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Local Fiscal Policies and their Impact on the Number and Spatial Distribution of New Firms*

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Abstract

We examine the effect of local business taxation and local public good and service (PIGS) provision on the number and spatial distribution of new firms. The analysis draws on panel data for the universe of firm foundations in German municipalities, matched to municipalities' local business tax rates and the level and structure of their local PIGS provision. Methodologically, we estimate fixed effects poisson models coupled with a control function approach. The results suggest that local business taxation (PIGS provision) has a strong negative (positive) impact on the number of new firms in the policy-changing jurisdiction. Local business taxes are, moreover, found to exert beggar-thy-neighbor externalities on neigboring jurisdictions: tax reductions strongly lower the number of neighbors' firm foundations, implying that the aggregate number of new firms remains unchanged; while PIGS provision, on average, exerts no significant impact on the number of firms in adjacent jurisdictions, negative effects emerge for subsets of PIGS and firms.

JEL classification: D22, H4, H7, R30

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I. Introduction

Fostering the emergence of new businesses is a key concern for cities and municipalities around the globe (e.g. U.S. Chamber of Commerce Foundation (2016), Forbes (2017)). Whether and which policies are effective in channeling firm foundation decisions and help to attract inter-jurisdictionally mobile new businesses is largely indetermined though. The aim of this paper is to empirically identify the causal effect of fiscal policies, namely local business taxation and the provision of local public goods and services (PIGS), on firm foundation rates. Our testing ground is Germany, where local government spending - similar to other countries - significantly contributes to aggregate public spending and local governments, moreover, autonomously set local business tax rates.[1]

To guide our empirical analysis, the paper starts out with a stylized theoretical two-jurisdiction-model. The model predicts that lower local business taxes raise the number of firm foundations in the policy-changing jurisdiction as more businesses enter the market and interjurisdictionally mobile new firms are attracted from the neighbouring locality. The latter effect implies that local business taxation gives rise to a beggar-thy-neighbour externality on the neighboring jurisdiction. Local PIGS provision is, moreover, predicted to have an ambiguous effect on the number of new firms in both, the PIGS-providing municipality and the neighboring jurisdiction. On the one hand, new PIGS spur firm entry in both jurisdiction (conditional on the assumption that PIGS raise firm profits in both localities). On the other hand, the relative attractiveness of communities changes: the quantitative gain in pre-tax

[1] Local government spending makes up around 20-30% of overall government spending in developed countries (see OECD Statistics on Government Expenditure by Function). In Germany, local governments spent around 230 billion EURO in 2015 (see the website of the German Statistical Office). German localities moreover autonomously set the local business tax rate and the local property tax rate (with the latter being significantly less important in revenue-terms). In general, the level of sub-national tax autonomy significantly varies across countries (with sub-national governments in some countries having no tax instruments at hand at all).

profits is plausibly larger for firms in the PIGS-increasing jurisdiction, which boosts its relative attractiveness and pulls in new firms that would have otherwise been founded in the neighboring jurisdiction. If the PIGS-increasing locality also taxes the additional PIGS-related profits at a higher business tax rate and firms within its borders, in consequence, obtain less PIGS-related *after-tax* benefits than firms in the neighoring jurisdiction, the effect may be reversed though, making the prediction on the overall link between PIGS and the number of new firms in the two jurisdictions ambiguous.[2]

These predictions are brought to the data. We use Germany as a testing ground and draw on panel information on the universe of firm foundations in German municipalities linked to data on communities' local business tax choices and their local PIGS provision. PIGS are modeled based on spending information from municipality accounts, which is translated into PIGS capital stocks applying the perpetual inventory method. The data allows us to differentiate between detailed PIGS categories, including, e.g., spending for infrastructure, schools and recreational facilities. Methodologically, we rely on fixed effects Poisson models, which absorb time constant heterogeneity in firm foundation rates across German municipalities (see Guimarães *et al.* (2003) and Arauzo-Carod and Manjón-Antolín (2012)).[3] Following our theoretical predictions, we, moreover, allow for both, own and cross-municipality effects of business tax choices and PIGS provision, with the latter being modeled by spatial lags of the regressors (see LeSage *et al.* 2009).

[2] The testing ground for our empirical analysis is Germany, where local business tax rates vary widely across localities, among other reflecting heterogeneity in locality size and the presence of agglomeration economies (see e.g. Koh *et al.* (2013)), partisanship of executive and legislative bodies and electoral cycles (see e.g. Foremny and Riedel (2014), Freier and Odendahl (2015)). Note, moreover, that while the government budget potentially links PIGS spending to local business tax rate choices, our theoretical hypotheses are, in line with the existing literature, formulated as ceteris paribus effects of changes in one policy instrument conditional on the other.

[3] Guimarães *et al.* (2003) show that Poisson model estimates can be interpreted as estimates of a Conditional Logit model and are therefore suitable to model location decisions. Arauzo-Carod and Manjón-Antolín (2012), on top, show that the Poisson model can be used to determine the effects of geographically distributed regressors.

To address remaining endogeneity concerns, we apply a control function approach, where the PIGS capital stock and the local business tax rate are instrumented using two excluded instruments. PIGS spending is instrumented exploiting variation in local business tax revenues, and eventually local public spending, generated by the 'Renewable Energy Sources Act' (RES Act) of 2000. This Act was initiated by the German federal government to promote energy production from renewable sources. Among others, the law created strong incentives for firms to construct wind power plants resulting in a substantial increase in the number of plants across Germany. As wind power plants are subject to local taxation, local business tax revenues of affected municipalities increased. Specifically, our instrumental variable strategy relies on differences in post-reform revenue and spending trends of communities with high levels of wind strength and unpopulated space relative to other localities - reflecting that wind power plants can only be built in areas with sufficient wind and sufficient free space.

Moreover, the municipalities' local business tax rate is instrumented exploiting variation in the so-called 'reference business tax' from the German municipal fiscal equalization scheme. Municipal fiscal equalization is organized through fiscal transfers from the state level to the municipality level if a municipality's fiscal capacity falls short from its fiscal needs.[4] The latter is a conceded budget per resident, the former a measure for tax revenues at standardized tax rates (see e.g. Buettner and Holm-Hadulla (2008)). Local business tax revenues add to localities' fiscal capacity at such a standardized 'reference business tax rate'. This implies that, if the reference tax is larger than the municipality's actual tax rate, localities appear richer in the equalization scheme than they actually are and vice versa. Anecdotal evidence suggests that municipalities respond to changes in the position of their reference tax relative to the actual tax rate: If the reference tax is increased above the actual

[4] If fiscal needs fall short from fiscal capacity, municipalities do not have to give up funds.

rate, local municipal councils also tend to adjust the business tax rate upwards. Following this line of argumentation, we instrument the local business tax choices with a dummy variable indicating if the reference tax rate in the fiscal equalization scheme is smaller or larger than a municipality's actual local business tax (where we use the actual rate in a pre-sample period to avoid obvious endogeneity concerns).[5]

Based on these instruments, the control function approach is implemented. In a first step, we run four sets of ordinary least squares regressions, where municipalities' PIGS provision, their local business tax and the spatial lags of these policy variables are regressed on the described instruments, a set of control variables and the spatial lag of all regressors. In a second step, the predicted residuals of these first stage regressions are included as regressors in the Poisson model for the number of new firm foundations to retrieve consistent estimates (see e.g. Wooldridge 2010). We, moreover, use bootstrapping to obtain valid standard errors. To correct for possible violations of the underlying Poisson distribution, the bootstrapped standard errors are, furthermore, clustered on the municipality level.

In line with our theoretical presumptions, our results suggest that local business taxes exert a large negative effect on the number of firm foundations in the policy-changing jurisdiction. The estimated elasticity is -4.6 and thus in the range of prior estimates, see e.g. Becker *et al.* (2012) and Suárez Serrato and Zidar (2016). We, furthermore, show that business taxation exerts a strong fiscal externality on neighboring jurisdictions: Reducing the tax rate significantly lowers the number of firm foundations in other adjacent jurisdictions, implying that the aggregate number of new firms is unaffected by the tax-change. This suggests that business taxation largely serves as a beggar-thy-neighbor policy instrument.

[5]Note that time variation in the reference tax instrument hence relates to adjustments in the reference tax only. Furthermore, as discussed below, additional locality revenues related to the 'Renewable Energy Sources Act' might also trigger adjustments in municipalities' local business tax choices, which is accounted for in the first-stage-regressions. See below for details.

Moreover, we find evidence for a positive effect of PIGS on the number of firm foundations in the policy-changing jurisdictions. Quantitatively, a 1%-increase in a municipality's PIGS stock raises the number of new firm foundations by 0.78% on average. For subsets of PIGS and subgroups of firms, the effect turns out to be even larger: A 1%-increase in PIGS targeted at families (e.g. public swimming, schooling, youth services) raises the number of new firm foundations in industries employing many workers who live with young children by 2.3%. While PIGS provision, moreover, on average does not significantly impact on the number of new firm foundations in neighbouring jurisdictions, we find significant externalities for subsets of PIGS and subgroups of firms.

Our paper makes several contributions. Firstly, we add to a flourishing empirical literature on the effect of corporate taxes on firms' investment and location choices. While a negative link between federal corporate taxation and cross-country investment and location choices is well established (see e.g. Feld and Heckemeyer (2011) for a recent survey), evidence for the regional and local level tends to be scarce (see e.g. Brülhart *et al.* (2012), Becker *et al.* (2012), Suárez Serrato and Zidar (2016) and Giroud and Rauh (2017) for exceptions). Our analysis, moreover, differentiates from many prior papers by taking care of different potential endogeneity problems: Firstly, we combine a fixed effects framework with an instrumental variables approach to account for a correlation of localities' policy choices with unobserved municipality characteristics in the cross-sectional and longitudinal dimension; secondly, we allow for externalities of policy choices on neighboring jurisdictions. Testing for potential cross-jurisdictional effects has been largely ignored in the prior literature, despite the fact that allowing for such effects is conceptually and economically important: From a methodological point of view, estimates for tax and PIGS effects on firm activity in the policy-changing jurisdiction are biased if such externalities do exist and they are not accounted for in the empirical framework (as, technically speaking, the stable unit treatment value assumption, SUTVA, is violated and 'control' municipalities adjacent to treated municipalities are also affected by the policy change).[6] On top, quantifying the size of fiscal externalities is economically important: fiscal policy choices that exert externalities on neighboring jurisdictions render decentralized policy-setting inefficient and may call for a (re-)allocation of tax and spending power to higher government tiers in federations.

Furthermore, we are, to the best of our knowledge, the first to provide a comprehensive analysis of the causal link between local PIGS and firm activity. While a number of much-noted recent papers assesses whether economic activity is affected by large supra-regional infrastructure projects, like the construction of dams, motorways and railroads (see e.g. Duflo and Pande (2007), Donaldson (2018) and Moeller and Zierer (2018)) and by place-based policies (see e.g. Neumark and Simpson (2015)), these policy interventions differ from local public good provision in two ways: Firstly, they are planned and financed by the federal level, implying that fiscal externalities (at the sub-national level) are ruled out by definition. Secondly, while most supra-regional infrastructure projects directly increase firm productivity, many local PIGS, like public swimming, parks, schooling and youth services, are first and foremost targeted at households. Our paper stresses that the latter may, nevertheless, spur local firm foundations as entrepreneurs might obtain benefits from PIGS provision and may, for that reason, relocate to PIGS-providing localities or because a firm's workers might become more productive or may be willing to live and work in a locality or region for a lower wage.[7] As described above, our empirical results

[6]Note that instrumental variable strategies do not solve this problems if instruments are correlated across space (as they plausibly often are, see below).

[7]Note that the literature paid some attention to the consequences of local schooling expenditures on *households* by studying the effect on student outcomes (see e.g. Jackson *et al.* (2016)) or property prices (see e.g. Ries and Somerville (2010)). Potential effects on firm behaviour have so far been ignored though.

confirm a link between local PIGS and firm foundation rates.

The rest of the article is structured as follows. In Section II, we present a stylized theoretical model to guide our empirical approach. Section III describes the institutional background of the empirical analysis and the data used. The estimation strategy and empirical results are presented in Section IV. Section V concludes.

II. Theoretical Considerations

Before turning to the empirical analysis, we develop a simple theoretical model to guide our empirical approach. Consider a world with two communities $j = 1, 2$, which are located at the end points of the unit interval. We denote the location of municipality j by g_j and assume $g_1 = 0$ and $g_2 = 1$. There is a mass 1 of firms that are characterized by their location preferences. The bliss location point of firm k is denoted by x^k. We assume that bliss points are uniformly distributed across the unit interval. Firm owners decide in which locality to locate by maximizing their profit after mobility costs which relate to moving away from the bliss location. Mobility costs from locating at municipality j are given by $m(|x^k - g_j|) = m(\delta_j^k)$, where δ_j^k denotes the distance between firm k's location bliss point and municipality j and $m'(\cdot) > 0$.[8]

Municipalities control two policy instruments that affect firm profits: the corporate income tax rate t_j and the level of public input goods and services (PIGS) c_j. In the following, we will assume that PIGS raise firm profits. The benefit that a firm located in municipality j receives from PIGS provision is denoted by $B_j(c_1, c_2)$.

Assumptions. *The function $B_j(c_1, c_2)$ satisfies:*

1. $\frac{\partial B_j}{\partial c_j} > 0$.

[8] Note that we hence assume that firms may not be able to locate in a community at the location of their bliss point. This may reflect zoning restrictions or that firm owners have a preference to locate their business in their home residential community, which may, however, for business reasons (e.g. market access) not be a suitable business location.

2. $\frac{\partial B_i}{\partial c_j} > 0,\ i \neq j$.

3. For any given PIGS level in municipality i, $\bar{c}_i$: $\frac{\partial B_j(c_j,\bar{c}_i)}{\partial c_j} > \frac{\partial B_i(c_j,\bar{c}_i)}{\partial c_j}$.

The first assumption states that firms benefit from higher PIGS provision in their host municipality. This positive effect on corporate profitability may firstly relate to PIGS provision that directly increases firm productivity, e.g. publicly funded research and development centers. Alternatively, PIGS may help to lower input costs; public infrastructure provision may e.g. lower transportation costs or PIGS directed towards households may imply that employees are willing to work for lower wages to enjoy the benefits from regional amenities (e.g. recreation facilities, like parks or public swimming).[9] The second assumption states that increases in PIGS also have a positive effect on firm profits in the neighbouring municipality. Roads may e.g. also reduce transport costs for firms located in adjacent localities (if they, for example, reduce the travel time to the next highway) or may benefit workers in neighbouring jurisdictions who are then willing to work for lower wages. Finally, the third assumption states that the incremental PIGS benefits to businesses decrease with the distance to the PIGS providing community, i.e. firms located in community $i \neq j$ benefit less from an increase in c_j than firms located in locality j.

The profit net of mobility cost and taxes of firm k when it locates in municipality j is then given by

$$\begin{aligned}\pi_j^k &= (1-t_j)\big(V + B_j(c_1,c_2) - \gamma m(\delta_j^k)\big) - (1-\gamma)m(\delta_j^k) \\ &= (1-t_j)\big(V + B_j(c_1,c_2)\big) - (1-\gamma t_j)m(\delta_j^k),\end{aligned}$$

where V is a location independent component of profits and $0 < \gamma < 1$ denotes

[9] B_j may also be interpreted as the PIGS-related utility of an enterpreneur when he locates in community j. In this case, a link between local PIGS and B_j may not only be established via changes in firm profits but might also emerge because the enterpreneur obtains direct benefits from PIGS provision (like public swimming or parks) when locating in jurisdiction j.

the fraction of mobility cost that are tax deductible. Each firm has to make two decisions: first, it has to decide whether to enter the market, and second, conditional on entry, it has to decide in which community to locate. We begin the analysis with the second decision.

Location Choice. A firm with bliss point x locates in municipality 1 if

$$\Delta(x) \equiv \pi_1^k - \pi_2^k =$$
$$(t_2 - t_1)V + \big((1-t_1)B_1(c_1,c_2) - (1-t_2)B_2(c_1,c_2)\big) + (1-\gamma t_2)m(1-x) - (1-\gamma t_1)m(x) \geq 0$$

To rule out cases where all firms locate in one municipality, we assume that $m(1)$ is sufficiently high. The optimal location decision rule and and how it depends on municipalities' policy choices is stated in the following two lemmas.

Lemma 1. *There exists a unique cutoff value $\bar{x}$ such that firms with location bliss point $x^k \leq \bar{x}$ locate at municipality 1 and firms with location bliss point $x^k > \bar{x}$ locate at municipality 2.*

Proof. See Appendix A.

Lemma 2. *$\bar{x}$ is a function of t_1, t_2, c_1 and c_2 where*

1. *$\bar{x}$ decreases in t_1 and increases in t_2.*

2. *The impact of higher PIGS provision on $\bar{x}$ is ambiguous.*

    - *$\bar{x}$ shifts to the right in response to an increase in c_1 if*

    $$(1-t_1)\frac{\partial B_1}{\partial c_1} > (1-t_2)\frac{\partial B_2}{\partial c_1},$$

    and shifts to the left otherwise.

- *Analogously, $\bar{x}$ shifts to the right in response to an increase in c_2 if*

$$(1-t_1)\frac{\partial B_1}{\partial c_2} > (1-t_2)\frac{\partial B_2}{\partial c_2},$$

  and shifts to the left otherwise.

Proof. See Appendix A.

Lemma 2.1, intuitively, states that a municipality becomes a less attractive firm location when its business tax rate increases. Lemma 2.2 shows that PIGS provision also affects the relative attractiveness of communities as a firm location, with the sign depending on the incremental net-of-tax-benefit of higher PIGS provision for firms in the two jurisdictions. As stated in the assumptions, the incremental pre-tax benefit of PIGS is assumed to be larger for firms in the PIGS-providing jurisdiction. This, however, does not necessarily imply that the PIGS-increasing jurisdiction becomes the more attractive place for firm location: If its business tax rate is sufficiently larger than the tax in the other jurisdiction, the higher marginal pre-tax PIGS-benefits may be eaten up by the higher tax levy. Intuitively, this becomes more likely if the difference between the pre-tax benefits from PIGS earned by firms in the two jurisdictions is small (i.e. when the benefits of PIGS provision fade out slowly with distance).[10]

Entry. We now turn to firms' decisions to enter into the market or not. To endogenize the number of firms that enter, we assume that the location independent

[10] Note that our stylized theoretical model, in line with our empirical setup below and the existing literature, makes ceteris paribus predictions on how firm choices depend on local business tax rates and PIGS provision respectively, conditional on the choice of the other policy instrument. Note, moreover, that in our empirical setting local business tax rates vary widely across jurisdictions, which may root in heterogeneity across localities in various dimensions, including the size of jurisdictions or the partisan composition of legislative and executive bodies, see also Footnote 2. As our empirical analysis is concerned with the impact of fiscal policies on firm behaviour, we refrain from analysing governments' optimal policy choices in our theoretical framework.

component of firm profits V is a random variable with distribution function $F(v)$ and strictly positive density $f(v)$.[11] A firm with bliss point $x \leq \bar{x}$ enters into municipality 1 only if

$$(1-t_1)\big(V+B_1(c_1,c_2)\big)-(1-\gamma t_1)m(x)\geq 0 \iff$$
$$V \geq \frac{1-\gamma t_1}{1-t_1}m(x)-B_1(c_1,c_2)\equiv \bar{v}_1(x,t_1,c_1,c_2).$$

It can easily be checked that $\bar{v}_1$ increases in t_1 implying that under a higher corporate tax rate only firms with higher draws for V will find it optimal to enter. This reflects that higher corporate tax rates reduce firm profits and thus incentives to enter. Analogously, $\bar{v}_1$ decreases in both c_1 and c_2 implying that PIGS provision in either municipality spurs entry.

The total mass of firms locating at municipality 1, M_1, can be calculated as

$$M_1=\int_0^{\bar{x}} \text{prob}(V\geq \bar{v}_1(x,t_1,c_1,c_2))dx=\int_0^{\bar{x}}\Big[1-F\big(\bar{v}_1(x,t_1,c_1,c_2)\big)\Big]dx.$$

Analogously, a firm with location bliss point $x>\bar{x}$ enters into municipality 2 if

$$(1-t_2)\big(V+B_2(c_1,c_2)\big)-(1-\gamma t_2)m(1-x)\geq 0 \iff$$
$$V \geq \frac{1-\gamma t_2}{1-t_2}m(1-x)-B_2(c_1,c_2)\equiv \bar{v}_2(x,t_2,c_1,c_2),$$

yielding a total mass of entering firms in municipality 2

$$M_2=\int_{\bar{x}}^{1} \text{prob}(V\geq \bar{v}_2(x,t_2,c_1,c_2))dx=\int_{\bar{x}}^{1}\Big[1-F\big(\bar{v}_2(x,t_2,c_1,c_2)\big)\Big]dx.$$

It is now straight forward to assess how changes in the corporate income tax rate and PIGS provision affect the number of firms in both municipalities.

[11] Notice that we assume that the distribution of V is independent from the location bliss point.

Consider first an increase in t_2. Notice that a change in t_2 affects two cutoff values. First, the location cutoff $\bar{x}$ below which firms locate in municipality 1 and, second, the cutoff value for the location independent components of firm profits $\bar{v}_1(x, t_1, c_1, c_2)$ and $\bar{v}_2(x, t_2, c_1, c_2)$, above which firms find it optimal to enter. By Lemma 2, the increase in t_2 shifts $\bar{x}$ to the right. Moreover, a higher value of t_2 increases $\bar{v}_2$ (see above) and thus reduces incentives to enter in municipality 2, while it leaves profits of firms locating in municipality 1 and thus $\bar{v}_1$ unaffected. Hence, higher tax rates in municipality 2 unambiguously increase (decrease) the mass of firms in municipality 1 (2). Formally, applying Leibnitz' Rule yields

$$\begin{aligned}
\frac{\partial M_1}{\partial t_2} &= \frac{\partial}{\partial t_2} \int_0^{\bar{x}(t_2)} \Big[1 - F\big(\bar{v}_1(x, t_1, c_1, c_2)\big)\Big] dx \\
&= \int_0^{\bar{x}(t_2)} \frac{\partial}{\partial t_2} \Big[1 - F\big(\bar{v}_1(x, t_1, c_1, c_2)\big)\Big] dx + \Big[1 - F\big(\bar{v}_1(\bar{x}, t_1, c_1, c_2)\big)\Big] \frac{\partial \bar{x}}{\partial t_2} \\
&= -\int_0^{\bar{x}} f(\bar{v}_1) \underbrace{\frac{\partial \bar{v}_1}{\partial t_2}}_{=0} dx + \Big[1 - F\big(\bar{v}_1\big)\Big] \frac{\partial \bar{x}}{\partial t_2} \\
&= \Big[1 - F\big(\bar{v}_1\big)\Big] \frac{\partial \bar{x}}{\partial t_2} > 0,
\end{aligned}$$

where we suppressed the dependence of the functions $\bar{v}_1$ and $\bar{x}$ on their arguments for notational simplicity. Analogously,

$$\begin{aligned}
\frac{\partial M_2}{\partial t_2} &= \frac{\partial}{\partial t_2} \int_{\bar{x}(t_2)}^1 \Big[1 - F\big(\bar{v}_2(x, t_2, c_1, c_2)\big)\Big] dx \\
&= -\int_{\bar{x}}^1 f(\bar{v}_2) \frac{\partial \bar{v}_2}{\partial t_2} dx - \Big[1 - F\big(\bar{v}_2\big)\Big] \frac{\partial \bar{x}}{\partial t_2} < 0.
\end{aligned}$$

The analysis for changes in t_1 is analogous.

Next, we analyse how PIGS provision in municipality 2 affects the mass of firms in both municipalities. Notice again that a change in c_2 affects both the location cutoff $\bar{x}$ and the entry cutoffs $\bar{v}_1(x, t_1, c_1, c_2)$ and $\bar{v}_2(x, t_2, c_1, c_2)$. The change in the mass of firms at municipality 1 and 2 can be calculated by differentiating M_1 and M_2. Applying Leibnitz' Rule yields

$$\begin{aligned}
\frac{\partial M_1}{\partial c_2} &= \frac{\partial}{\partial c_2}\int_0^{\bar{x}(c_2)} \Big[1 - F\big(\bar{v}_1(x, t_1, c_1, c_2)\big)\Big] dx \\
&= \int_0^{\bar{x}(c_2)} \frac{\partial}{\partial c_2}\Big[1 - F\big(\bar{v}_1(x, t_1, c_1, c_2)\big)\Big] dx + \Big[1 - F\big(\bar{v}_1(\bar{x}, t_1, c_1, c_2)\big)\Big] \frac{\partial \bar{x}}{\partial c_2} \\
&= -\int_0^{\bar{x}} f(\bar{v}_1)\frac{\partial \bar{v}_1}{\partial c_2} dx + \Big[1 - F\big(\bar{v}_1\big)\Big] \frac{\partial \bar{x}}{\partial c_2}.
\end{aligned}$$

The analogous expression for municipality 2 is

$$\begin{aligned}
\frac{\partial M_2}{\partial c_2} &= \frac{\partial}{\partial c_2}\int_{\bar{x}(c_2)}^{1} \Big[1 - F\big(\bar{v}_2(x, t_2, c_1, c_2)\big)\Big] dx \\
&= -\int_{\bar{x}}^{1} f(\bar{v}_2)\frac{\partial \bar{v}_2}{\partial c_2} dx - \Big[1 - F\big(\bar{v}_2\big)\Big] \frac{\partial \bar{x}}{\partial c_2}.
\end{aligned}$$

The change in the mass of firms depends on two terms: the first term reflects entry incentives, while the second term reflects location choices. The first terms are both positive[12] reflecting that higher PIGS provision increases profits in both municipalities, thus spurring entry. The sign of the second term is ambiguous in both expressions. By Lemma 2,

$$\frac{\partial \bar{x}}{\partial c_2} < 0 \qquad \text{if} \qquad (1 - t_2)\frac{\partial B_2}{\partial c_2} > (1 - t_1)\frac{\partial B_1}{\partial c_2}$$

In this case, higher PIGS provision in municipality 2 makes municipality 2 the more attractive location leading to an increase in M_2. In municipality 1, however, the positive entry effect is opposed by the higher propensity of firms to locate in municipality 2 yielding an ambiguous overall effect for the change in M_1. Conversely, if $\partial \bar{x}/\partial c_2 > 0$, municipality 1 gains firms while the effect on municipality 2 is

[12] As $\partial \bar{v}_1/\partial c_2$ and $\partial \bar{v}_2/\partial c_2$, are both negative, see above.

ambiguous. The analysis is analogous for changes in c_1.

Summarizing, we arrive at two predictions: Firstly, lower corporate tax rates are predicted to increase the mass of new firms in the policy-changing jurisdiction and decrease the mass of new firms in the other municipality. Secondly, the effect of PIGS on firm entry is ambiguous for both municipalities.

III. Institutional Background and Data

In the following, these predictions will be brought to the data. The testing ground are firm foundations in West German municipalities. This section describes the institutional background and the data set used for the empirical analysis.

A. Institutional Background

Municipalities in Germany are the lowest institutional legislative jurisdiction. They have self elected legislative governments and have the right to solve any local matters autonomously (Article 28 of the German constitution). Localities generate income from two main sources. First, a fraction of the personal income tax and the value added tax revenue administered at the federal and state level are distributed to German municipalities based on fiscal rules.

Second, localities autonomously set the local business tax rate, which is levied on business earnings of incorporated and non-incorporated firms located within a community's borders. The definition of the business tax base is determined by federal law and is thus homogenous across municipalities. The tax significantly contributes to the tax burden on businesses in Germany and is also the most important revenue instrument at German communities' own discretion.[13] The business tax multiplier set by German municipalities is measured in business tax points and is multiplied by

[13] Communities also levy a local property tax which is, however, a significantly less important revenue source than the local business tax.

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)).[14] Note, moreover, that the majority of local tax revenues remains with the locality. Only a minor fraction is redistributed by fiscal equalization schemes.

German municipalities also provide various local public goods and services, e.g. related to the construction and maintenance of roads, sewerage, kindergartens and primary schools. Further, municipalities have to provide social benefits to the unemployed and social welfare recipients. Additionally, public goods and services related to culture and sport facilities, tourism, and public transport may be provided. Note that while some expenditures are mandatory, including administration, social security and financing liabilities, others are optional, including e.g. spending for theaters, youth centers, the promotion of science, health care, sport and recreation facilities.

B. Data

As described above, our empirical analysis assesses the effect of business taxes and local PIGS on the number of firm foundations. The analysis draws on data from different sources.[15] First, we use data on the number of firm foundations in German municipalities between 1998 and 2006, specifically the total number of newly registered corporate enterprises, partnerships and self employed people (full time and with at least 1 employee) per municipality drawn from the *Gewerbeanzeigenstatistik* of

[14] As will be stated below, the average local business tax multiplier set by localities within our sample is 339 business tax points. Multiplied with a base rate of 5%, this translates in a tax levy of around 17% (with this calculation ignoring that firms' effective tax burdens are also determined by the deductibility of local business tax payments from the local business tax base).

[15] Note that our sample period saw a moderate number of mergers and separations of West German municipalities. Despite the limited importance of this issue, we account for possible changes of municipality borders. Specifically, we take the municipality structure at December 31, 2007 as a baseline and use publicly available information on mergers and separation to calculate values for the 2007-municipalities in all other sample years. If two municipalities e.g. joined in 2007, their expenditures for prior sample years are calculated as the sum of their separate values.

the German State Statistical Offices.[16] Note that the registration of a new branch will also be counted as a new foundation and that, by law, owners are required to register any new business. Figure (1) shows a histogram of the number of firm foundations in our sample in 2001.[17] In the empirical analysis to come, we will drop municipalities with a population greater 300,000 to exclude dominant cities (like Munich or Cologne) that act as outliers in the data.[18] Our final data set comprises 8,130 municipalities.

This data is augmented by information on the local business tax rate set by German communities and their local public good and service provision. The PIGS information stems from disaggregated accounting data of German municipalities between 1992 and 2006 provided in the *Jahresrechnungsstatistik* of the State Statistical Offices. The data comprises information for different spending categories. In the analysis to come, we will focus on autonomous spending by German communities, i.e. disregard community spending that is mandatory by German law (e.g. spending for housing support paid to welfare recipients) or organized through higher administrative units like counties. This leaves us with administrative and capital expenditures by German municipalities for (a) public security, (b) schools, (c) public education and culture, (d) child and youth care, (e) health, recreation and sports, (f) public transportation and parking, (g) construction and housing, (h) municipality streets as well as (j) economic promotion.[19] We will apply the

[16] Note that the *Gewerbeanzeigenstatistik* is available since 1998. We, moreover, restrict the analysis to years prior to 2006 as information on PIGS spending from German municipality accounts (see below) fails to be available in consistent format before and after 2007 due to a change in the German municipality accounting system in 2007.

[17] The figure is based on a sample of municipalities with a number of firm foundations less than the 95% quantile of the firm foundation distribution in 2001.

[18] Moreover, we exclude city-states (Bremen and Hamburg) from the analysis.

[19] Public security comprises spending for police, fire fighters, public order and ambulance services; spending for schools comprises spending for school buildings and facilities for primary and secondary schools located in the community; spending for culture and public education comprises spending for science and research, museums, theatres and concert halls, public libraries, regional traditions and monuments; spending for child and youth care comprises spending for public youth services and family-related services; spending for health, sport and recreation comprises

perpetual inventory method to generate values for the actual PIGS stock of each municipality (in different PIGS categories). To do so, we calculate the initial stock value K_0 using expenditure information for the pre-sample period 1992 to 1997 with

$$K_0 = \frac{\overline{EXP}}{g_{gdp} + \frac{1}{T}}. \tag{1}$$

where $\overline{EXP}$ stands for the mean PIGS expenditures between 1992 to 1997, g_{gdp} for the GDP growth rate and T for the average operating life. Note that we will assume a GDP growth rate of 2%.

We assume linear depreciation of the initial capital stock. Depreciation rates are calculated using publicly available information about operating lifes of assets in the different spending categories. Investment is represented by capital expenditures for a specific PIGS category in every year. Additionally, we add administration expenditures in every year, but assume 100% depreciation of the latter within one year. Hence, the PIGS capital stock $C_{\ell,i,t}$ of asset ℓ in municipality i at time t reads

$$C_{\ell,i,t} = \sum_{k=0}^{T_\ell} EXP_{\ell,i,t-\ell}\left(1 - \frac{k}{T_\ell}\right) + ADM_{\ell,i,t} \tag{2}$$

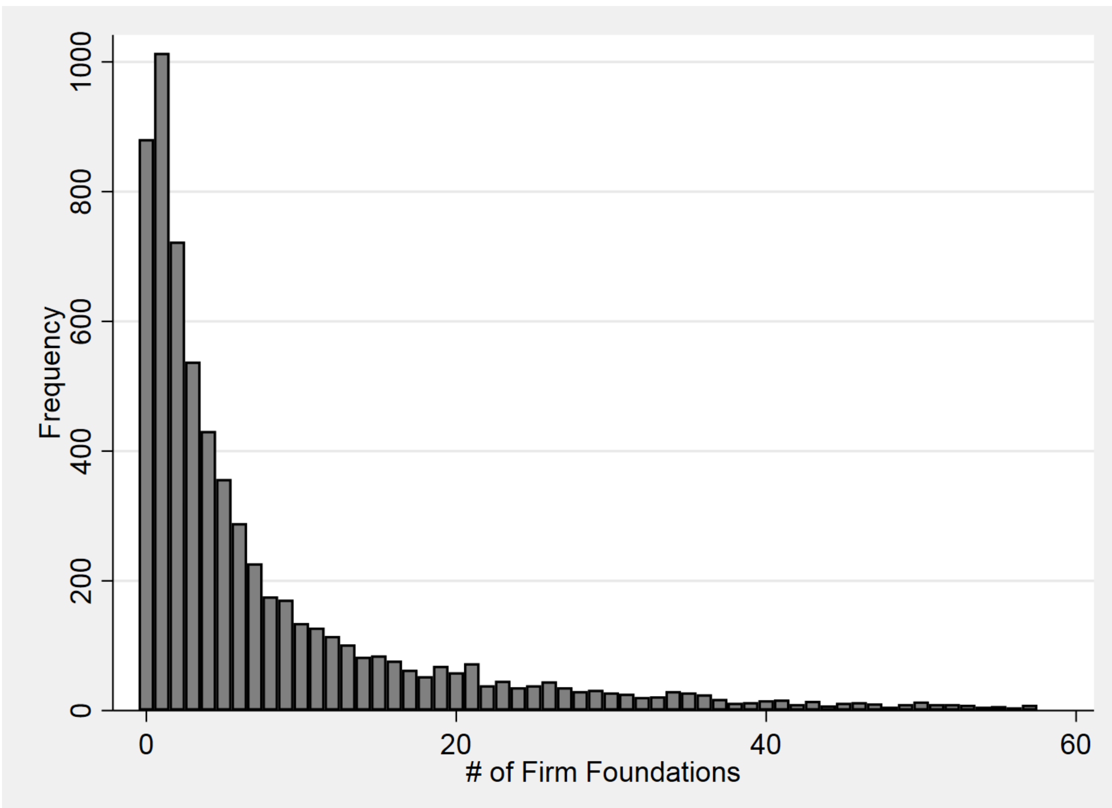
with $EXP_{\ell,i,t}$ depicting capital expenditures, $ADM_{\ell,i,t}$ administration expenditures and T_ℓ the average operating life of asset category ℓ. We assume that the expenditures in 1992 (the starting year of our data) are equal to the capital expenditures plus the initial capital stock K_0. Hence, expenditures before 1992 are assumed to be equal to 0. Note that the capital stock in equation (2) is constructed for the

spending for sport facilities and sport support, public swimming, gardens and parks; spending for public transportation and parking comprises spending for street lightning and cleaning, the construction and maintenance of parking spaces as well as public transport services; spending for construction and housing comprises spending for public building authorities, urban planning and construction as well as housing promotion; spending for streets comprises spending for municipality streets only - the construction and maintenance of streets that cross municipality borders like highways are the responsibility of federal or state governments.

different PIGS categories described above and then summed up to a total PIGS capital stock per municipality.

Finally, we add socio-economic municipality characteristics to our data. The latter include information on municipal population in 1000, the unemployment rate, the share of low, medium and high skilled workers and the number of students (per 1000 inhabitants) and doctors (per 100,000 inhabitants).[20]

Figure 1: Histogram of Firm Foundations in 2001



Descriptive statistics are presented in Figure (2) and in Table (1). Figure (2) depicts our sample municipalities' average PIGS stock per PIGS category relative

[20] Note that information on the share of workers, the number of students and the number of doctors is available at the county level only.

the total PIGS capital stock in the year 2006. The figure indicates that the largest fraction of the PIGS stock of German municipalities is associated with schools, followed by child- and youth care as well as streets, public transport and parking and recreational facilities. PIGS related to culture, public education, economic promotion and social security are, in quantitative terms, less important.

Figure 2: Average Share of PIGS Stocks in 2006

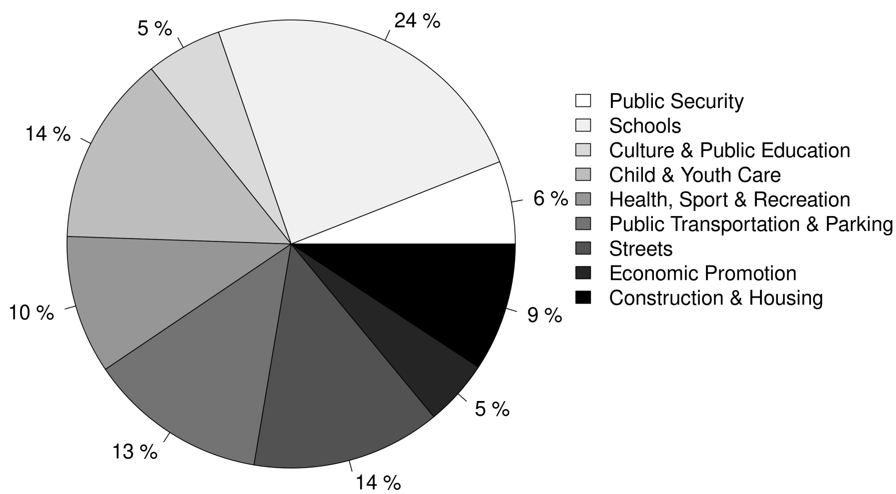


Table (1) moreover shows that the average municipality in our data observes around 11 firm foundations per year and has 6,700 inhabitants. The average PIGS capital stock is 30.4 Million Euro and the average PIGS stock per inhabitant 5139 Euros, with significant variation across municipalities though. Moreover, the average local business tax multiplier set by our sample jurisdictions is 339 business tax points, which multiplied with a base rate ('Messzahl') of 5% (see above) translates into a local business tax rate of around 17% (see also Footnote 14).

Table 1: Descriptive Statistics

	Mean	Std. Dev.	Pctl(25)	Pctl(75)
# of Firm Foundations	10.65	32.32	0.00	8.00
Population in 1,000	6.71	16.79	0.82	6.02
Unemployment Rate in %	5.35	1.82	4.00	6.40
Share of Low Skilled Workers in %	17.55	2.97	15.20	19.70
Share of Medium Skilled Workers in %	63.29	3.75	60.60	65.90
Share of High Skilled Workers in %	5.61	2.30	4.20	6.20
Students per 1,000 Inhabitants	5.18	14.98	0.00	3.20
Doctors per 100,000 Inhabitants	131.93	22.84	121.40	139.20
Local Business Tax Multiplier	339.02	31.12	320.00	352.00
Total PIGS Stock in 1 Mio. Euro	30.44	68.40	3.59	30.35
Total PIGS Stock per Capita in Euro	5,139.12	2,327.23	3,672.67	6,083.29
Observations	8130			

Notes: Calculations are based on the year 2006 and include 8,130 municipalities. The total PIGS stock per capita is calculated based on the localities' population in the pre-sample year 1997. Information on the number of firm foundations per municipality stems from the *Gewerbeanzeigenstatistik*, PIGS information from the *Jahresrechnungstatistik*, data on municipalities' local business tax rates, population and unemployment rates from *Statistik Lokal*, all provided by the German Statistical Office. Data on skilled workers, students and doctors is drawn from the INKAR data provided by the Federal Institute for Research on Building, Urban Affairs and Spatial Development.

IV. Estimating Fiscal Policy Effects on Firm Foundation

A. *Baseline Estimation*

To test for a link between local business taxes, PIGS and firm foundations, we estimate a model of the following form

$$E\left(y_{it}|\mathbf{X}_{it}, C_{it}, T_{it}, \lambda_i, \delta_t\right) = \exp\left(\gamma\mathbf{X}_{it} + \beta_1 C_{it} + \beta_2 T_{it} + \lambda_i + \delta_t\right) \quad (3)$$

where y_{it} denotes the number of firm foundations in jurisdiction i at time t, C_{it} the value of the total PIGS capital stock, T_{it} the local business tax and $\mathbf{X}_{it}$ the vector of socio-economic control variables described above. This latter includes municipalities' number of inhabitants, implying that the model accounts for potential effects related to PIGS usage rivalry.[21] Additionally, we control for municipality

[21] We believe that accounting for potential PIGS rivalry effects by adding population as a control regressor is superior to scaling the PIGS variable by population as the former, contrary to the latter, does allow for but does not impose rivalry effects. When using the PIGS capital stock scaled by population as regressor, we obtain qualitatively similar but quantitatively somewhat larger results than the ones reported in this paper.

fixed effects λ_i and time fixed effects δ_t. We calculate cluster robust standard errors on the municipality level to allow for deviations from the Poisson distribution (see Wooldridge 2010).

The estimation results for Equation 3 are presented in Table B1 in the online appendix. The findings suggest that local business taxes (PIGS) exert a significantly negative (positive) effect on the number of new firm foundations. In quantitative terms, both effects turn out to be moderate in size.[22]

We do not consider these estimates to retrieve causal effects though. While the fixed effects approach in Equation 3 rules out omitted variable bias related to time-constant unobserved factors, the estimated coefficients may still be biased by reverse causality or by time-varying unobserved correlates of municipalities' policy choices and the number of new businesses. If localities, for example, respond to declines in local economic activity and firm foundation rates with countercyclical fiscal policies (i.e. increases in PIGS spending or reductions of the local business tax rate), our baseline estimates would be biased towards zero.

B. *Control Function Approach and Spatial Effects*

To address these concerns, we set up the following control function approach

First Stage:

$$C_{it} = \gamma_1 \mathbf{X}_{it} + \gamma_2 \mathbf{Z}_{it} + \lambda_i + \delta_t + \nu_{it}$$

$$T_{it} = \gamma_1 \mathbf{X}_{it} + \gamma_2 \mathbf{Z}_{it} + \lambda_i + \delta_t + \mu_{it}$$

Second Stage:

$$E[y_{it}|\mathbf{R}_{it}] = exp\left(\gamma \mathbf{X}_{it} + \beta_1 C_{it} + \beta_2 T_{it} + \lambda_i + \delta_t + \nu_{it} + \mu_{it}\right) \quad (4)$$

[22]Note that the coefficients of a Poisson regression can be interpreted as semi-elasticities (see e.g. Cameron and Trivedi (2005)).

with ν_{it} and μ_{it} denoting the predicted residuals calculated from regressing C_{it} and T_{it} on the control variables $\mathbf{X}_{it}$ and the excluded instruments $\mathbf{Z}_{it}$ using ordinary least squares.[23] Standard errors are bootstrapped with 100 draws to obtain valid standard errors when instrumenting the PIGS capital stock and the local business tax rate.

We make use of two instruments. The PIGS capital stock is instrumented using variation generated by the 'Renewable Energy Sources Act' (RES Act) of 2000. This Act was initiated by the German state to promote energy production from renewable sources. Among others, the law created heavy subsidies for firms constructing wind power plants resulting in a substantial increase in the number of plants across Germany. Wind power plants are subject to local taxation and directly increase local business tax revenues. We hence expect that localities that attracted new wind power plants in the wake of the RES Act observed a surge in their local tax revenue and in consequence their local spending.[24] Our instrument exploits that wind power plants, to maximize energy output, are only built in areas with high wind strength and sufficient free/unpopulated space. The latter follows from the fact that guidelines for approving the construction of wind power plants in Germany state that the typical distance of an energy production area with seven wind power plants from the next local town should be at least 1500 meters. Following this notion, our instrument captures differences in the emergence of spending behaviour of localities with low levels of wind and/or little free agricultural space and localities with both, high levels of wind and free agricultural space, after the passing of the RES Act in 2000.

[23] $\mathbf{R}_{it} = \{\mathbf{X}_i, C_{it}, T_{it}, \lambda_i, \delta_t, \nu_{it}, \mu_{it}\}$ represents our set of regressors.

[24] Our first stage results confirm the notion that communities with high levels of wind strength and significant free agricultural space increased their local PIGS spending in the wake of the RES Act (see below). Alternatively, localities might respond to the additional tax revenue from the new wind power plant activity by lowering their local business tax rates. Our first stage models allow for this possibility as we also augment the first stage model for the local business tax rate by the described wind energy instrument.

Figure 3: Quantiles of Mean Wind Strength and Agricultural Land

(a) Mean Wind Strength in 80m Height (b) Mean Agricultural Land

Notes: The figure depicts the quantiles of mean wind strength in 80m height and mean fraction of agricultural land in West German communities. Darker colors are associated with higher quantiles.

To construct the instrument, we will use the mean wind strength (from 1981 to 2000, provided by the German Weather Service) in a height of 80 meters and the total agricultural land in km^2 within German municipalities. Figure (3) depicts 1% quantiles of these variables graphically. Darker colors are associated with higher quantiles. The figure suggests that wind strength and agricultural land vary substantially between localities. Especially localities in the North-West of Germany (in Lower-Saxony and Schleswig-Holstein) are likely to observe high wind strength and sufficient agricultural land. The empirical analysis to come will rely on variation in wind strength and free agricultural space within states by including a full set of state-year fixed effects as control variables.

Furthermore note that the construction of the instrument relies on the assumption that (most of) the profits of wind turbines are taxed in the host location of the wind turbine. If local wind power plants are organized within separate legal entities, this obviously holds true.[25] If they are part of larger groups that span several jurisdictions, the local business tax base is apportioned across jurisdictions according to a formula apportionment system with profit consolidation at the federal level and payroll apportionment. While the operation of wind power plants commonly does not involve any labour and thus wage payments, the German local business tax law acknowledges that the allocation of the tax base does not have to be based on the payroll factor if this mechanism leads to an unfair tax base allocation (Art. 33, Local Business Tax Law). Anecdotal evidence suggests that, during our sample period, wind turbine jurisdictions received a significant fraction of wind turbine profits based on this legal provision and the notion that there is, in general, little labour involved in electricity generation. Langenmayr and Simmler (2018) simulate wind turbine profits in Germany assuming that profits are taxed in the host jurisdiction of the wind turbine. When regressing the observed actual local business tax base on the simulated profits, they find a strong correlation between the two measures.[26]

Furthermore note that we will cross-check the sketched instrumental variable strategy by also running regressions where we instrument locality spending with agricultural land used for corn production in German municipalities interacted with post RES 2000 reform indicators. The rationale for that robustness check is that

[25] Note that wind power plants, if organized in separate legal entities, commonly are set up as unincorporated businesses. As these entities do not employ any personal, they are not counted as a firm foundation in the definition of our dependent variable. We are hence confident that our main estimates do not pick up mechanical effects related to the foundation of entities for wind power plants. To corroborate this point, we present robustness checks below.

[26] After our sample period, from 2009 onwards, an explicit allocation mechanism for wind turbines was introduced in the local business tax law, stating that 30% of the tax base from wind turbine activity are to be allocated according to wages (and thus, commonly, to the management jurisdiction of the group) and 70% are to be allocated according to fixed assets, excluding office furniture and equipment (and thus, commonly, to the wind turbine jurisdiction) (Art. 29, Par. 2 Local Business Tax Law).

the introduction of the RES Act also heavily subsidized bio-energy production and thereby increased prices for corn and thus profits of corn-farmers, which again are subject to local business taxation (see, e.g., Habermann and Breustedt (2011).[27]

On top of that, the local business tax rate is instrumented with the so-called 'reference business tax' from the German municipal fiscal equalization scheme. Municipal fiscal equalization is organized through fiscal transfers from the state level to the municipality level. If a municipality's fiscal capacity falls short from its fiscal needs, it receives funds from the state level (while it commonly does not have to give up funds if fiscal needs fall short from fiscal capacity). Note that fiscal needs are a conceded budget per resident, while fiscal revenues are a measure for tax revenues at standardized tax rates.[28] Local business tax revenues add to localities' fiscal capacity at such a standardized 'reference business tax rate'. This implies that, if the reference tax is larger than the municipality's actual tax rate, localities appear richer in the equalization scheme than they actually are and vice versa. Anecdotal evidence suggests that municipalities respond to changes in the position of their reference tax relative to the actual tax rate: If the reference tax is increased above the actual rate, local municipal councils, with an elevated propensity, adjust the business tax rate upwards (see e.g. IHK (2016)).[29] Following this line of argumentation, we instrument the local business tax choices with a dummy variable indicating if the reference tax rate in the fiscal equalization scheme is smaller or larger than a municipality's actual local business tax rate. To avoid obvious endogeneity concerns, the

[27] Since agricultural land use data is not available on the municipality level, we use county level information on the share of agricultural land used for corn production multiplied with the size of agricultural land in a jurisdiction to construct the variable.

[28] The rationale for measuring fiscal capacity as tax revenues at standardized rather than actual tax rates is to avoid that municipalities lower their local business and property tax rates in order to lower their fiscal capacity in the fiscal equalization scheme.

[29] Note that, from a theoretical perspective, all communities have an incentive to raise their local business tax rate in response to a reference tax increase. As outlined in the text, anecdotal evidence and our empirical analysis, however, show that this incentive is particularly pronounced for localities whose local business tax was above the reference tax before and is below after.

reference tax is compared to the actual rate in a pre-sample period (1997), implying that time variation in the reference tax instrument relates to adjustments in the reference tax only.

Furthermore, we extend the sketched control function approach by adding the spatial lags of the tax and PIGS regressors to the estimation model. This serves two purposes: Firstly, it allows us to test for fiscal externalities of tax and PIGS choices on other jurisdictions, which is relevant from an economic perspective as the presence of such externalities renders decentralized policy-making inefficient. The related results hence inform policy debates on the assignment of tax and spending rights across government tiers. Moreover, adding the spatial lag of the policy variables is necessary to avoid bias in the coefficient estimates that capture the tax and PIGS effects on the foundation of new firms in the policy-changing jurisdictions. To see this, consider a jurisdiction that decreases its local business tax rate. If policy choices are positively correlated across space (which tax competition models suggest they are, see e.g. Devereux *et al.* (2008)), this tax reduction triggers a decrease in the local business tax of neighbouring localities as well. While the decline in the host jurisdiction tax exerts a positive effect on the number of firm foundations, the decrease in neighboring communities' tax rates is expected to depress the number of firm foundations in the considered jurisdiction. If spatial effects are not modelled, the coefficient estimate for the jurisdiction's own tax variable captures the joint effect of both tax policy adjustments and hence underestimates the impact of the own tax instrument in absolute terms. Analogous considerations, moreover, apply in the PIGS dimension.

Furthermore note that this type of endogeneity problem is not solved by instrumenting for the own-policy effects as described above if changes in the instruments are correlated across space.[30] We hence account for spatial lags of the PIGS capital

[30]Such correlations plausibly often do exist: In our case, the exposure to wind and the availability

stock in our control function model, treating the policy variables as well as the spatial lags as endogenous. Specifically, we estimate four first stage equations which regress the local business tax, the PIGS stock and the spatial lags of the two policy measures on the wind instrument and the reference tax instrument sketched above as well as the spatial lags of the instruments and the set of control variables and their spatial lags. The predicted residuals from the four first stage regressions are included as regressors in the second stage model.

Finally note that the spatial lags are calculated based on a spatial weighting matrix that accounts for neighbors within 15km distance (baseline), 20km and 40 km (robustness check) respectively, measured as the Great-Circle distance between municipality centroids. Values of the weighting matrix correspond to the inverse distance between neighboring municipalities (baseline), to uniform weights and the inverse distance squared between neighboring localities (robustness checks) respectively and take on the value of zero for non-neighbors (where the matrix is row-standardized such that the weights add up to 1).

Estimation Results

The baseline estimates for our control function approach are reported in Table 2 and Table B2 in Appendix B, with Table 2 (Table B2) depicting the results of the second (first) stage model. First stage result patterns are as expected and confirm our considerations in the previous chapter. The second stage models confirm a statistically significant impact of local business tax and PIGS choices on firm foundation rates. Columns (1) and (2) of Table 2 present control function models, where the local business tax rate and the PIGS stock are included as sole policy regressors. Specification (3) jointly includes both policy variables and Specification (4) estimates the full model additionally including the spatial lags of the policy re-

of agricultural land may very well be correlated across space as may be changes in the position of the jurisdiction's tax rate relative to the reference tax.

gressors. The coefficient estimates for the local business tax and the PIGS stock turn out negative and statistically significant across specifications. Quantitatively, the control function estimates are significantly larger than the baseline estimates in absolute terms, suggesting that endogeneity issues along the lines discussed above bias coefficient estimates in the baseline setting. Specification (4) suggests that the elasticity of firm foundations w.r.t. local business tax changes amounts to -4.6.[31] This is comparable to recent estimates in regional contexts by Becker *et al.* (2012) for Germany and by Suárez Serrato and Zidar (2016) for the US, but tends to be at the upper end of estimated business activity responses to corporate taxation in international contexts (see e.g. deMooji and Ederveen (2003) and Feld and Heckemeyer (2011) for surveys).

Table 2: Control Function Poisson Regressions

	(1)	(2)	(3)	(4)
Local Business Tax	-0.0083***		-0.0084***	-0.0137**
	(0.0019)		(0.0021)	(0.0055)
Local Business Tax, Spatial Lag				0.0188***
				(0.0065)
Total PIGS Stock		0.0199**	0.0120	0.0257***
		(0.0086)	(0.0081)	(0.0086)
Total PIGS Stock, Spatial Lag				0.0327
				(0.0273)
N	70653	70653	70653	70653
Municipality Fixed Effects	✓	✓	✓	✓
State X Year Fixed Effects	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Control Functions	✓	✓	✓	✓

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{**}p < 0.01$. The table reports the second stage results for the control function approach presented above, where the local business tax, the PIGS stock and the spatial lag of the two variables are treated as endogenous. The dependent variable is the number of firm foundations per municipality and year. Spatial lags are constructed based on neighbors within 15 km distances and inverse-distance weighting. The model includes a full set of state-year fixed effects and the control variables described in Section 3 as well as their spatial lags.

Specification (4), moreover, yields a positive and quantitatively large coefficient estimate for the spatial lag of the local business tax variable, suggesting that higher business taxes push out new firms to locate in neighboring localities. As the point

[31] Note that a 1%-change in the local business tax rate corresponds to an increase by 3.39 business tax points on average (cf. Table 1), which according to the estimate translates in a drop in the number of new firms by $4.644\% (= 3.39 \cdot (-0.0137))$.

estimates for the own tax effects and the spatial lag do not significantly differ in absolute terms, the results point to strong beggar-thy-neighbor effects: increases in the number of firm foundations when local business taxes decline are suggested to largely reflect that businesses are attracted from neighboring jurisdictions as opposed to the emergence of genuinely new economic activity.

The model, moreover, suggests that PIGS exert a significantly positive impact on the number of new firms in the policy-changing jurisdiction. In quantitative terms, the elasticity to the PIGS capital stock is determined with 0.78.[32] The coefficient estimate for the spatial lag of the PIGS stock, moreover, while positive, does not gain statistical significance, rejecting that PIGS exert a significant impact on the number of new firm foundations in neighboring municipalities.

Table 3: Spatial Lag, Inverse Distance Weights

Radius, Spatial Lag	20km	40km
	(1)	(2)
Local Business Tax	-0.0121**	-0.0095**
	(0.0050)	(0.0043)
Local Business Tax, Spatial Lag	0.0149**	0.0065
	(0.0061)	(0.0064)
PIGS Stock	0.0223***	0.0154*
	(0.0079)	(0.0086)
PIGS Stock, Spatial Lag	0.0154	-0.0396
	(0.0276)	(0.0317)
N	70653	70653
Municipality Fixed Effects	✓	✓
State X Year Fixed Effects	✓	✓
Controls	✓	✓
Control Functions	✓	✓

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Specifications (1) and (2) reestimate the baseline model in Specification (4) of Table 2, defining neighboring communities for the calculation of spatial lags as all municipalities within a 20km and 40km great distance circle (as opposed to 15km in the baseline specification).

Robustness Checks

Tables 3 to 5 present robustness checks. Firstly, we rerun the models using different definitions of the spatially lagged regressors. The specifications in Table 3 stick

[32] An increase in the PIGS capital stock by 1% corresponds to a rise by 0.34 Million Euro on average (cf. Table 1) and is estimated to trigger a drop in the number of new firms by 0.78%($= 0.34 \cdot 0.0257$). Note, moreover that, as described in the Introduction, we are not aware of other papers that estimate the link between local PIGS provision and firm activity. Country-level estimates in Bénassy-Quéré *et al.* (2007) also suggest a positive link between government spending and firm activity, which is quantitatively smaller than our estimate though.

to inverse distance weighting of neighboring communities but increase the group of neighbors to municipalities within a 20 and 40km radius. Table 4 presents specifications that reestimate our baseline model, constructing the spatial lags of regressors based on uniform weights and squared inverse distance weights, again accounting for neighbors within a 15km, 20km and 40km distance radius respectively. Overall the results confirm our baseline estimates but suggest that tax competition effects between neighboring communities quickly fade out in geographic distance.

Table 4: Alternative Weights

	Uniform Weights			Inverse Distance Squared Weights		
	15km (1)	20km (2)	40km (3)	15km (4)	20km (5)	40km (6)
Local Business Tax	-0.0132***	-0.0110*	-0.0084**	-0.0137**	-0.0127**	-0.0114**
	(0.0033)	(0.0061)	(0.0042)	(0.0058)	(0.0053)	(0.0050)
Local Business Tax, Spatial Lag	0.0183***	0.0125*	0.0003	0.0181***	0.0159**	0.0130*
	(0.0047)	(0.0072)	(0.0076)	(0.0069)	(0.0063)	(0.0070)
PIGS Stock	0.0264***	0.0211***	0.0112	0.0258***	0.0236***	0.0221***
	(0.0087)	(0.0077)	(0.0081)	(0.0090)	(0.0083)	(0.0082)
PIGS Stock, Spatial Lag	0.0300	0.0061	-0.0509	0.0272	0.0198	-0.0130
	(0.0284)	(0.0308)	(0.0349)	(0.0288)	(0.0276)	(0.0327)
N	70645	70645	70645	70653	70653	70653
Municipality Fixed Effects	✓	✓	✓	✓	✓	✓
State X Year Fixed Effects	✓	✓	✓	✓	✓	✓
Control Variables	✓	✓	✓	✓	✓	✓
Control Functions	✓	✓	✓	✓	✓	✓

$*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Specifications (1)-(3) present robustness checks on the baseline model specification, where the spatial lags of the regressors are calculated using uniform weighting of neighboring jurisdictions. Specifications (4)-(6) present robustness checks on the baseline model specification, where the spatial lags of the regressors are calculated using inverse distance squared weighting of neighboring jurisdictions. Specifications (1)+(4)/(2)+(5)/(3)+(6) account for neighbors within 15km/20km/40km of the locality centroid.

Moreover, we check on the validity of our instrumental variable strategy. One obvious concern, when it comes to the RES wind instrument, is that the erection of wind power plants may directly impact on our dependent variable - either because new wind power plants are, themselves, counted as new establishments or because wind power plants exert a direct positive effect on the local economy. We consider neither to be of importance for our analysis. Firstly, wind turbines have mostly been erected by individuals (without any full-time employees) and are thus not counted as new establishments in our analysis (see the definition of our dependent variable in Section III). Secondly, we used data on the actual erection of wind turbines in our sample jurisdictions to crosscheck on that point and defined modified dependent variables, where we substract actually erected turbines from the number of new establishments in a given municipality and year. The results are reported in Specifications (2) and (3) of Table 5.

In Specification (2), the dependent variable is the number of new establishments per municipality and year less 1 in years in which new wind power plants were erected (hence assuming that new turbines were erected by the same new firm).[33] In Specification (3), the dependent variable is the number of newly established firms in a municipality and year less the actual number of newly erected wind turbines (hence assuming that each wind turbine is erected by a separate new firm). Note that the sample size differs from the baseline specification as we were unable to merge the wind turbine information to our main data for two German states (Baden-Württemberg and Saarland).[34] For comparison, Specification (1) of Table 5 reestimates our baseline model (Specification (4) of Table 2) in the restricted sample. The results indicate that the described modification of the dependent variable, in line with our considerations above, affects coefficient estimates neither qualitatively nor quantitatively. As spelled out above, a second concern may be that the erection of wind power plants might have a direct positive effect on the local economy. We consider this to be highly unlikely as the installation and maintenance of wind turbines requires highly specialized skills and equipment and is hence organised in firms that work on a supra-regional basis.

To further assess the robustness of our findings, we rerun the analysis with an alternative instrument. Specifically, the RES 2000 act - next to subsidies for

[33] The wind turbine data has been obtained from the operator database (http://www.btrdb.de/).

[34] Specifically, access to the *Gewerbeanzeigenstatistik* was granted separately for individual German states by the State Statistical Offices in charge. Data access is organized via a common data lab of the statistical offices and via remote data access. All states, with the exception of Baden-Württemberg and Saarland, on top, allowed us to export the aggregate number of firm foundations per community and year. As linking the *Gewerbeanzeigenstatistik* with external information is restricted to variables that researchers initially applied for, we were unable to merge in the wind turbine data, which was not part of our initial project proposal. The specifications in Table 5 are estimated based on the exported firm count data for the other states.

wind energy production - also granted generous subsidies for the production of bio fuel (see Section 3 for details). As this increased the profits of farmers and the tax revenues of their host communities, we exploit differences in the emergence of revenues and spending between communities with high and low capacities for corn production after the act was passed for empirical identification (see Section 3 for the definition of 'capacity for corn production').[35] The second stage results are presented in Column (4) of Table 5 and, reassuringly, turn out to be qualitatively and quantitatively similar to our baseline estimates.

Table 5: Wind vs. Corn Instrument

	Wind			Corn
	(1)	(2)	(3)	(4)
Local Business Tax	-0.0145***	-0.0118**	-0.0119**	-0.0127**
	(0.0046)	(0.0047)	(0.0050)	(0.0059)
Local Business Tax, Spatial Lag	0.0152***	0.0142**	0.0132**	0.0114**
	(0.0057)	(0.0056)	(0.0064)	(0.0062)
Total Capital Stock (in 1M Euro)	0.0288**	0.0222**	0.0251**	0.0310
	(0.0113)	(0.0097)	(0.099)	(0.0356)
Total Capital Stock (in 1M Euro), Spatial Lag	-0.0455	-0.0277	-0.0425	-0.0764
	(0.0389)	(0.0233)	(0.0317)	(0.0509)
N	61054	61054	61054	61054
Year Fixed Effects	✓	✓	✓	✓
Municipality Fixed Effects	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Control Functions	✓	✓	✓	✓
Correction Built Wind Turbines		Yes(less 1)	YES (less #)	

$p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$. Specification (1) reestimates the baseline model in a sample without the states of Baden-Württemberg and Saarland. In Column (2), we report the results for analogous model specifications, where the dependent variable is the number of new establishments per municipality and year minus 1 if at least one new wind turbine has been erected in the respective community in a particular year. In Column (3), the analogous model is estimated with a dependent variable which is the number of new establishments per municipality and year minus the actual number of wind turbines built in a jurisdiction and given year. In Specification (4), we instrument community spending with communities' capacity for corn production instead of wind strength and agricultural space.

Finally note that we ran a jackknife analysis, which confirms that none of our results is driven by a particular German state (not reported in the paper).

The effect of PIGS on family and transport intensive industries

The analysis so far has been restricted to assessing the effect of the *aggregate* PIGS stock on the aggregate number of firm foundations per jurisdiction and year. The impact of PIGS on firm profits, enterpreneurs' wellbeing and, in consequence,

[35]Specifically, the corn capacity variable defined in Section 3 is interacted with an indicator for years after the implementation of the RES 2000 act and, additionally, with a linear time trend for the post reform years.

firm foundation choices may, in turn, well differ across industries and across different types of PIGS. We test for this possibility based on two sets of consideration: Firstly, many PIGS provided by German municipalities are targeted at households and specifically at families with children. This, among others, concerns youth facilities, education, sports and recreation options, like playgrounds, parks, public swimming and public soccer courts. While it is individuals who directly benefit from these PIGS, firms may capture some of the related rents through lower wage costs (as workers are willing to work for lower wages in areas with family-related amenities) or increased worker productivity.[36] In the following, we will assess the effect of such 'family-PIGS' on the number of new firm foundations in 'family-intensive' industries. Theoretically, one might expect to see higher own-PIGS responses than in the baseline model as the considered firm pool is expected to be particularly strongly affected by the considered PIGS. In terms of PIGS spillover effects, predictions are ambiguous. On the one hand, one might expect to see higher positive spillover effects as commuting of enterpreneurs and workers might imply that municipalities close to residential communities with attractive family PIGS may become attractive firm locations. On the other hand, the busy time schedule of families may counteract this effect as parents may be reluctant to commute between communities. Moreover, the benefits of many family-PIGS, like schooling and childcare, exclusively accrue to households that reside in the PIGS-providing community, potentially further dampening the emergence of positive spillover effects.[37]

In the empirical analysis, 'family-PIGS' are defined as PIGS provision related to schools, recreations and sports, culture and public education, youth services and public transport. We, moreover, identify 'family-intensive' industries based on firm-

[36] Alternatively, enterpreneurs may obtain direct benefits from PIGS provision and may for that reason be drawn to locate in communities with high levels of 'family-PIGS'.

[37] Families in Germany are e.g. only eligible to nursery places in their community of residence. Analogously, school choices tend to be restricted.

level information on the employment structures of all German establishments provided in the 'Establishment History Panel' of the Institute for Employment Research (IAB). Specifically, we use the waves for 1996 to 2007 to define 'family-intensity' according to the fraction of workers per firm, who are aged between 35 and 49 and are thus in the age range where individuals commonly live with children.

Following this definition, Specifications (1) and (2) of Table 6 present the results of control function models where the dependent variable corresponds to the number of new firm foundations per community and year in family-intensive and non-family-intensive industries respectively, defined as 2-digit industries with an average fraction of 'family-aged' workers above and below the median respectively. Specifications (3) and (4) rerun the same specifications using as dependent variable the number of new firms in 2-digit industries with an average family-intensity above and below the 75th percentile of the distribution respectively.

To avoid that our estimated 'family-PIGS' effect is confounded by - potentially correlated - PIGS provision in other dimensions, we subsume the PIGS stock related to communities' voluntary PIGS spending in other dimensions in one variable and include it as a control regressor in the indicated specifications. The family-related and other PIGS stock variables are thereby instrumented based on a shift-share-approach (see Bartik (1991)), where the wind instrument is weighted by the fraction of the PIGS stock in the two PIGS categories relative to the overall PIGS stock in the pre-sample period 1997 in the first stage regressions.

The results suggest that family-related PIGS exert a significant and quantitatively large effect on the number of firm foundations in family-intensive industries, while the effects on firm foundations in non-family intensive industries are small and statistically insignificant. Specification (1) (Specification (3)) suggests that an increase in the stock of family-related PIGS by 1% (corresponding to an increase by

0.2 Mio Euros, on average) raises the number of firm foundations in industries with a family-intensity above the median (75th percentile of the distribution) by 1.2% (2.3%). The coefficient estimate for the spatial lag of family-related PIGS (calculated based on neighbors within a 15km distance radius and with inverse distance weights) moreover turns out negative and large in absolute size, suggesting strong beggar-thy-neighbor effects. The latter result contrasts our baseline findings, which suggested no significant PIGS spillover effects across borders. As sketched above, this may reflect a reluctance of parents to commute to work or capture that many family-PIGS can only be captured by households actually residing within community borders. Specifications (1)-(4) in Table B3 in the online appendix corroborate this evidence and show that similar results emerge when PIGS categories other than family-intensive PIGS are modelled in detail.[38] Note, moreover, that, interestingly, we do not find significant differences in the response of family-intensive and non-family-intensive firms to changes in the local business tax rate, which indicates that the two type of firms do not differ in their general responsiveness to fiscal incentives.

As a second strategy, we assess the effect of the provision of public streets on the number of new firm foundations in *transport intensive industries*. The notion behind this sub-analysis is that transport-intensive firms are presumed to rely on a functioning road network and that PIGS investment in that dimension, in consequence, raise the attractiveness of municipalities as a location for firms in transport-intensive industries. In the following, we will use the average ratio of material inputs to sales as a proxy for the transport intensity of 2-digit-industries, calculated from firm

[38]We again rely on a shift-share-strategy when implementing the control function approach. Note, moreover, that in the specifications of Table 7, the coefficient estimates for the spatial lag of the family-PIGS stock tend to be larger in quantitative terms than the coefficient estimates for the own effect of the family-PIGS stock. This asymmetry vanishes when the rest of the PIGS capital stock is modelled in more detail as in Table B3 of the online appendix. Note, moreover, that the estimates in Table B3 also suggest that firms in family-intensive sectors react more sensitively to the building and maintenance of community streets (which may relate to the fact that short-distances-mobility is important for families and a good infrastructure network reduces driving times within a locality).

Table 6: Family and Transport Intensive Industries

	Median		Pctl(75)		Median		Pctl(75)	
	Family Intensive Industries				Transport Intensive Industries			
	Yes	No	Yes	No	Yes	No	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Local Business Tax	-0.0120	-0.0138**	-0.0092	-0.0135**	-0.0162***	-0.0140*	-0.0177***	-0.0142***
	(0.0099)	(0.0059)	(0.0257)	(0.0059)	(0.0041)	(0.0079)	(0.0066)	(0.0049)
Local Business Tax, Spatial Lag	0.0115	0.0176***	0.0170	0.0172**	0.0163***	0.0164*	0.0189**	0.0153**
	(0.0122)	(0.0068)	(0.0330)	(0.0072)	(0.0063)	(0.0087)	(0.0080)	(0.0071)
People Goods	0.0575***	0.0101	0.1159**	0.0122				
	(0.0205)	(0.0113)	(0.0517)	(0.0116)				
People Goods, Spatial Lag	-0.0815*	0.0490*	-0.2884***	0.0449*				
	(0.0427)	(0.0272)	(0.1062)	(0.0263)				
Streets					0.0143	0.0178	0.0163	0.0151
					(0.0094)	(0.0110)	(0.0118)	(0.0107)
Streets, Spatial Lag					-0.0457	0.0145	-0.0352	-0.0139
					(0.0441)	(0.0539)	(0.0564)	(0.0564)
Other Stock	0.0489***	0.0135	0.0987**	0.0154	0.0177**	0.0212*	0.0205*	0.0191*
	(0.0180)	(0.0094)	(0.0450)	(0.0106)	(0.0090)	(0.0113)	(0.0117)	(0.0103)
Other Stock, Spatial Lag	-0.0486	0.0273	-0.1386	0.0251	-0.0116	0.0278	-0.0133	0.0153
	(0.0365)	(0.0226)	(0.0955)	(0.0246)	(0.0293)	(0.0363)	(0.0344)	(0.0352)
N	54525	70254	34143	70522	68838	66344	63563	69517
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Municipality Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
State X Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Control Functions	✓	✓	✓	✓	✓	✓	✓	✓

$^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. The table presents model specifications, where the dependent variable is the number of new firms in (non-)family-intensive/(non-)transport-intensive industries as defined in the main text. In Specifications (1) and (2), firms with a 'family-intensity' above and below the median are counted, in Specifications (3) and (4), firms with a family-intensity above and below the 75th percentile of the distribution. Analogously, in Specifications (5) and (6), the dependent variable is the number of new firms with a transport-intensity above and below the median, in Specifications (7) and (8), firms with a transport-intensity above and below the 75th percentile of the distribution. The definition of the spatial lags of the regressors accounts for neighbors within 15km distance and uses inverse distance weights. The definition of the 'Streets' regressor corresponds to Section 3, people goods comprise schools, recreations and sports, culture and public education, youth services and public transport; other goods comprises all other categories described in Section 3. Note that the difference in the number of observations across specifications relates to communities, where the dependent variable takes on the value zero for all sample years, so that the respective municipality is dropped from the sample.

accounts provided in Bureau van Dijk's DAFNE data.[39]

Specifications (5) to (8) of Table 6 report specifications where the number of new firm foundations in transport-intensive and non-transport-intensive industries respectively is regressed on the value of community streets (constructed based on the perpetual inventory method sketched in Section 3). In Specifications (5) and (7), the dependent variable is the number of new firm foundations per community and year in transport-intensive industries, defined as those with a ratio of material inputs over total sales above the median and the 75th percentile of the distribution respectively. Inversely, in Specifications (6) and (8), the dependent variable is the number of firm foundations in non-transport intensive industries, defined as industries with material inputs relative to overall sales below the median and the 75th percentile of

[39] As firm coverage in DAFNE is rather poor prior to the mid 2000s, the transport intensity of firms is calculated based on data for the year 2009.

the distribution respectively. Note, moreover, that the control function approach is again implemented based on the shift-share-strategy described above.

The coefficient estimates for the street regressor turn out small and statistically insignificant in all specifications, suggesting that community streets do not exert a significant impact on the emergence and attraction of new firms. We consider this finding to reflect that our analysis only captures expenditures related to the construction and maintenance of streets within a given municipality. Roads and highways that cross municipality borders, connect regions and have been shown by earlier research to impact firm behavior (see e.g. Moeller and Zierer (2018)), in turn, fall into the responsibility of higher government tiers. The insignificant effect of local street infrastructure on transport-intensive industries might, moreover, reflect that a major fraction of related public spending is assigned to the maintenance of existing roads instead of the construction of genuinely new infrastructure. Prior research suggests that, after the core infrastructure is built, firm benefits related to such 'marginal' investments tend to be limited (see e.g. Fernald (1999)). For the sake of completeness, furthermore note that the tax effects on the emergence of new firms are again quantitatively similar to our baseline estimates for both subgroups of firms.

V. Conclusion

In this paper, we estimated the effect of local business taxes and local PIGS provision on the number and spatial distribution of new firms. Using Germany as a testing ground and estimating fixed effects Poisson regressions coupled with a control function approach, we find that both, local business taxes and PIGS provision exert a quantitatively significant impact on the number of new firm foundations in the policy-changing jurisdiction. The findings hence suggest that local fiscal policies do change firm behaviour. Our results, moreover, point to beggar-thy-neighbor externalities: Reductions in local business tax rates are found to strongly lower the number of news firms in neighboring communities, implying that the aggregate number of firms remains unchanged. Analogous beggar-thy-neighbor externalities emerge in the PIGS dimension - for subsets of firms and PIGS. Evidence on such spillovers informs policy debates about the assignment of tax and spending rights to government tiers - supporting proponents of a stronger centralization of policy instruments.

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Appendix A: Proofs for Theoretical Model

Proof of Lemma 1. Under the assumption that $m(1)$ is sufficiently high,

$$\Delta(0) = (t_2 - t_1)V + \big((1-t_1)B_1(c_1,c_2) - (1-t_2)B_2(c_1,c_2)\big) + (1-\gamma t_2)m(1) - (1-\gamma t_1)m(0) > 0$$

and

$$\Delta(1) = (t_2 - t_1)V + \big((1-t_1)B_1(c_1,c_2) - (1-t_2)B_2(c_1,c_2)\big) + (1-\gamma t_2)m(0) - (1-\gamma t_1)m(1) < 0.$$

By the intermediate value theorem, there exists $\bar{x}$ with $\Delta(\bar{x}) = 0$. Because

$$\frac{\partial \Delta(x)}{\partial x} = -(2 + \gamma(t_1 + t_2))m'(x) < 0,$$

$\Delta(x)$ is monotone and thus $\bar{x}$ is unique and $\Delta(x) > 0$ if $x < \bar{x}$ and $\Delta(x) < 0$ if $x > \bar{x}$.

Proof of Lemma 2. $\bar{x}$ is implicitly defined by $\Delta(\bar{x}) = 0$. By the implicit function theorem, it is sufficient to consider $\partial\Delta(x)/\partial p$ for $p \in \{t_1, t_2, c_1, c_2\}$.

1. For the first part of Lemma 2, consider

$$\begin{aligned} \frac{\partial \Delta(x)}{\partial t_1} &= -(V + B_1(c_1,c_2) - \gamma m(x)) < 0, \\ \frac{\partial \Delta(x)}{\partial t_2} &= (V + B_2(c_1,c_2) - \gamma m(1-x)) > 0, \end{aligned}$$

   where the signs follow from

$$(V + B_j(c_1,c_2) - \gamma m(\cdot)) = \frac{\pi^* + (1 - \gamma m(\cdot))}{1 - t_j} > 0,$$

   where π^* is the profit of the firm given an optimal location and entry choice.

2. For the second part of the lemma, consider

$$\begin{aligned} \frac{\partial \Delta(x)}{\partial c_1} &= (1-t_1)\frac{\partial B_1}{\partial c_1} - (1-t_2)\frac{\partial B_2}{\partial c_1} > 0 \text{ if } (1-t_1)\frac{\partial B_1}{\partial c_1} > (1-t_2)\frac{\partial B_2}{\partial c_1}, \\ \frac{\partial \Delta(x)}{\partial c_2} &= (1-t_1)\frac{\partial B_1}{\partial c_2} - (1-t_2)\frac{\partial B_2}{\partial c_2} > 0 \text{ if } (1-t_1)\frac{\partial B_1}{\partial c_2} > (1-t_2)\frac{\partial B_2}{\partial c_2}, \end{aligned}$$

   as stated in Lemma 2.

Appendix B: Estimates Baseline Model

Table B1: Baseline Poisson Regressions

	Poisson (1)	Poisson (2)	Poisson (3)
Local Business Tax	-0.0010**		-0.0009*
	(0.0005)		(0.0005)
PIGS Stock		0.0014***	0.0013**
		(0.0005)	(0.0005)
N	70653	70653	70653
Municipality Fixed Effects	✓	✓	✓
State X Year Fixed Effects	✓	✓	✓
Controls	✓	✓	✓
Control Functions	✓	✓	✓

$*p < 0.10$, $**p < 0.05$, $**p < 0.01$.

Columns (1) to (3) of Table B1 presents the results for variants of the baseline model in Equation 3. While all specifications absorb time-constant unobserved heterogeneity across jurisdictions and includes a full set of state-year fixed effects and the control variables outlined in Section 3, Specification (1) (Specification (2)) includes the local business tax (the PIGS capital stock) as the sole policy regressor. The point estimate for the local business tax regressor is -0.001 and statistically significant at the 5% level. Quantitatively, a 10% increase of the mean local business tax rate is suggested to decrease the expected count of firm foundations by 3.39% ($33.9 \times 0.1\%$).[40] Specification (2) yields a positive and significant significant point estimate of 0.0014 for the PIGS regressor. Quantitatively, a 10% increase of the PIGS Stock increases the number of firm foundations by 0.43% ($3.044 \times 0.14\%$). Combining both the tax rate and our proxy for the total capital stock in one regression (see specification (3)) yields similar results. Hence, using a simple Poisson regression to capture the effects of tax rates and expenditures for PIGS on the number of firm foundations yields significant but moderate point estimates.

[40] Note that, as outlined in the main text, the local business tax is measured in local business tax points, with an average of 339 local business tax points in our sample. To arrive at the local business tax in percentage points, the variable is multiplied with a so-called 'Messzahl', which took on the value of 5% for incorporated businesses and for income of non-incorporated businesses above EUR 48,000 during our sample period.

Table B2: First Stage Estimates

	Tax (1)	Stock (2)	Tax, Spat. Lag (3)	Stock, Spat. Lag (4)
Reference Tax Dummy	8.6476***	0.1377	1.8179***	-0.1767
	0.7791	0.2669	0.3563	0.1558
Reference Tax Dummy, Spatial Lag	18.7990***	-2.7488***	22.9233***	-1.1876***
	1.8893	0.6574	1.1752	0.4198
Wind X Agriculture X Reform	-0.0014	0.0063***	-0.0004	-0.0006***
	0.0013	0.0010	0.0007	0.0002
Wind X Agriculture X Reform X Trend	-0.0002	0.0005**	-0.0003	0.0000
	0.0004	0.0003	0.0003	0.0001
Wind X Agriculture X Reform, Spatial Lag	-0.0070***	-0.0024**	-0.0074***	0.0041***
	0.0024	0.0012	0.0011	0.0005
Wind X Agriculture X Reform X Trend, Spatial Lag	-0.0016**	-0.0009**	-0.0012***	-0.0009***
	0.0008	0.0004	0.0004	0.0003
Observations	70653	70653	70653	70653
F-Statistic	96.33***	16.71***	668.37***	131.84***
State X Year Fixed Effects	✓	✓	✓	✓
Municipality Fixed Effects	✓	✓	✓	✓
Control Variables	✓	✓	✓	✓

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. The table presents first stage regressions for our baseline control function approach, regressing localities' business tax rate (Column (1)), PIGS capital stock (Column (2)), the spatial lag of the local business tax rate (Column (3)) and the spatial lag of the PIGS capital stock (Column (4)) on the instruments and the control regressors as well as their spatial lag. Note that spatial lags are calculated accounting for neighboring localities within a 15km radius and inverse distance weights. 'Reference Tax Dummy' moreover is a dummy variable indicating whether the reference tax from the fiscal equalization scheme is larger or smaller than the community's local business tax rate in 1998 (see Section IV for details). 'Wind' and 'Agriculture' capture the communities' exposure to wind and its free agricultural space as described in Section IV. 'Reform' is a dummy variable which takes on the value 1 for years after 2000 and 'Trend' is a variable that takes on the value 0 in the reform year 2000 and values 1, 2, 3 and so on for the following years 2001, 2002, 2003 etc.. Note, moreover, that all models, furthermore, include Wind X Reform, Wind X Reform X Trend and the spatial lag of these two variables.

Table B3: Family and Transport Intensive Industries

	Median		Pctl(75)		Median		Pctl(75)	
	Family Intensive Industries				Transport Intensive Industries			
	Yes (1)	No (2)	Yes (3)	No (4)	Yes (5)	No (6)	Yes (7)	No (8)
Local Business Tax	-0.0164*	-0.0134**	-0.0262	-0.0132**	-0.0150***	-0.0119	-0.0169***	-0.0122***
	0.0096	0.0054	0.0244	0.0054	0.0038	0.0073	0.0065	0.0046
Local Business Tax, Spatial Lag	0.0156	0.0179***	0.0489	0.0172**	0.0186***	0.0161**	0.0209**	0.0163***
	0.0136	0.0068	0.0306	0.0073	0.0062	0.0079	0.0083	0.0059
People Goods	0.0611**	-0.0071	0.1512**	-0.0044	0.0052	-0.0069	0.0185	-0.0087
	0.0288	0.0169	0.0604	0.0195	0.0133	0.0165	0.0193	0.0185
People Goods, Spatial Lag	-0.0487	0.0109	-0.1785**	0.0100	-0.0037	0.0088	-0.0145	0.0116
	0.0447	0.0273	0.0762	0.0303	0.0234	0.0284	0.0276	0.0287
Streets	0.0481**	0.0014	0.1140**	0.0035	0.0102	0.0019	0.0181	0.0012
	0.0236	0.0135	0.0507	0.0158	0.0106	0.0137	0.0157	0.0142
Streets, Spatial Lag	-0.0550	0.0063	-0.1484**	0.0052	-0.0173	0.0176	-0.0256	0.0113
	0.0424	0.0237	0.0739	0.0273	0.0208	0.0263	0.0242	0.0228
Economic Promotion	-0.1330	0.1435	-0.4632	0.1376	0.0837	0.1630*	0.0019	0.1756*
	0.1380	0.0882	0.2934	0.0899	0.0703	0.0888	0.0839	0.1014
Economic Promotion, Spatial Lag	0.1334	0.0072	1.1582*	-0.0042	-0.0197	0.0922	0.0317	0.0243
	0.3349	0.1722	0.6538	0.1730	0.1556	0.2002	0.1935	0.1929
Other Stock	0.1165	-0.0581	0.2859	-0.0524	-0.0242	-0.0638	0.0187	-0.0707
	0.0997	0.0665	0.2350	0.0620	0.0536	0.0696	0.0563	0.0748
Other Stock, Spatial Lag	-0.0631	0.1538	-0.0561	0.1419	0.0912	0.1673	0.0382	0.1791
	0.1780	0.1114	0.3617	0.1175	0.1175	0.1133	0.1350	0.1137
N	54525	70254	34143	70522	68838	66344	63563	69517
Control Function Errors	✓	✓	✓	✓	✓	✓	✓	✓
Municipality Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
State X Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Control Functions	✓	✓	✓	✓	✓	✓	✓	✓

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. The table presents model specifications, where the dependent variable is the number of firms in (non-)family-intensive/(non-)transport-intensive industries as defined in the main text. In Specifications (1) and (2), the number of firms with a 'family-intensity' above and below the median are counted (see definition in the main text), in Specifications (3) and (4), firms with a family-intensity above and below the 75th percentile of the distribution. Analogously, in Specifications (5) and (6), the dependent variable is the number of firms in industries with a transport-intensity above and below the median (see definition in the main text), in Specifications (7) and (8), firms in industries with a transport-intensity above and below the 75th percentile are counted. The definition of the spatial lags of the regressors accounts for neigbors within 15km distance and weights are based on inverse distance. The definition of the 'Streets' and 'Economic Promotion' regressors corresponds to Section 3, people goods comprise schools, recreations and sports, culture and public education, youth services and public transport and 'other stock' all other categories described in Section 3. Note that the difference in the number of observations across specifications relates to communities, where the dependent variable takes on the value zero for all sample years, so that the respective locality is dropped from the sample.

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