changes is larger in small communities.<sup>41</sup>

<sup>41</sup>Note that the specification do not include municipality fixed effects. While the estimates are

<b>Table B4: Robustness Checks Baseline Results III</b>			
	(1)	(2)	(3)
Sample	Small	Large	All
Log Average Firm Size	-0.9160*	-1.8551**	
	(0.5505)	(0.8810)	
Log Average Firm Size			-1.3741***
Lowest Pop Tertile			(0.4779)
Log Average Firm Size			-1.5574***
Middle Pop Tertile			(0.5047)
Log Average Firm Size			-1.5047***
Top Pop Tertile			(0.5012)
Observations	15,336	15,344	30,680
Municipality FE	no	no	no
County-year FE	yes	yes	yes
Controls	yes	yes	yes
IV (countries)	Germany	Germany	Germany
F statistic	45.03	34.71	7.31
Under-Identification p-value	0.00	0.00	0.00

Notes: Robust standard errors that account for clustering at the municipality level in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. See the notes to Table 1 for a description of the variables. 'Small' municipalities are municipalities with a population below the sample median, 'large' municipalities are municipalities with a population above the median. Lowest/Middle/Top Pop Tertile indicate the tertiles of the population distribution.

Table B5 presents results of two robustness checks for the channel analysis. First, we reestimate the baseline specification without instrumenting average firm size as regressor. Column (1) reports the baseline OLS result. In Column (2) we include the mobility controls and in Column (3) also the lobby controls. The pattern of the results is similar to the baseline estimates. The point estimate for the average firm size decreases when including the mobility controls and is unchanged when controlling in addition for the lobbying variable. The reduction in the point estimate for the average firm size is with 40% lower than in the baseline estimations but this is less surprising given the downward bias of the OLS estimate. Second, we reestimate the baseline model where we do not only instrument for the average firm size but also for jurisdiction size as measured by the number of employees. Since population and employees are highly correlated, we control for population decile dummies instead of log population. Column (4) shows the results when instrumenting only the number of employees (and excluding average firm size as regressor). We use two excluded instruments. The first is the (ln) number of railway connections in 1895 and the second the population density in 1910.<sup>42</sup> The test comparable when including municipality fixed effect, the precision of the estimates is rather low.

<sup>42</sup>The data on railway connections in 1895 is obtained from "Handbuch der deutschen Eisenbahnstrecken" and includes information on all train connections in Germany between 1835 and 1935. The population density in 1910 stems from the population census in 1910 and is obtained from the

statistics suggest the instruments to be relevant. Furthermore, the test for overidentifying restrictions cannot be rejected supporting the exogeneity of our instruments. In Column (5), we also instrument the average firm size using the instrument based on German firms. The point estimate for the average firm size turns out to be very similar to the results of our baseline specification. Moreover, the point estimate for the number of employees is largely unchanged. In Column (6), we additionally include the mobility controls and in Column (7) also the lobby control. The pattern of the results is again very similar to the baseline estimates. The point estimate for the average firm size drops when including the mobility controls and is unchanged when including in addition the lobby control. The reduction in the point estimate for average firm size, when the mobility controls are included, is 60% and thus supports the notion that mobility is the main driver of the firm-size tax rate link.

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"Kaiserliches Statistisches Amt (1915), Die Volkszählung im Deutschen Reiche am 1. Dezember 1910, Kaiserliches Statistisches Amt, Berlin" and is matched to the municipalities in our data set based on historic maps (see Koh et al. (2013))

Table B5: Robustness Checks Mobility Channel							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average Firm Size	-0.2329*** (0.0697)	-0.1432** (0.0663)	-0.1364** (0.0661)		-1.3629*** (0.4545)	-0.5799 (0.4744)	-0.5529 (0.4737)
Log Employees				0.7675** (0.3563)	0.9604** (0.4111)	0.6445 (0.4055)	0.6154 (0.4043)
Tax Sensitivity		2.7222*** (0.1704)	2.7280*** (0.1702)			3.0800*** (0.2093)	3.0873*** (0.2093)
Share Multinational Firms		-0.4169** (0.1716)	-0.3443** (0.1748)			-0.3737 (0.2568)	-0.3091 (0.2560)
Share Domestic Groups		0.0207 (0.1767)	0.0184 (0.1761)			0.1658 (0.1881)	0.1598 (0.1872)
Share Lobby Firms			-0.3767* (0.1980)				-0.3129 (0.2050)
Observations	30,680	30,680	30,680	28,144	28,144	28,144	28,144
Municipality FE	no	no	no	no	no	no	no
County-year FE	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes
IV	no	no	no	yes	yes	yes	yes
SW F-Stat (Employees)				22.81	35.82	33.42	33.37
SW Chi-sq (Employees)				0.00	0.00	0.00	0.00
SW F-Stat (Firm Size)					39.58	38.76	38.51
SW Chi-sq (Firm Size)					0.00	0.00	0.00
Hansen p-value				0.95	0.98	0.60	0.57
First Stage Log Employees: Point Estimate							
(ln) # railway 1895				0.0896*** (0.0145)	0.0856*** (0.0139)	0.0868*** (0.0140)	0.0873*** (0.0139)
(ln) Pop density 1910				0.0331* (0.0145)	0.0349* (0.0138)	0.0386** (0.0137)	0.0390** (0.0137)
IV (Germany)					34.8495*** (3.4709)	29.0475*** (3.4714)	29.0853*** (3.4659)
First Stage Log Average Firm Size: Point Estimate							
(ln) # railway 1895					0.0093 (0.0113)	0.0111 (0.0109)	0.0118 (0.0109)
(ln) Pop density 1910					0.0057 (0.0117)	0.0102 (0.0117)	0.0108 (0.0116)
IV (Germany)					32.8540*** (2.6656)	26.1758*** (2.6184)	26.2251*** (2.6120)

Notes: Robust standard errors that account for clustering at the municipality level in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the 1%, 5% and 10% level respectively. See the notes to Table 1 for a description of the variables. Furthermore, (ln) # railway 1895 is the number of railway connections in 1895, (ln) Pop density 1910 the population density in 1910. IV (Germany) is the instrument for the average firm size as constructed in the main analysis, based on German firms.



## Appendix C: Construction of the Tax Elasticities

As described in the main text, we, among others, approximate firm mobility by estimating the elasticity of corporate activity to changes in the business tax rate for narrowly defined subsets of firms. These estimates are then assigned back to individual entities and aggregated to the municipality level, serving as control variables for the 'mobility channel' in our main analysis.

The following section describes the empirical approach to retrieve these tax elasticities. The estimation relies on the AMADEUS/ DAFNE accounting data described in the main text. Firms are linked to municipalities via address information. Firms with unlimited liability (e.g. sole proprietor or partnerships) and firms that relocate across locality borders are excluded from the sample. The estimation equation reads:

$$\text{Log } FA_{k,t} = a_k + \rho_t + \beta_{fs,ms,ia,mt} \cdot \tau_{k,t} \cdot \sum_{fs=1}^{fs=4} D_{fs} \cdot \sum_{ms=1}^{ms=4} D_{ms} \cdot \sum_{ia=1}^{ia=10} D_{ia} \cdot \sum_{mt=1}^{mt=4} D_{mt} + \epsilon_{k,t} \quad (3)$$

The dependent variable is the natural logarithm of fixed assets of firm  $k$  at time  $t$ .<sup>43</sup> It is regressed on a full set of firm-specific effects ( $a_k$ ) and a full set of year fixed effects ( $\rho_t$ ) as well as the firm-specific corporate tax rate ( $\tau_{k,t}$ ). The tax rate is firm-specific as it depends on the legal form and the ownership structure of the firm as well as on the tax rate in the firm's host jurisdiction.<sup>44</sup> The construction of the corporate tax variable is explained in more detail below. To allow the tax effect to vary across firm groups, we furthermore interact the tax rate with dummy variables for firm size quartiles (fs), host jurisdiction size quartiles (ms), indicators for 1-digit industry affiliation (ia) and size quartiles for the host municipalities' local business tax (mt). This sub-sample-definition follows the notion that firm mobility may differ between large and small firms (see our discussion in Section 2) and between industries (e.g. related to the (in)tangible nature of main production factors). Accounting for the host municipality's population, moreover, captures effects related to mobility-reducing agglomeration rents. Finally, we allow the tax elasticities to vary between municipalities with different local business tax levels to capture potential remaining mobility differences between firms rooted in unobserved mobility drivers. This presumes an inverse relationship between the hosting of mobile entities and local business tax choices (irrespective of the source of these mobility differences), implying that we expect to see higher mobility rates in

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<sup>43</sup>Note that the approach relies on corporate fixed assets as the information is significantly better covered than alternative size measures like employment.

<sup>44</sup>In principle, it depends on the location of the establishments and not only of the headquarters. Since we do not observe establishments in our data, we use the location of the headquarter.

lower-tax jurisdictions. As described in Equation 3, the tax elasticities are allowed to flexibly vary in the four dimensions, resulting in 543 firm-cell-estimates.<sup>45</sup>

To avoid reverse causality problems, identification of the corporate tax effect on firm activity, in the main specifications, relies on tax variation induced by a federal corporate tax reform in 2008 (instead of variation in local business tax rates). The reform firstly reduced the federal corporate income tax rate from 25 to 15%, which provides identifying variation as the tax rate reduction affected only incorporated firms and unincorporated firms with corporate shareholders. Unincorporated firms with limited liability (GmbH & Co.KG) owned by individuals, in turn, remained unaffected by the reform and can hence be used as a control group.<sup>46</sup>

On top the reform changed firms' local business tax burden. Precisely, before the federal corporate tax reform 2008, the local business tax was deductible from its own tax base and from the corporate tax base. The reform abolished this deductibility and furthermore changed the base rate ('Messzahl'), with which the local tax multipliers chosen by municipalities is multiplied from 5% to 3.5% (see also Section 3 of the main text). The local business tax rate in a municipality with a multiplier of 400, for example, was 17.3% before 2008, and 14% after the reform.<sup>47</sup> The described changes in the 'Messzahl' and the deductibility of the local business tax are additionally used as identifying business tax variation when estimating Equation 3.

As described above, the empirical model is estimated drawing on AMADEUS/DAFNE data. The sample is restricted to the time period 2004 to 2010 and comprises more than 2.5 million firm-year observations.  $\tau_{k,t}$  is calculated as firms' 'comprehensive' business tax rate, accounting for both federal corporate taxation as well as local business taxation. To isolate variation induced by the federal tax reform in 2008, we set the municipality multiplier to 380 for all firms and all sample years when calculating  $\tau_{k,t}$ . In robustness checks, we relax this assumption and assess the sensitivity of our results to estimating elasticities based on both, variation induced by the federal tax reform in

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<sup>45</sup>Allowing tax elasticities to vary across four firm-size groups, ten industries, four host population size groups and four tax level groups would result in 640 firm-cell-estimates. Note, however, that some of these cells lack a sufficient number of firm observations, implying that tax elasticities are eventually estimated for 543 subgroups of firms.

<sup>46</sup>The latter firms are similar to S-corporations in the US. Their income is taxed on a flow-through basis. If their shares are held by individuals, the business income is subject to personal income tax. Since we do not observe the overall income of the shareholders, we assume a marginal tax rate of 42%, which is the highest income bracket of the personal income tax scheme.

<sup>47</sup>The local business tax rate before 2008 is calculated as  $\frac{0.05*m}{1+0.05*m}$  with  $m$  as the multiplier set by the municipality. After the 2008 reform it is simply  $0.035 * m$ .

2008 as well as by changes in local business tax multipliers.

<b>Table C1: Distribution of Estimated Tax Elasticities</b>						
	Mean	P5	P25	P50	P75	P95
Coefficients (Var-2008)	-1.1399	-1.8834	-1.4611	-1.2012	-.9200	-0.2435
Coefficients (Var-all)	-0.8914	-1.6550	-1.2163	-0.9552	-0.6676	0.0003

Notes: The table depicts the distribution of the estimated tax elasticities for 543 sub-groups, defined according to firm size quartiles, industry affiliation and the population and local business tax quartiles of firms' host municipalities. 'Coefficients (Var-2008)' depicts the distribution of the tax coefficients from a specification where only tax variation related to the federal tax reform in 2008 is exploited for empirical identification. 'Coefficients (Var-all)' are tax sensitivities derived from a specification which exploits tax variation related to the 2008-reform as well variation in local tax multipliers for empirical identification. P5 to P95 indicates the respective percentiles of the distribution of estimated tax elasticities.

The distribution of the 543 estimated semi-elasticities is depicted in Table A6 (for both tax elasticities obtained based on using only variation related to the federal tax reform in 2008 ('Coefficients (Var-2008)') as well as tax elasticities obtained from additionally accounting for variation in local tax multipliers ('Coefficients (Var-all)'). The average estimated elasticities are in line with the existing literature but show significant variation in tax elasticities across sub-groups of firms. Furthermore note that our estimations confirm the notion that firm activity is more responsive to corporate taxation in large firms. Reestimating Equation (2), allowing the tax coefficient to vary across firm size classes only, yields tax sensitivities that, in absolute terms, increase in the size of the firm ( $-0.96$  for the smallest size class and  $-1.40$  for the largest size class). Analogously, reestimating Equation (2), allowing the tax coefficient to only vary across population size classes, yields tax sensitivities that decline, in absolute terms, with growing population size of the host locality, which is in line with the notion of mobility-reducing agglomeration rents (with a tax elasticity of  $-1.33$  in the smallest population size class and  $-0.98$  in the largest population size class). Finally, we redo the same exercise, allowing the tax coefficients to vary across local business tax classes. In line with the notion spelled out above, we find a negative correlation between the level of the local business tax and the estimated absolute tax elasticities ( $-1.28$  for firms in municipalities with the smallest level of the local business tax and  $-0.93$  for firms in the municipalities with the largest local business tax).