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Fédéric Holm-Hadulla

## Fiscal equalization and the tax structure

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**Abstract**

Sub-national governments often finance substantial parts of their budgets via taxes on capital or other mobile factors – despite having access to alternative, less distortionary, revenue sources. This paper develops three hypotheses to explain this pattern and tests them in a natural experiment from Germany. The first hypothesis is that fiscal redistribution between jurisdictions lowers the perceived excess burden of distortionary taxation and thereby raises its attractiveness from the perspective of local governments; the second is that a desire for redistribution within jurisdictions induces a shift away from less distortionary tax instruments, despite their superior efficiency properties; the third is that distortionary taxation serves as a Pigouvian intervention to correct externalities. The empirical analysis supports redistribution between jurisdictions as important, but insufficient, to fully explain the observed reliance on distortionary taxation. Among the remaining two hypotheses, the data favour Pigouvian over distributional motives as a further rationale for the local taxation of mobile factors.

***JEL Classification:*** H23; H25; H71, H77

***Keywords:*** *Federalism; Fiscal Equalization; Tax Structure; Natural Experiment; Difference-in-Difference*

## Non-technical summary

The challenge of taxing mobile factors at the level of local government is a leitmotif of the literature on fiscal federalism. As emphasized in the seminal contribution of Oates (1972), the excess burden generated by the mobility of tax bases generally limits their suitability as a source of finance for local budgets. By implication, it is natural to expect local governments to avoid heavy reliance on such tax instruments if they have access to alternative, less distortionary, revenue sources to finance their spending commitments.

This intuition, however, is at odds with observed tax policy in many jurisdictions. One striking example is Germany, where cities and municipalities are constitutionally entitled to raise revenues from a local business tax on highly mobile corporate profits and from a local property tax levied on an immobile and largely constant base consisting of local real estate. Clearly, the characteristics of the respective tax bases would favour the local property tax as a main source of revenue. In practice, however, the opposite constellation prevails. In 2016, for instance, German municipalities on average raised almost four times as much revenue from the local business tax than from the local property tax. Moreover, far from being an isolated German phenomenon, sub-national governments in several other countries also raise a non-negligible share of their tax revenues from mobile factors, despite having alternative instruments at their disposal.

To explain this puzzle, the paper explores three competing theories for the strong reliance on distortionary local taxation and tests them in a natural experiment from Germany.

The theoretical analysis starts from a standard tax competition model to study the decision problem of a benevolent local government that finances public spending through a distortionary tax on perfectly mobile capital and a non-distortionary tax on immobile land. In this basic model set-up, it is optimal for local governments to fully finance public spending through land taxation and to set the capital tax rate to zero. In a second step, I augment this model by three features that may provide a rationale for local governments to choose a positive capital tax rate. The first consists of redistributive fiscal transfers between jurisdictions, which are a common element in the federal structure of many countries. I show that such transfers may induce sub-national governments to set a positive capital tax rate, even in the presence of non-distortionary revenue sources, since adverse tax base effects of capital taxation are partly compensated through higher grants. However, accounting for the impact of fiscal transfers proves insufficient to square the theoretical predictions with salient empirical patterns. Observed reliance on distortionary taxation by local governments in Germany, for

instance, systematically exceeds the levels justified by fiscal transfers according to the model.

To address this shortcoming, I then introduce two further prominent motives for governments to engage in distortionary taxation. The first considers distributional concerns within jurisdictions as a further determinant of the tax structure. The second treats distortionary taxation as an efficient intervention to correct externalities from local production. Both model extensions indeed yield positive capital tax rates as an outcome of the local decision problem. Moreover, they provide a framework to discriminate between the distribution- versus efficiency-rationale for distortionary taxation. This is because the two model extensions yield opposite predictions on how changes in fiscal transfers affect the tax structure: if distributional motives prevail, fiscal equalization tilts the tax structure towards capital taxation; if efficiency motives prevail, fiscal equalization tilts the tax structure towards land taxation.

To test these ambiguous theoretical predictions, I finally turn to an empirical analysis using a natural experiment to identify exogenous changes in key fiscal equalization parameters for causal inference. The experiment derives from a Constitutional Court ruling in Germany's most populous state which imposed an increase in the intensity of fiscal transfers affecting only a subgroup of municipalities. Using the resultant differential treatment in difference-in-difference estimations, the analysis provides robust evidence that increases in the intensity of fiscal equalization cause a statistically significant and economically relevant upward response in tax rates with respect to both, business and property taxation. The response of property tax rates is substantially more pronounced than that of business tax rates and, with regard to the latter tax instrument, the responsiveness tends to decline the larger the per capita tax base in the respective municipality. Both patterns are consistent with the welfare theoretic interpretation of local capital taxation as a Pigouvian intervention to correct externalities. Accordingly, the analysis suggests that the tendency of local tax structures to lean towards distortionary taxation reflects efficiency considerations, rather than distributional motives.

From a policy perspective, the empirical evidence from Germany, pointing to stronger response of property than of business taxation, suggests that fiscal equalization may act as a means to induce a less distortionary tax structure. At the same time, the theoretical analysis highlights important caveats as to whether these findings are likely to translate to other institutional settings – for instance pertaining to the level of national governments, where distributional motives may dominate as a driver of distortionary taxation of mobile factors. In this case, the model would predict intergovernmental transfers to lead to a more distortionary tax structure.

*[I]nterjurisdictional mobility of economic units (...) provides an avenue of escape from local taxation with the resulting inefficiencies in resource use and frustration of distributional objectives. To avoid these difficulties, decentralized governments can try to seek out immobile bases for taxation.*

(Wallace E. Oates, 1972, Fiscal Federalism, p. 143)

# 1 Introduction

The challenge of taxing mobile factors at the level of local government is a leitmotif of the literature on fiscal federalism. As emphasized in the seminal contribution of Oates (1972), the excess burden generated by the mobility of tax bases generally limits their suitability as a source of finance for local budgets. By implication, it is natural to expect local governments to avoid heavy reliance on such tax instruments if they have access to alternative, less distortionary, revenue sources to finance their spending commitments.

This intuition, however, is at odds with observed tax policy in many jurisdictions. One striking example is Germany, where cities and municipalities are constitutionally entitled to raise revenues from a local business tax on highly mobile corporate profits and from a local property tax levied on an immobile and largely constant base consisting of local real estate.[1] Clearly, the characteristics of the respective tax bases would favour the local property tax as a main source of revenue. In practice, however, the opposite constellation prevails. In 2016, for instance, German municipalities on average raised almost four times as much revenue from the local business tax than from the local property tax.[2] Moreover, far from being an isolated German phenomenon, sub-national governments in several other countries also raise a non-negligible share of their tax revenues from mobile factors, despite having alternative instruments at their disposal.[3]

[1] The local business tax is levied on firm profits accruing in the respective jurisdiction and has been shown to exert strong negative tax base effects; see Büttner (2003). The local property tax is levied on the assessed value of real estate in the jurisdiction and is almost an epitome of a non-distortionary tax – *inter alia* because the statutory real estate valuations used to calculate property tax liabilities have not been updated for more than five decades, so even the potential capitalization of that tax in real estate prices would leave the tax base unaffected; see Füss and Lerbs (2017) for additional institutional detail.

[2] See German Federal Statistical Office, Fachserie 14, Reihe 10.1, Realsteuervergleich 2016, Table 1; https://www.destatis.de/DE/Publikationen/Thematisch/FinanzenSteuern/Steuern/Realsteuer/Realsteuervergleich.html.

[3] See Blöchliger and Pinero Campos (2011) for a detailed discussion of sub-national tax structures in OECD countries.

To explain this puzzle, the current paper explores three competing theories for the strong reliance on distortionary local taxation and tests these theories in a natural experiment from German municipal finance.

The theoretical analysis starts from a canonical tax competition model in the tradition of Zodrow and Mieszkowski (1986). Specifically, it considers the decision problem of a benevolent local government that finances public spending through a distortionary tax on perfectly mobile capital and a non-distortionary tax on immobile land. In this basic model set-up, it is optimal for local governments to fully finance public spending through land taxation and to set the capital tax rate to zero – a conclusion that is consistent with basic intuition and replicates a central result from the literature on tax competition with multiple tax instruments (see Wildasin (1986) and Bucovetsky and Wilson (1991) for seminal contributions).

In a second step, I augment this model by three features that may provide a rationale for local governments to choose a positive capital tax rate. The first consists of redistributive fiscal transfers between jurisdictions, which are a common element in the federal structure of many countries. Following widespread institutional practice, these transfers are modelled as vertical 'fiscal equalization' grants from a higher layer of government to the local level, which derive their redistributive properties from the fact that the grants allocated to a jurisdiction are inversely related to its own tax base.[4] In line with the related literature, I show that this inverse relationship may induce sub-national governments to set a positive capital tax rate, even in the presence of alternative non-distortionary revenue sources, since adverse tax base effects from capital taxation are partly compensated through higher grants.[5] However, I also show that this model extension is insufficient to square the theoretical predictions with salient empirical patterns. Observed reliance on distortionary taxation by local governments in Germany, for instance, systematically exceeds the levels justified by fiscal equalization according to the

[4] For an overview and taxonomy of different types of fiscal equalization schemes, see Boadway (2004). The focus of the current paper is on explicit intergovernmental transfer schemes, which are a common institutional feature in federal countries. As pointed out by Kenen (1969), however, the prevalence of intergovernmental redistribution is even broader; in fact, it extends to any fiscally integrated economy with federal tax and interpersonal transfer schemes as these schemes tend "to offset or compensate for regional differences" (Kenen (1969), p. 47), even in the absence of explicit intergovernmental redistribution systems. For further discussion, see Farhi and Werning (2017).

[5] For theoretical treatments, see Wildasin (1989), Dahlby and Wilson (1994), Smart (1998), and Köthenbürger (2002). For empirical evidence, see for instance Büttner (2006), Egger et al. (2010), Baskaran (2014) and Rauch and Hummel (2016) in the context of German municipal finance, as well as Dahlby and Warren (2003) and Smart (2007) for the Australian and the Canadian case, respectively.

model.

To address this shortcoming, I then introduce two further prominent motives for governments to engage in distortionary taxation, instead of solely relying on less distortionary revenue sources. The first draws on the political economics literature, in particular the contributions by Persson and Tabellini (2000) and Fuest and Huber (2001), to consider distributional concerns within jurisdictions as a further determinant of the tax structure. The second draws on the welfare economics literature, in particular the contributions originating from Pigou (1920), on the use of distortionary taxation as a means to correct externalities from local production. Both model extensions indeed yield positive capital tax rates as an outcome of the local decision problem. Their main insight, however, is that they also provide a framework to discriminate between the political-economics and the welfare-theoretic interpretations of distortionary taxation.

This is because the two model extensions yield opposite predictions on how changes in fiscal equalization affect the tax structure (*i.e.* the relative reliance on distortionary versus non-distortionary taxation). In particular, I show that, if distributional motives prevail, fiscal equalization tilts the tax structure towards capital taxation (the intuition is that fiscal equalization lowers the excess burden of capital taxation from the perspective of local governments, while preserving the political economy motives for shifting the tax burden away from land). By contrast, if Pigouvian efficiency motives prevail, fiscal equalization tilts the tax structure towards land taxation (in this case, the intuition is that fiscal equalization induces an increase in capital taxation but this response is attenuated by the concomitant reduction in the local capital intensity, which in turn reduces the need to correct production externalities via taxation).

To test these ambiguous theoretical predictions, I then turn to an empirical analysis using a natural experiment to identify exogenous changes in key fiscal equalization parameters for causal inference. The experiment derives from a Constitutional Court ruling in Germany's most populous state, North Rhine-Westphalia (NRW). For a sub-group of municipalities, this ruling imposed an increase in the intensity of tax-base dependent fiscal equalization, while keeping it unchanged for the others. Using this differential treatment across municipality subgroups in difference-in-difference estimations, the analysis provides robust evidence that increases in the intensity of fiscal equalization cause a statistically significant and economically

relevant upward response in tax rates with respect to both, business and property taxation. The response of property tax rates is substantially more pronounced than that of business tax rates and, with regard to the latter tax instrument, the responsiveness tends to decline the larger the per capita tax base in the respective municipality. Both patterns are consistent with the welfare theoretic interpretation of local capital taxation as a Pigouvian intervention to correct externalities. Accordingly, the results suggest that the tendency of local tax structures to lean towards distortionary taxation reflects efficiency considerations, rather than distributional motives. As such, the analysis also supports the classical view in the related literature that governments would shun taxes on mobile bases as a redistributive instrument at the local level (see Stigler (1957) and Musgrave (1971) for early contributions, as well as Calabrese et al. (2018) for the most recent analysis).

Besides this novel insight into the forces shaping local tax policy, the current paper further adds to the literature on the incentive effects of intergovernmental transfers on tax policy. This literature has typically focused on the overall 'tax effort' that governments apply to specific distortionary tax instruments in response to a change in transfers. But if governments have multiple tax instruments at their disposal and the transfer scheme alters the relative incentive to use these different instruments, it may not only change the tax effort, but also the tax structure. Such changes in turn would influence the distributional outcomes, efficiency properties, and competitiveness implications of tax policy in the federation as a whole. Accordingly, the analysis of tax structures, as presented in the current paper, may serve as an important complement to existing studies on the incentive effects of intergovernmental transfers.

From a policy perspective, the empirical evidence from Germany, pointing to stronger response of property than of business taxation, suggests that fiscal equalization may act as a means to induce a less distortionary tax structure. At the same time, the theoretical analysis highlights important caveats as to whether these findings are likely to translate to other institutional settings – for instance pertaining to the level of national governments, where distributional motives may dominate as a driver of distortionary taxation of mobile factors. In this case, the model would predict intergovernmental transfers to lead to a more distortionary tax structure.

The remainder of the paper proceeds as follows. Section 2 introduces the theoretical model

and derives the impact of fiscal equalization under alternative model extensions. Section 3 describes the institutional background, data and identification strategy underlying the econometric analysis, before Section 4 presents the results. Section 5 concludes.

# 2 Theoretical motivation

## 2.1 The model

**Local governments.** Consider a federal system of government comprising a large number of sub-federal jurisdictions, $i = 1, 2, ..., N$. Each jurisdiction is run by a benevolent planner, henceforth referred to as the 'local government'. Local governments provide a local public good and have access to two tax instruments to finance government spending: one is a source-based tax on perfectly mobile capital employed by firms, the other is a tax on the land endowments of immobile households in the respective jurisdiction.

Moreover, consistent with the institutional setting in the ensuing empirical analysis, local governments receive 'fiscal equalization' grants from the federal layer of government.[6] These grants do not entail any conditionality as to how local governments use the additional public funds (*e.g.* whether to translate them into higher government spending, lower taxes, or a combination of the two). But the amount of fiscal equalization grants to each jurisdiction depends on local economic conditions according to a redistributive formula.

Approximating the set-up in many federal countries, this formula equalizes a fraction $\theta$ of the difference between indicators of the 'fiscal need' and 'fiscal capacity' of each local government. The definition of fiscal capacity, which is central to the incentive effects of the equalization scheme on tax policies and will play a key role in the ensuing empirical analysis, is derived by multiplying each of the two tax bases with a separate 'standardized tax rate' ($\overline{\tau}_i^k$ and $\overline{\tau}_i^b$). This feature, in practice, aims at avoiding that jurisdictions can directly manipulate the amount of grants they receive by changing their actual tax rates. At the same time, the equalization scheme implies that changes in local tax policy may exert indirect influence on grant allocation to a given jurisdiction via their potential impact on tax bases. Taken together,

[6] Following the taxonomy in Boadway (2004), the fiscal equalization system considered here thus follows a 'gross scheme' that "*involves transfers from the central government to the regions financed from central tax revenues*", rather than a 'net scheme' that "*consists of self-financing region-to-region transfers*" (See Boadway (2004), p. 213).

the fiscal equalization formula may be summarised as:

$$g_i = y_i - \vartheta_i^k k_i - \vartheta_i^b b_i \tag{1}$$

where $y_i$ defines the notional maximum amount of grants a jurisdiction could receive (*i.e.* if both its tax bases were zero); and the parameters $\vartheta_i^k$ and $\vartheta_i^b$ measure the reduction in grants associated with a one-unit increase in the capital and land tax base, respectively, calculated as the product of the equalization rate $\theta$ and the respective standardized tax rates $\overline{\tau}_i^j$, with $j = b,k$. Considering own-source revenues and fiscal equalization grants, the local government budget constraint thus combines to:

$$z_i = y_i + (\tau_i^k - \vartheta_i^k)k_i + (\tau_i^b - \vartheta_i^b)b_i \tag{2}$$

where $z_i$ denotes per capita spending on the local public good; $k_i$ is the per capita capital stock and $b_i$ the per capita land endowment in the jurisdiction; $\tau_i^k$ and $\tau_i^b$ are the rates at which local governments tax capital and land, respectively; and $y_i$, $\vartheta_i^k$ and $\vartheta_i^b$ are the parameters of the fiscal equalization scheme introduced above.

**Firms and households.** In each jurisdiction, firms produce a homogenous private good combining labor and capital according to a constant returns to scale technology. Production per unit of labor is given by $x_i = f(k_i)$ where $x_i$ is per capita output and $k_i$ is the capital intensity in jurisdiction $i$. The production function is twice continuously differentiable and strictly concave in capital, *i.e.* $f_{ik} > 0 > f_{ikk}$, where subscripts denote partial derivatives. Capital is perfectly mobile so that net rates of return are equated across jurisdictions at a common rate, $\rho$. Moreover, perfect competition ensures that in each jurisdiction the gross return on capital equals its marginal product, *i.e.* $f_{ik} = \rho + \tau_i^k$, which implies a negative tax elasticity of the local capital intensity, with: $\frac{dk_i}{d\tau_i^k} = \frac{1}{f_{ikk}} < 0$.

Jurisdictions are populated by a large number of households with identical preferences and endowments (the assumption of identical endowments will be relaxed in Section 2.3 to allow for distributional conflict within jurisdictions). Each household inelastically supplies one unit of labor at their place of residence and receives a wage, $w_i$, corresponding to residual output after capital has been remunerated, such that: $w_i = f(k_i) - f_{ik}k_i$. In addition, each household

owns part of the jurisdiction's land area. This per capita land endowment net of local land taxes, $(1-\tau_i^b)b_i$, can be transformed into the consumption good at zero cost. To simplify notation, I assume absentee capital ownership. Since the jurisdictions in the model are too small for their tax policies to have an impact on the world rate of return, this assumption is without loss of generality.

Households fully spend their disposable income on the production good which, along with public consumption, enters a utility function: $u_i = v_i(z_i) + x_i$. This quasi-linear specification of household preferences does not alter the key findings in this section compared to a more general set-up, but facilitates the introduction of political economy considerations in the model (see Section 2.3).

**Tax structure.** To study the choice of tax structure, I first consider a benevolent local government that maximises the utility of a representative household, subject to the household's and the government's budget constraints (the subsequent sections extend the analysis to other types of decision problems). Substituting these budget constraints into the household utility function and maximising with respect to the two tax rates, $\tau_i^b$ and $\tau_i^k$, the government's optimization problem yields the following first-order conditions:

$$v_{iz} = 1 \tag{3}$$

$$v_{iz} = \frac{k_i}{k_i + (\tau_i^k - \vartheta_i^k)\frac{dk_i}{d\tau_i^k}} \tag{4}$$

Accordingly, governments in optimum seek to equate the marginal utility of the local public good to the marginal cost of public funds from the respective tax instrument (defined as the reduction in private consumption necessary to generate a given level of fiscal revenue with this tax). Given the non-distortionary nature of $\tau_i^b$, its marginal cost of public funds always equals one (Equation 3). By contrast, the distortionary nature of $\tau_i^k$ drives up the marginal cost of public funds from this tax instrument, since the revenue-increase from higher tax rates is (partly) counteracted by its adverse tax base effects due to capital mobility, as captured by $\frac{dk_i}{d\tau_i^k} < 0$ in the denominator of Equation 4.

Absent fiscal equalization, it is therefore suboptimal for sub-federal governments to en-

gage in any capital taxation if they have access to an alternative, non-distortionary, source of revenue. That is: with $\vartheta^k = 0$, the optimal level of $\tau_i^k$ is zero and local governments instead fully finance public spending through $\tau_i^b$. As such, the model replicates a central result from the literature on tax competition with multiple tax instruments (see Wildasin (1986) and Bucovetsky and Wilson (1991) for seminal contributions); and it conforms to the straightforward intuition that capital taxation, due to its adverse tax base effects, creates an excess burden that drives the marginal cost of public funds above that deriving from land taxation and, hence, renders capital taxation inferior to land taxation as a means to finance local public spending.

Equation 4 also exposes the mechanism by which fiscal equalization enters the government's decision problem: since grants are inversely related to the tax base, fiscal equalization reduces the marginal cost of public funds for capital taxation from the perspective of local governments. The reason is that part of the adverse tax base effect is compensated through higher grants; and the higher the marginal contribution rate, $\vartheta_i^k$, the stronger is this effect. At the same time, even with fiscal equalization ($\vartheta_i^k > 0$), the capital tax does not contribute to the financing of local government spending since the only capital tax rate that simultaneously satisfies both first-order conditions is $\tau_i^k = \vartheta_i^k$. Accordingly, this model set-up grants no role to distortionary taxation other than to match the marginal contribution rate imposed by the fiscal equalization system.

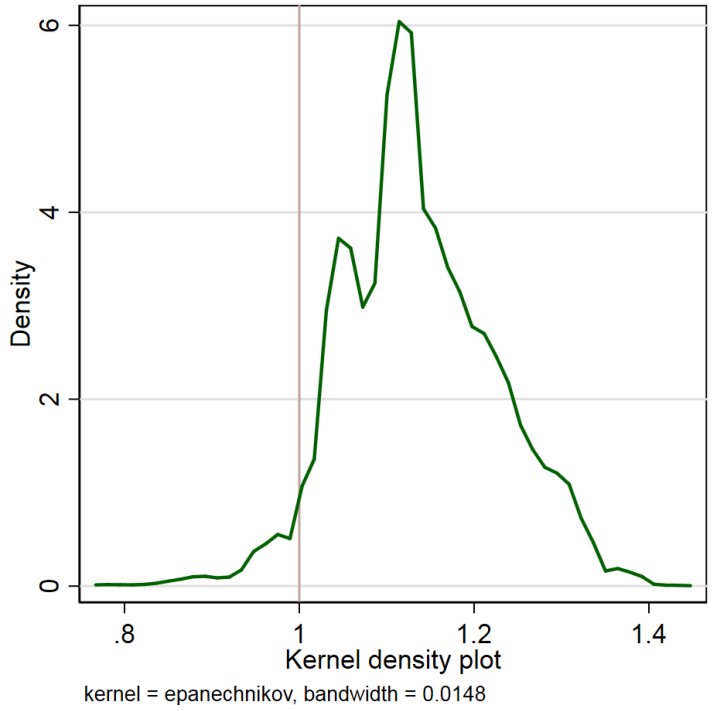
## 2.2 Discussion

While providing interesting insights into the mechanisms by which fiscal equalization may affect tax effort, the limited role of capital taxation in the government's optimization problem does not appear entirely appealing to understanding the choice of tax structures: governments in many countries do rely on capital taxes to finance substantial parts of their budgets – despite their having access to alternative, less distortionary, tax instruments and even in institutional settings in which fiscal equalization constitutes an unlikely cause.

In fact, this constellation also arises in the case of German municipal finance that I will consider in the ensuing empirical analysis and that, in several key aspects, closely resembles the set-up considered in the above theoretical model (see 3.1 for a detailed account of the institutional background): German municipalities have access to two tax instruments to finance

local public spending; one is a local business tax that exerts strong negative tax base effects (see Büttner (2003)); the second is a local property tax that, *de facto*, is very similar the non-distortionary land tax $\tau_i^b$ considered in the model. In addition, municipalities are embedded in an extensive fiscal equalization scheme that shares key characteristics with the stylized scheme included in the model; in particular, it also entails an inverse relationship between the amount of grants a municipalities receives and its own business and property tax bases.

Figure 1: Distribution of the ratio between local business tax and marginal contribution rates




The sample consists of all North Rhine-Westphalian municipalities over the years 1992 to 2002 that received fiscal equalization grants over this period. Marginal contribution rates are calculated as the product between the equalization rate and the applicable standardized tax rate; see Section 3 for additional detail on the sample and institutional background.

The precise calibration of this inverse relationship is public information and codified in municipal finance law. Hence, it is possible to directly calculate the empirical counterparts to the marginal contribution rates, $\vartheta_i^k$ and $\vartheta_i^b$, in the model. Based on these calculations, actual tax policy appears to be systematically at odds with the prediction that distortionary capital taxation plays no role other than to match the marginal contribution rate in the fiscal equalization system. Figure 1 plots the distribution of actual local business tax rates relative to

a measure of the respective marginal contribution rates (corresponding to $\frac{\tau_i^k}{\vartheta_i^k}$) in the sample of municipalities used in the ensuing empirical analysis. The bulk of the distribution lies above one, indicating a clear tendency for business tax rates to exceed marginal contribution rates.

Of course, it is not surprising that the above model does not yield a precise prediction of empirical regularities in tax policy, not least in view of its very parsimonious and stylized set-up. However, the failure to explain basic stylized features of actual tax policy in the sample suggests that it is worthwhile exploring further motives for governments to engage in distortionary taxation.

## 2.3 The impact of fiscal equalization on the tax structure under alternative motives for capital taxation

This section thus augments the basic model with two classic motives for governments to use distortionary tax instruments, instead of solely relying on less distortionary revenue sources. The first draws on the political economics literature, and in particular the contributions by Persson and Tabellini (2000) and Fuest and Huber (2001), to incorporate distributional concerns into the analysis of tax structures in the context of inter-jurisdictional mobility of tax bases ('redistribution motive'). The second draws on the welfare economics literature, and in particular the contributions that have originated from Pigou (1920), on the use of distortionary taxation as a means to correct externalities from economic activity ('efficiency motive'). Both extensions require only limited adjustments to the baseline model. But, even when relying on standard assumptions from the related literature, they yield opposite conclusions as to the impact of fiscal equalization on the tax structure.

**Redistribution motive.** To incorporate political economy considerations, I relax the assumption of equal land- and labour-endowments across households within each jurisdiction and consider fiscal policy as the outcome of a simple majority voting process, rather than the choice of a benevolent local planner. Each household's land and labor endowments are exogenously given, but may now differ across the local population, such that $(1+e_i^j)b_i$ and $(1-e_i^j)$ specify the respective endowments of household $j$ in jurisdiction $i$ and the distribution of $e_i^j$ is characterized by mean zero and median $e_i^m$.

As discussed in Persson and Tabellini (2000), the assumption of negatively correlated en-

dowments ensures that within-jurisdiction heterogeneity can be mapped into a unidimensional scale, although the initial decision problem has two dimensions: the level and the composition of taxes. Together with quasi-linear households preferences, such unidimensional heterogeneity of endowments in turn ensures the existence of a Condorcet winner, consisting of the preferred policy of the voter with median endowments.[7] As such, it constitutes the most parsimonious way to integrate distributional concerns into the analysis and ensure consistency with the related literature.

The decision problem thus boils down to the choice of tax rates $\tau_i^b$ and $\tau_i^k$ that maximize the median voter's utility, subject to her and the government's budget constraints and taking into account the adverse tax base effects from capital taxation. In analogy to the optimization problem in Section 2.1, this yields the following first-order conditions:

$$v_{iz} = 1 + e_i^m \tag{5}$$

$$\xi_i^m = \frac{k_i}{k_i + (\tau_i^k - \vartheta_i^k)\frac{dk_i}{d\tau_i^k}}. \tag{6}$$

where $\xi_i^m \equiv \frac{1+e_i^m}{1-e_i^m}$ denotes the relative shares of land and wages in the median voter's income.

Equation 5 states that the optimal choice of the land tax equates the marginal utility of public consumption to the concomitant marginal reduction in private consumption from the perspective of the median voter. Equation 6 states that the optimal choice of the capital tax equates the relative shares of land and wages in the median voter's income to the marginal cost of public funds related to this tax instrument (defined in analogy to the right-hand side of Equation 4).

To capture the common notion that landowners typically exert a relatively strong influence on local policy-making (see, *e.g.*, Wildasin and Wilson (1996); Fischel (2005); and Füss and Lerbs (2017)), it is instructive focus on the case $e_i^m > 0$ (or, equivalently, $\xi_i^m > 1$). In this case, the capital tax has to exceed its marginal contribution rate (*i.e.* $\tau_i^k > \vartheta_i^k$) to satisfy the first-order condition in Equation 6. In contrast to Equation 4, the model thus provides a rationale

[7] For a proof that the combination of quasi-linear preferences and unidimensional heterogeneity of endowments is a sufficient condition for the existence of a Condorcet winner, see Persson and Tabellini (2000), Chapter 2.2.

for positive capital taxation also in the absence of fiscal equalization. This rationale derives from the median voter's incentive to shift some of the tax burden from land to labour, which (due to perfect capital mobility) fully bears $\tau_i^k$ in the form of lower wages. The median voter's preferred level of $\tau_i^k$ trades off this incentive to shift the tax burden to labour against the additional excess burden that capital taxation entails relative to land taxation – or, put differently, it trades off distributional concerns against efficiency considerations.[8]

**Efficiency motive.** To consider the role of externalities as a motive for local governments to engage in distortionary capital taxation, I return to the baseline model from Section 2.1 but assume that the production process of firms imposes a cost on other agents in the jurisdiction. I model this externality as raising the cost of providing a given level of local public goods. This set-up is similar to the model in Varian (1994) but, in contrast to the latter, the negative externality does not affect other firms but the government sector.

Formally, the externality is reflected in the government cost function $c_i(k_i, z_i)$, where $c_{ik} > 0$, $c_{ikk} > 0$ and, for ease of comparison with Section 2.1 and without loss of generality, $c_{iz} = 1$. The negative production externality may be thought of, for instance, as pollution or noise that governments have to compensate through abatement measures in order to preserve a given quality of local public goods. The cost function captures the assumption that abatement becomes increasingly costly as the exposure to the externality increases.[9] In this case, the first-order condition for the capital tax rate is:

$$v_{iz} = \frac{k_i}{k_i + (\tau_i^k - \vartheta_i^k - c_{ik})\frac{dk_i}{d\tau_i^k}} \tag{7}$$

[8] As an aside, the result of median voters' potentially choosing positive capital tax rates provides an interesting perspective on the related theoretical literature. In particular, Fuest and Huber (2001) and Borck (2003) conclude that the equilibrium would always be characterised by a zero capital tax rate when, as in the current paper, capital is mobile, jurisdictions are too small to influence the world interest rate, and an alternative non-distortionary tax instrument is available. This difference to the predictions presented here derives from the type of distributional conflict arising in the respective models. The aforementioned papers consider the capital tax as a means for immobile workers to shift part of the tax burden on capital-owners – an effort that the latter are able to fully escape in the presence of small jurisdictions and perfect mobility. In the current paper, the capital tax instead acts as a means for immobile 'landowners' (*i.e.* median-voters with $e_i^m > 0$) to shift part of the tax burden to, equally immobile, 'workers'.

[9] The increasing marginal cost of the externality is in line with the specification in Varian (1994). Alternative modeling approaches with similar implications include, for instance, an increasing marginal disutility of the respective activity for other agents in the economy (as in Sandmo (1975)) and a decreasing marginal productivity of abatement technologies (as in van der Ploeg and Bovenberg (1993)). I opt for the convex cost function since it constitutes the minimally invasive approach to integrate externalities into the baseline model from Section 2.1.

and the first-order condition for the land tax rate is the same as in Equation 3 since its sole purpose remains to generate budgetary revenue.

The modified first-order condition for $\tau_i^k$ thus entails an alternative (Pigouvian) motive for capital taxation, even for $\vartheta_i^k = 0$, namely: to ensure that firms internalise the cost that an increase in the local capital intensity imposes on the local government. From a normative perspective, it is interesting to note that the resultant tax structure is first-best efficient, reflecting the completeness of the tax instrument set (in the sense of Wildasin (1986)): governments have two tax instruments that are suitable to attaining two separate goals – correcting externalities via $\tau_i^k$ and raising revenue via $\tau_i^b$ (see also Chari and Kehoe (1990) and Oates and Schwab (1988)).[10]

Vice versa, this implies that any positive value of $\vartheta_i^k$ would drive capital taxation above efficient levels, suggesting that, from a pure efficiency perspective, fiscal equalization should only compensate differentials in the non-distortionary tax base (*i.e.* $\vartheta_i^b > 0$ and $\vartheta_i^k = 0$). If the respective cross-jurisdictional distributions systematically differ for the land- and capital-tax bases, however, this approach may of course conflict with equity considerations at the federal level of government.[11]

**Comparative statics.** While based on straightforward extensions of the baseline model, the two motives for capital taxation have different implications for the impact of fiscal equalization on the tax structure. To see this, consider the following comparative statistics exercises for a change in the marginal contribution rate (see Appendix 6.1 for explicit expressions of the capital and land tax rates that local governments choose in optimum).

In the model with distributional conflict, the comparative statics yield:

$$\frac{d\tau_i^k}{d\vartheta_i^k} = \left[1 - \left(\frac{1}{\xi_i^m} - 1\right)\left(1 + \varepsilon_i^k\right)\right]^{-1} \tag{8}$$

[10] As shown by Ogawa and Wildasin (2009), this efficiency result may also hold when externalities arise across jurisdiction borders. Also, it is interesting to note that, in the presence of positive externalities, Equation 7 predicts $\tau_i^k < 0$. This, however, does not imply that the government subsidises mobile capital in net terms. Instead, with $\vartheta_i^k = 0$, the 'net fiscal burden' borne by capital – consisting of the sum of the capital tax rate and the increased (reduced) spending that the government needs to undertake so as to correct the negative (positive) externality from capital – amounts to zero (see Wildasin (2003) for a discussion of the net fiscal burden concept); and, with $\vartheta_i^k > 0$, the net fiscal burden on capital is positive.

[11] For instance, in the sub-national context, the spatial structure of economic activity tends to be highly concentrated, with some urban jurisdictions hosting the lion's share of production, whereas more rural jurisdictions tend to be characterised by a high land intensity. The incidence of an equalization scheme solely dependent on the land tax base would hence differ markedly across these different parts of the federation.

where the elasticity $\varepsilon_i^k \equiv \frac{k_i}{f_{ikk}} \frac{\partial f_{ikk}}{\partial k_i}$ describes how the curvature of the production function varies with the local capital intensity. The second term in squared brackets on the right-hand side captures the tax-shifting incentive of the median voter and ranges between $-1 < \left(\frac{1}{\xi_i} - 1\right) < 0$ for $0 < e_i^m < 1$. The third term captures the adverse tax base effect from capital taxation and, for standard assumptions on the production function, also ranges between $-1 < \left(1 + \varepsilon_i^k\right) < 0$.[12] Taken together, this implies that $\frac{d\tau_i^k}{d\vartheta_i^k} > 1$.[13]

Since the analysis aims at deriving the impact of fiscal equalization on the tax structure, this finding for the capital tax needs to be benchmarked against the response of the land tax. Inserting the median voter's preferred level for $\tau_i^k$ into the budget constraint to back out the preferred level for the land tax, and totally differentiating the resultant expression for $\tau_i^b$, this yields $\frac{d\tau_i^b}{d\vartheta_i^b} = 1$. Hence, the response of land taxes merely offsets the negative budget impact of the increase in the marginal contribution rate on the land tax base, to continue meeting the government's budget requirement. Since the land tax base is constant, no additional incentive effect arises.

Accordingly, if positive capital taxes are driven by distributional motives, the response of capital taxes to changes in the marginal contribution rate should be stronger than that of land taxation. The implication is that a uniform increase in $\vartheta_i^k$ and $\vartheta_i^b$ should tilt the tax structure towards capital taxation. The intuition is that the increase in the marginal contribution rate lowers the marginal cost of public funds from capital taxation, while leaving the political economy motives for shifting the tax burden to labour unchanged.

[12] Consider, for instance, the Cobb-Douglas production function $F(K,L) = K^\alpha L^{1-\alpha}$, which in capita terms may be written as $f(k) = k^\alpha$, with $f_{kk} = \alpha(\alpha-1)k^{(\alpha-2)}$ and $f_{kkk} = \alpha(\alpha-1)(\alpha-2)k^{\alpha-3}$, which implies $\varepsilon_i^k = \alpha - 2$ and hence yields the result stated in the text for all production technologies with a non-zero contribution from both input factors (*i.e.* for $0 < \alpha < 1$). The intuition for $\varepsilon_i^k < 0$ is that, at higher $k$, the curvature of the production function falls so that a larger decline in the capital intensity in response to a given capital tax increase is necessary to drive up the marginal product of capital by an amount that is sufficient to attain a gross return equal to the world interest rate $\rho$.

[13] Note that, in the specific institutional setting studied in Sections 3 and 4, changes in standardised tax rates may have an additional effect due to the *de facto* endogeneity of $y_i$ to $\bar{\tau}_i^j$. This is because the upper-level government first determines the total amount of fiscal equalization grants to be paid to the municipal level and then calculates a basic multiplier for fiscal need that, given the sum of the fiscal capacities of the municipalities, exactly exhausts the pre-determined total amount of grants. Due to this feature, a recalculation of fiscal capacities triggered by a change in standardized tax rates would generally also go along with an adjustment in $y_i$. While it is not clear whether municipalities internalise this complex 'second-round effect', the empirical analysis controls for changes in $y_i$ to avoid that they confound the impact estimates for $d\tau_i^j / d\vartheta_i^j$.

Turning to the model with externalities, the same comparative statics exercise yields:

$$\frac{d\tau_i^k}{d\vartheta_i^k} = \left(1 - \frac{c_{ikk}}{f_{ikk}}\right)^{-1} \tag{9}$$

which, given $c_{ikk} > 0$ and $f_{ikk} < 0$, implies that $\frac{d\tau_i^k}{d\vartheta_i^k} < 1$, whereas again $\frac{d\tau_i^b}{d\vartheta_i^b} = 1$. Accordingly, if externalities are the cause of positive capital taxes, then the response of capital taxes to changes in the marginal contribution rate should be weaker than that of land taxes. The implication is that a uniform increase in $\vartheta_i^k$ and $\vartheta_i^b$ should tilt the tax structure towards land taxation. The intuition here is that the response of capital taxation to an increase in the marginal contribution rate is attenuated by the decline in the marginal cost of the production externality due to the tax-induced decline in the local per capita stock.

**Summary.** To summarise, the two model extensions, despite relying on standard assumptions regarding the determinants of sub-federal policies, yield opposite conclusions with respect to the impact of fiscal equalization on the tax structure. In view of these ambiguous theoretical predictions, the next section turns to an empirical analysis, based on a natural experiment from German municipal finance, to test whether any of them receives support in the data.

# 3 A natural experiment from German municipal finance

German municipal finance provides for an interesting 'laboratory' to analyse the incentive effects of redistributive grant schemes on fiscal policy, including on the choice of tax structures. First, German municipalities are embedded in extensive fiscal equalization and revenue sharing mechanisms that combine, in a stylised manner, many of the relevant features observed in other countries. Second, under the German fiscal constitution, municipalities have broad autonomy in setting the rates on two very different tax bases. Third, this specific context allows me to exploit a natural experiment deriving from a Constitutional Court ruling in Germany's most populous state, North Rhine-Westphalia (NRW), to identify exogenous changes in key fiscal equalization parameters for causal inference. Before presenting the identification strategy (Section 3.2), I briefly review in some more detail the key institutional features that govern fiscal affairs at the subnational level in Germany (Section 3.1).

### 3.1 Institutional background

**Tax assignment.** As pointed out in Section 2.2, municipal governments may raise own-source revenue via a local business tax (*Gewerbesteuer*) and a local property tax (*Grundsteuer*). The local business tax is essentially levied on operating profits generated by firms located in the municipality and has been shown to exert strong negative tax base effects (see Büttner (2003)), thus displaying similar features as the distortionary capital tax $\tau_i^k$ in the model.

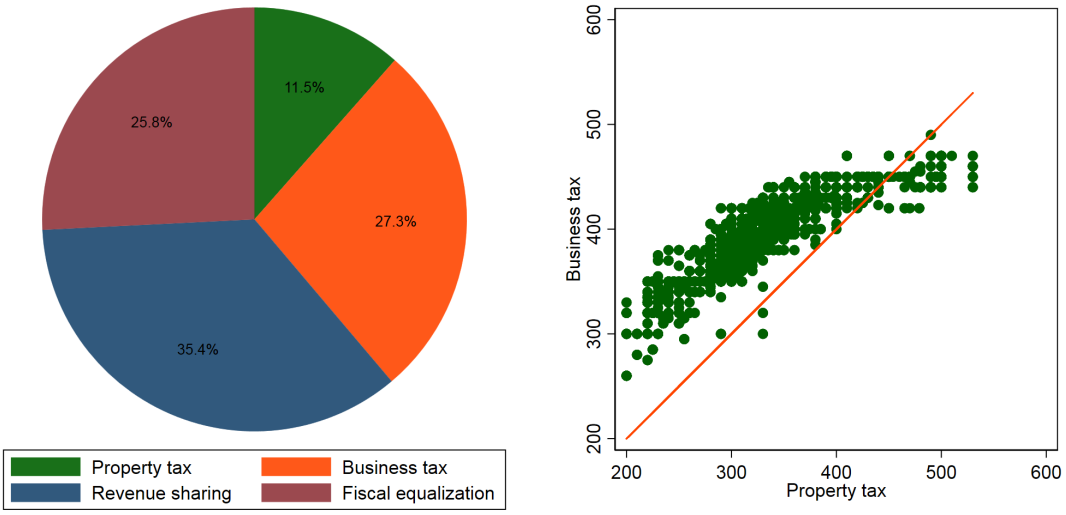
For the property tax, the statutory tax base is the *value* of real estate within the territory of the municipality.[14] As such, the German property tax, at first glance, might not appear as a suitable empirical counterpart to the non-distortionary tax on immobile land, as modelled by $\tau_i^b$ in the previous section: since property taxes should be expected to capitalize in real estate values, their increase would also be accompanied by adverse tax base effects, in contrast to the non-distortionary tax considered in the model (see Oates (1969) for a seminal study on property tax capitalization). In practice, however, the last official assessment of the property values used to calculate property tax liabilities dates back to 1964 (see Spahn (2004)); and the law initially adopted to allow for reassessments of taxable property was suspended in 1965 so that, since then, not even a legal basis has existed based on which the assessed property values could be updated (see Füss and Lerbs (2017)). As a consequence, the potential capitalization of this tax in property values would not be reflected in the municipal tax base so that, from the perspective of municipal governments, the local property tax has similar features as the non-distortionary land tax $\tau_i^b$.[15]

Both tax instruments account for sizeable shares of municipal revenues, but between the two, the revenue composition of German municipalities is clearly tilted towards the business tax, with the average revenue share from that tax amounting to almost twice the share from the property tax (see Figure 2, left panel). Also the rate on the latter tax base, on average, clearly

[14] With respect to the property tax, municipalities may set different tax rates on: *(i)* property devoted to agricultural use and *(ii)* property used for residential and commercial purposes. In the ensuing analysis, I focus on the latter type of property tax since it accounts, on average, for almost 95% of overall property tax revenue of the sample municipalities.

[15] As the tax autonomy of municipalities is restricted to the choice of rates, whereas the definition of bases is specified in federal law and thus uniform across municipalities, the rates provide a direct and comparable measure of local tax policy. Specifically, municipalities choose a local tax collection rate (*Hebesatz*) which is then multiplied by a base rate (*Steuermesszahl*) to obtain the local tax rate. The base rate is uniform across municipalities and, over the sample period studied below, amounted to 5% for the business tax and 0.35% for most types of property. As base rates are outside the remit of municipalities, I focus on collection rates and use the terms 'tax collection rates' and 'tax rates' synonymously unless the distinction is of immediate relevance.

Figure 2: Composition of municipal revenues (left panel; in %) and level of local business and property tax collection rates (right panel; in %)




The left panel shows the average revenue composition of North Rhine-Westphalian municipalities in 2002 (see 3.4 for detail on sample definitions); the property tax share is based on the sum of property taxes A and B. The right panel shows average tax collection rates for each municipality over the period 1992 to 2002; see Footnote 15 for further detail.

exceeded that on property, and barely any municipality set a higher collection rate for the property than for the business tax (see Figure 2, right panel). Overall, this heavy reliance on the local business tax is striking in view of its likely distortionary effects and further motivates the ensuing empirical analysis which considers fiscal equalization as one potential determinant of this constellation.

**Fiscal equalization and revenue sharing.** In the context of fiscal equalization, the municipal layer of government in Germany receives vertical transfers from the state (*Länder*) budget.[16] Moreover, the German federal, state, and municipal layers of government engage in revenue sharing, by which 15 percent of total personal income tax revenues and around 2 percent of total VAT revenues are allocated to municipalities, while the latter have no authority in setting the respective tax rates, which are determined at federal level.[17] These vertical transfers from fiscal equalization and revenue sharing make a sizeable contribution to the financing

[16] Following the taxonomy developed in Boadway (2004), German municipal fiscal equalization can be described as a *gross* scheme in which the participating jurisdictions, on aggregate, are net recipients of grants – as opposed to a *net* scheme consisting of 'zero-sum' horizontal transfers between jurisdictions on the same level of government. The only states without such vertical transfers from the state to the municipal level are Berlin, Bremen, and Hamburg as they have a dual administrative status as 'city-states'.

[17] Since 2009, municipalities have also received 12 percent of capital gains tax revenue but this is irrelevant to the present study, given the sample period ends before that date; see next section.

of municipalities, on average accounting for more than half of municipal revenue from their main revenue sources (see Figure 2).

The grant formula that governs the allocation of fiscal equalization transfers across municipalities, in turn, has a pronounced redistributive character. In particular, the volume of grants to each municipality is determined by the difference between indicators of 'fiscal need' and of 'fiscal capacity', which the state government defines in an annual municipal finance law (*Gemeindefinanzierungsgesetz*), such that: $g_{it} = \theta_{it}(n_{it} - c_{it})$, where $g_{it}$ denotes the fiscal equalization transfer to municipality $i$ in year $t$ and the equalization rate $\theta_{it}$ determines the fraction of the gap between fiscal need ($n_{it}$) and fiscal capacity ($c_{it}$) that is compensated through the grant scheme. In the sample, $\theta_{it}$ takes on a uniform positive value for all municipalities with $n_{it} > c_{it}$, which amounted to 0.95 until 1996 and 0.90 thereafter, and zero for all 'fiscally abundant' municipalities whose fiscal capacity equals or exceeds fiscal need (so that $g_{it} = 0$ if $n_{it} \leq c_{it}$).

Fiscal need is calculated based on a weighting scheme that accounts for the population size and other socioeconomic characteristics of each municipality.[18] Fiscal capacity is measured as the sum of the funds a municipality receives in the revenue sharing scheme ($g^s_{it}$) and a measure of its 'standardized tax revenue', with the latter being defined as the product of the tax base for the business and property tax, respectively, with a standardized tax rate for each of these tax instruments (denoted by $\bar{\tau}^k_{it}$ and $\bar{\tau}^b_{it}$).[19] Accordingly, it is possible to directly map the fiscal equalization and revenue sharing system into the stylized grant scheme considered in the model (Equation 1) as:

$$g_{it} = y_{it} - \vartheta^k_{it} k_{it} - \vartheta^b_{it} b_{it} \tag{10}$$

where $y_{it}$ is the part of the grant allocation formula that does not depend on the tax bases in the

[18] In particular, the equalization scheme in NRW over the period considered here defined fiscal need as $n_i = z(m_i w^p_i + s_i w^s_i + u_i w^u)$, where: $z$ is a uniform per capita grant; $m_i$ is the number of inhabitants in the municipality and $w^p_i$ is a weighting factor that increases with a jurisdiction's population size (ranging from 1 for small municipalities to around 1.5 for the largest cities); $s_i$ is the number of students in the municipality, whose weight $w^s_i$ depends on the type of school they attend (*e.g.* full-time versus half-time and primary versus secondary); $u_i$ is the number of unemployed in the municipality which are multiplied with a uniform weight $w^u$. For further detail, see Büttner and Holm-Hadulla (2008).

[19] By relying on standardized rather than actual tax revenue in the definition of fiscal capacity, the fiscal equalization scheme avoids that municipalities can directly manipulate their eligibility for grants by adjusting tax rates (Boadway (2004)).

jurisdiction and is defined as $y_{it} = \theta_{it} n_{it} + (1 - \theta_{it}) g^s_{it}$; the terms $\vartheta^k_{it} = \theta_{it} \overline{\tau}^k_{it}$ and $\vartheta^b_{it} = \theta_{it} \overline{\tau}^b_{it}$ are the marginal contribution rates; and $k_{it}$ and $b_{it}$ are the respective tax bases. The grant scheme thus has two main implications for municipal budgets: first, via the 'lump-sum' component $y_i$ it contributes to the financing of local government spending ('financing function') and, second, via the marginal contribution rates $\vartheta^k_{it}$ and $\vartheta^b_{it}$ it mitigates the effective revenue impact of a given change in the local tax bases; or, viewed from a cross-sectional perspective, it reduces revenue disparities across municipalities deriving from differences in tax bases ('redistribution function'). As in the comparative statics exercises in Section 2, the empirical analysis focuses on the incentive effects of changes in the marginal contribution rates on tax policy. At the same time, it also accounts for the financing function of the grant scheme to capture income effects on government incentives.

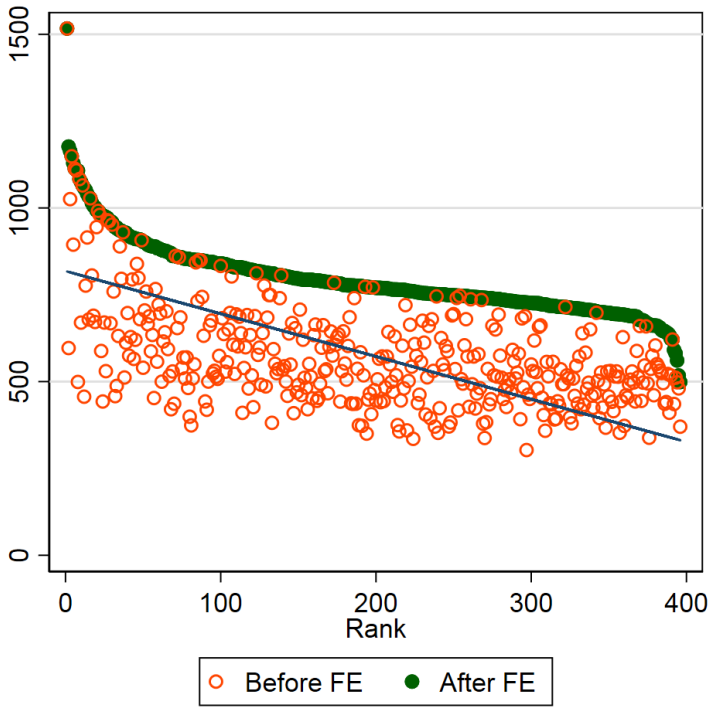
Figure 3 illustrates the financing and redistribution function of the grant scheme in NRW, comparing municipal fiscal capacity before and after fiscal equalization. As the gap between the circles and dots indicates, most municipalities receive additional funds from the equalization scheme, in some cases more than doubling their fiscal capacity. Besides this financing function, the figure also demonstrates how the equalization scheme (via the marginal contribution rate) reduces disparities in fiscal capacity across municipalities. This is visible from the fact that the decline in per capita fiscal capacity from stronger to weaker municipalities is substantially steeper before fiscal equalization (as shown by the line in Figure 3) than after fiscal equalization (as shown by the dots).

## 3.2 Identification strategy

The ensuing empirical analysis aims at estimating the causal effect of changes in the marginal contribution rate on local tax policy. A challenge in this regard is that the parameters of the fiscal equalization scheme themselves are the outcome of a political decision-making process in state parliaments[20] – a point recognised by several papers on the endogenous determinants of

[20] In the NRW case, this was explicitly confirmed by the State Constitutional Court, stating that: "*legislators are free to account for changed circumstances, new insights, and altered preferences in the yearly calibration of municipal fiscal equalization*"; see ruling VerfGH 9/92, 22/92, of the North Rhine-Westphalian State Constitutional Court, p. 11: *"[Es] steht (...) dem Gesetzgeber frei, veränderte Rahmenbedingungen, neue Erkenntnisse und gewandelte Präferenzvorstellungen bei der jährlichen Regelung des kommunalen Finanzausgleichs zu berücksichtigen."*

Figure 3: Financing and redistribution function of fiscal equalization (in € per capita)




The horizontal axis ranks, in descending order, the 396 municipalities of NRW according to their overall fiscal capacity, defined as the sum of their own fiscal capacity and the fiscal equalization grants they received according to the 2002 municipal finance law. The circles (dots) show the corresponding own fiscal capacity (sum of own fiscal capacity and fiscal equalization grants) in per capita terms. Circles and dots overlap for municipalities that did not receive equalization grants because fiscal capacity exceeded fiscal need. The line shows the linear fit from a regression of each municipality's own per capita fiscal capacity before equalization on its rank in the distribution.

intergovernmental grant allocation.[21] The factors entering this decision-making process may, in turn, interact with local tax policy, possibly in ways that are not directly observable. Hence, empirical models that treat any observed changes in equalization parameters as exogenous are prone to various forms of misspecification.

To address such endogeneity concerns, the empirical analysis relies on a natural experiment deriving from a State Constitutional Court case in NRW to identify exogenous variation in the marginal contribution rate.[22] The case was initiated by the city of Solingen in 1992

[21] For instance, Esteller-Moré et al. (2017) model grant allocation as driven by local lobby groups that exert political pressure to distort the rates at which tax-base differentials are equated in a fiscal equalization scheme. Solé-Ollé and Sorribas-Navarro (2008), studying the case of fiscal federalism in Spain, present empirical evidence of political factors determining the allocation of grants to municipalities. Büttner et al. (2011) show that, even without lobbying, the fiscal equalization scheme may serve as a strategic vehicle for higher-level governments to pursue self-interested policies.

[22] This natural experiment was first presented in Holm-Hadulla (2009); it has also been used in a study by Rauch and Hummel (2016), which applies it to a narrower research question, however.

to challenge the practice of higher standardized tax rates being applied to larger cities in the fiscal equalization scheme. According to this practice, cities with more than 150,000 inhabitants faced a standardized business (property) tax rate of 1.5 (0.7) percentage points above that applying to smaller municipalities (see Figure 4). The applicants challenged this differential treatment as arbitrary and unfair since it *ceteris paribus* reduced the equalization grants allocated to larger jurisdictions.

The Court ruling, released in July 1993, partly confirmed the applicant's concerns, arguing that: *(i)* the unequal treatment of municipalities via differentiated standardized tax rates could be justified from a constitutional law perspective only if "*an exhaustive analysis of all available evidence indicated that larger municipalities had a markedly stronger capacity to impose higher tax rates*";[23] whereas *(ii)* "*available data pointed to, at best, minor tax differentials in relation to the threshold of 150,000 inhabitants*".[24]

To resolve these constitutional concerns, the Court thus asked state legislators to provide an in-depth assessment of whether there were objective criteria that would justify systematically different standardized tax rates between larger and smaller municipalities.[25] In response to this ruling, the state government commissioned the Ifo Institute, an economic think tank, to carry out this assessment, the results of which were published in 1995. The Ifo report concluded that "*no marked differences in taxing capacity across North Rhine-Westphalian municipalities could be detected, especially not in relation to population size*" and that "*the prevailing differentiation of standardized tax rates with a threshold of 150,000 inhabitants is hence untenable*".[26]

Consequently, starting with the 1996 vintage of the municipal finance law, the North Rhine-Westphalian parliament began aligning standardized tax rates for small and large jurisdictions – a move that was explicitly motivated by the intention to remedy the constitutional

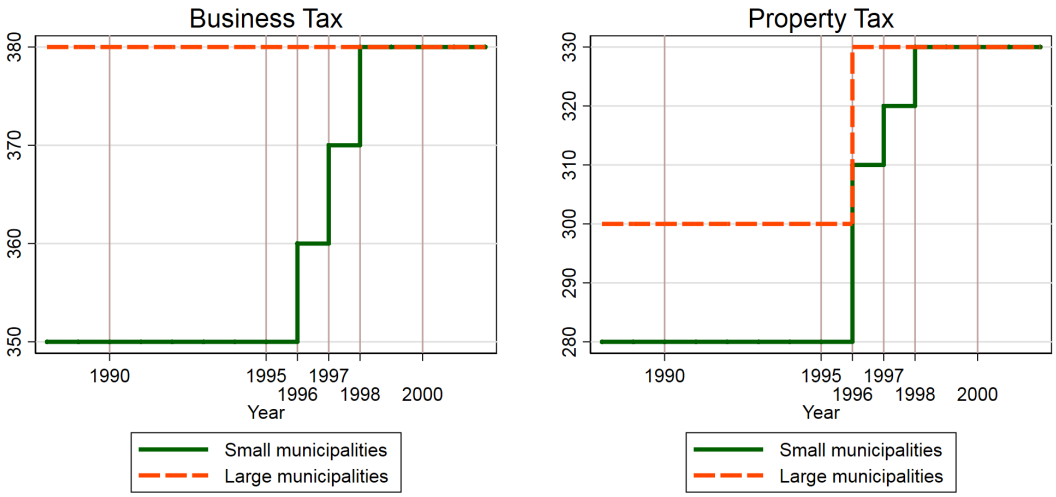
[23] See VerfGH 9/92, 22/92, p. 20: *"[Die Sprungstelle] bei der Erfassung der Realsteuerkraft [begegnet] keinen Bedenken, wenn (...) die Ausschöpfung aller Erkenntnismöglichkeiten deutlich günstigere Voraussetzungen für die Festsetzung höherer Hebesätze bei den größeren Gemeinden ergibt"*.

[24] See VerfGH 9/92, 22/92, p. 21: *"Nach dem vom Innenministerium vorgelegten Datenmaterial lassen sich im Hinblick auf die einzelnen Realsteuern allenfalls geringe Unterschiede aufzeigen, die von dem Schwellenwert bei 150.000 Einwohnern abhängig sind."*

[25] See VerfGH 9/92, 22/92, p. 22.

[26] See Parsche and Steinherr (1995) p. 69: "*Unserer Ansicht nach lassen sich keine deutlich unterschiedlichen Voraussetzungen zur Hebesatzanspannung bei den nordrhein-westfälischen Gemeinden feststellen, insbesondere nicht in Abhängigkeit von der Gemeindegröße (...) Die bislang praktizierte Differenzierung der fiktiven Hebesätze nach dem Schwellenwert von 150.000 Einwohnern ist damit nicht haltbar.*"

Figure 4: Standardized tax collection rates (in %)




The group of small (large) municipalities consists of those with a population up to (above) 150,000 inhabitants.

concerns raised by the Court (this legislative intent can be inferred, for instance, from the interventions of senior parliamentarians from the then-ruling coalition during the plenary hearings on the 1996 municipal finance law, which are documented in the respective protocols).[27]

Accordingly, the equalization of standardized tax rates constitutes an exogenous source of variation in the marginal contribution rate for municipalities with a population size below 150,000 that was imposed by constitutional imperatives and unrelated to fiscal and economic conditions prevailing at that time.

### 3.3 Tax rate patterns around the reform years

Given this natural experiment, the identification strategy builds on comparisons between the change in tax rates of municipalities affected by the reform (the 'treatment group') and the change in tax rates of municipalities unaffected by the reform (the 'control group'). To inform the choice of econometric specification that best implements that identification strategy, this section highlights some key patterns in the evolution of tax rates before, during and after the fiscal equalization reform.

[27]The ruling coalition, at that time, consisted of the Social Democratic Party (SPD) and the Alliance 90/The Greens Party. The motivation to equalize standardised tax rates so as to comply with the Court's ruling was stated by Franz-Josef Kniola (SPD), then-minister of the interior in charge of the administration of the municipal fiscal equalization scheme, during the first plenary discussions on the draft law (Plenarprotokoll Landtag Nordrhein Westfalen 12/14, p. 816 (A)), and further parliamentarians from the ruling coalition subsequently expressed support for his line of reasoning (e.g. Plenarprotokoll Landtag Nordrhein Westfalen 12/22, p. 1566 (A) and (D); p. 1570 (B) and (D)).

**Difference-in-difference estimates.** To this end, Table 1 displays coefficients from a set of basic difference-in-difference (DID) regressions (for further detail, see notes under the table). The sample for the estimates in columns 1 and 2 includes two years of data, consisting of 1995, as the last pre-reform year, and 1998, as the first post-reform year. The DID coefficient on the interaction term between the treatment- and reform year-dummies is statistically significant at a 1% (5%) level for the business (property) tax and, consistent with theory, points to an increase in both tax rates in response to the reform.

To inspect the timing of the tax rate response, columns 3 and 4 also add the interim reform years 1996 and 1997 to the sample and include the respective year dummies and interaction terms to the set of regressors. This set-up captures the stepwise increase in standardized tax rates over the reform period and tests whether tax rates, on average, immediately adjusted to the announcement of the reform or only responded to changes in standardized tax rates once they were implemented.

For the business tax, the estimates favour the latter hypothesis in that each of the interaction terms displays a highly significant coefficient, indicating that the tax rate response materialised in a gradual manner (column 3). For the property tax, the adjustment, at first glance, appears to be more sluggish as the DID coefficient turns significant only in the last reform year. However, it is important to recall that the standardized property tax rate was raised for both groups of municipalities in 1996 by the same amount (see Figure 4). Since municipalities seem to synchronise their tax rate response with the change in standardised tax rates, it is therefore not surprising to observe an insignificant coefficient for the interaction in 1996, when there was no differential 'treatment' for small versus large municipalities with regard to the standardized property tax rate. Instead, treating 1996 as the last pre-reform year for the property tax, the DID coefficients rise and attain higher significance levels (column 5).[28]

[28] Section 4 provides further detail as to whether the gradual response derives from individual municipalities choosing to adjust tax rates in a step-wise manner or different municipalities choosing to adjust tax rates at different points in time.

Table 1: Difference-in-difference coefficients

| | (1) LBT | (2) LPT | (3) LBT | (4) LPT | (5) LPT | (6) LBT | (7) LPT |
|---|---|---|---|---|---|---|---|
| Treatment | -0.180*** | -0.396*** | -0.180*** | -0.396*** | -0.408*** | -0.144*** | -0.351*** |
| | (0.012) | (0.027) | (0.012) | (0.027) | (0.028) | (0.010) | (0.020) |
| Post-Reform | 0.015*** | 0.086*** | | | | | |
| | (0.004) | (0.018) | | | | | |
| Treatment × Post-Reform | 0.035*** | 0.042** | | | | | |
| | (0.006) | (0.019) | | | | | |
| Treatment × Y1996 | | | 0.010*** | -0.011 | | | |
| | | | (0.002) | (0.015) | | | |
| Treatment × Y1997 | | | 0.027*** | 0.024 | 0.035** | | |
| | | | (0.005) | (0.018) | (0.014) | | |
| Treatment × Y1998 | | | 0.035*** | 0.042** | 0.054*** | | |
| | | | (0.006) | (0.019) | (0.015) | | |
| Standardized Tax Rate | | | | | | 0.445*** | 0.858*** |
| | | | | | | (0.076) | (0.245) |
| Observations | 792 | 792 | 1584 | 1584 | 1188 | 1584 | 1188 |

The coefficients in the first two columns are based on a regression of log tax rates of either the local business tax (LBT) or the local property tax (LPT) on: a Treatment dummy that is 1 for all municipalities with a population up to 150,000 inhabitants and zero otherwise; a Post-Reform dummy that is 0 in 1995 and 1 in 1998; as well as an interaction between these two variables (Treatment × Post-Reform). In the remaining columns, the Post-Reform dummy is replaced with a set of year-dummies (also in the corresponding interaction terms, where *e.g.* Treatment × Y1997 is the interaction of TRT with the dummy for the year 1997). Coefficients on the yearly dummies are not reported. The last two columns replace the treatment-year interactions with log standardized tax rates for the respective tax instruments. Estimations are based on the full set of municipalities in NRW. Standard errors are clustered at the county level. Asterisks indicate statistical significance at 10% (*), 5% (**), and 1% (***) levels.

Finally, the specifications in columns 6 and 7 replace the treatment-year interaction terms with the standardized tax rates, which is conceptually equivalent to the DID estimations but allows for a more direct comparison of elasticities across tax instruments. According to these estimates, the elasticity of actual to standardized tax rates is substantially higher for the property tax (amounting to 86%) than for the business tax rate (45%).

**Parallel trends assumption.** While providing some first instructive insights, it is unlikely that these coefficients capture the causal effect of the reform in standardized tax rates. The key identifying assumption underlying the above DID estimates is that, absent the reform, tax rates in the treatment and control groups would have followed parallel paths (see Meyer (1995)). To assess the plausibility of this parallel paths assumption, Figure 5 plots the evolution of tax rates in the run-up to the reform and throughout the (post-)reform period. Based on this comparison, the parallel paths assumption appears innocuous for the local business tax, which on average followed almost identical trends in the two groups of municipalities prior to the reform and only started diverging in the first reform year (see left panel). For the local property tax, however, the evolution of tax rates in the pre-reform period casts doubt on the plausibility of the parallel paths assumption in view of the substantially steeper increase of rates in the control group (see right panel).

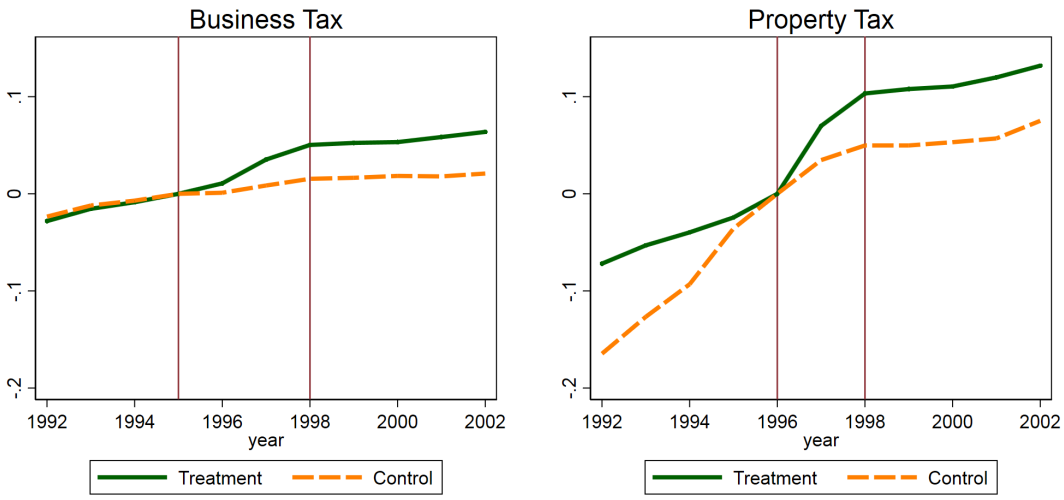
Accordingly, the specification of tax rates in (log) levels does not appear best-suited to identify causal effects of changes in standardized tax rates (a conclusion that continues to hold when controlling for further municipality characteristics; see Section 4). Instead, the empirical model thus focuses on the *changes* in actual and standardized tax rates to account for differences in pre-existing trends and conducts various robustness checks to ensure that differential pre-reform paths do not confound the estimation of causal effects.

### 3.4 Specification and data

The empirical estimates are thus based on panel data regressions of the form:

$$\Delta\tau_{it}^{j} = \alpha_{i}^{j} + \gamma_{t}^{j} + \beta^{j}\Delta\bar{\tau}_{it}^{j} + \delta^{j}\Delta X_{it}^{j} + \varepsilon_{it}^{j} \tag{11}$$

Figure 5: Evolution of tax collection rates over pre- and post-reform years




Tax collection rates are expressed in natural logs and normalised to 0 in the last pre-reform year. For the business (property) tax, the last pre-reform year is 1995 (1996). The treatment group includes all municipalities with a population up to 150,000 inhabitants; the control group includes all other municipalities in the sample. The chart presents the yearly means for each of these groups.

where all non-binary variables are defined in year-on-year log changes (denoted by $\Delta$) and: $\tau_{it}^{j}$ is the local business tax rate ($j = k$) or the local property tax rate ($j = b$) of municipality $i$ in year $t$; $\alpha_i^j$ and $\gamma_t^j$ are municipality- and year-fixed effects, respectively; $\bar{\tau}_{it}^{j}$ are the standardized tax rates for $j = k, b$ and $\beta^j$ is the corresponding slope parameter; $X_{i,t}^{j}$ includes a set of time-varying municipality-specific characteristics that serve as control variables with $\delta^j$ denoting the vector of coefficients for these controls; and $\varepsilon_{i,t}^{j}$ is an error term clustered at the county level.[29] As laid out in Bertrand et al. (2004), the choice of clustering is crucial to the validity of inference in DID models, when outcome variables exhibit high serial correlation. As part of the robustness checks in Section 4, I hence consider alternative clustering choices and inference procedures so as to address the risk of obtaining biased standard errors.

In the baseline specifications, the control variables include: *(i)* the tax-base independent component of the fiscal equalization scheme (corresponding to $y_{it}$ in Equation 10 and henceforth referred to as 'lump-sum grants') to capture municipalities' access to financing other than own-source revenues; *(ii)* total government spending to capture, in analogy to $y_{it}$, the spending

[29] Counties consist of geographically close municipalities, which tend to be broadly similar with regard to key socioeconomic characteristics and are likely to be hit by similar shocks. A number of larger cities do not belong to any county, so I assign a separate cluster to each of them. Overall, the baseline specifications are based on 54 clusters.

commitments that governments have to finance through grants and own-source revenues; and *(iii)* the number of inhabitants to reflect the findings from an extensive literature that proposes jurisdiction size as an important determinant of tax policy (see *e.g.* Bucovetsky (1991) and Wilson (1991)).

The sample consists of a strongly balanced panel comprising yearly data for all 396 municipalities in North Rhine-Westphalia over the period from 1992 to 2002. The sample end-date seeks to avoid overlaps with another reform of the North Rhine-Westphalian fiscal equalization scheme that took place in 2003 and would risk interfering with the identification strategy centering on the reforms in the mid-1990s. The sample start-date ensures pre- and post-reform horizons of a broadly similar length (the former stretching from 1992 to 1995 and the latter from 1998 to 2002). For most of the specifications, I further narrow down the time window around the reforms to guard against unobservable influences that could confound the impact estimates.[30]

As to the cross-section, a vast majority of 357 municipalities has a population below 150,000, thus belonging to the 'treatment group' that is affected by the differential increase in standardized tax rates, whereas the remaining 21 municipalities make up the 'control group'. Group composition is stable, with no municipality switching in either direction during the more narrow sample periods considered in the baseline estimations and only one city changing from the treatment to the control group towards the end of the maximum sample period.[31] The data have been sourced from the State and Municipal Database maintained by the statistical agency of NRW,[32] specifically the sections on: *Öffentliche Finanzen und Personal* (thematic code 7) and *Gebiet, Bevölkerung, Erwerbstätigkeit, Wahlen* (thematic code 1).

Table 2 presents descriptive statistics for the variables used in the estimations. Both tax rates display positive year-on-year growth rates over the sample, on average amounting to 1% for the business tax and slightly above 2% for the property tax. As visible also from Figure

[30] Foremny and Riedel (2014) present convincing evidence of German municipalities' adjusting local business tax rates in the run-up to municipal elections and Asatryan et al. (2017) provide support to the notion that democratic processes influence the choice of tax structure. However, no municipal elections took place in the sample underlying my baseline estimates (see Table 3); and, in the estimations making use of a longer sample that does include municipal election years (see Table 4), any potential impact from the electoral cycle should be absorbed by the year fixed effects, as election years are the same for all municipalities in a state.

[31] The population of the city Neuss changed from slightly below 150,000 inhabitants up until 1999 to slightly above that number from 2000 onwards.

[32] *Landesbank Nordrhein-Westfalen; Landesbetrieb Information und Technik Nordrhein-Westfalen; IT.NRW: https://www.landesdatenbank.nrw.de/ldbnrw/online/Menu=Willkommen.*

4, standardized tax rates change only infrequently and, in the case of the business tax, remain constant throughout the sample period for large municipalities.

There are some instances of extreme hikes and drops in the lump-sum component of the inter-governmental grant scheme, in some cases exceeding 150% in either direction. These reflect the switch of certain jurisdictions from the group of 'abundant' municipalities that do not receive fiscal equalization grants because their fiscal capacity exceeds fiscal need to the group of grant recipients (in which case they record steep year-on-year increases in $y_{it}$), or vice versa. While this constellation is infrequent, applying to less than 4% of the observations in the sample, the next section presents several robustness checks to account for this feature.

Table 2: Descriptive statistics

| *(y-o-y log* $\Delta \times 100$*)* | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|
| Local Business Tax Rate (LBT) | 1.02 | 2.36 | -23.64 | 18.23 |
| Local Property Tax Rate (LPT) | 2.20 | 4.72 | -19.74 | 33.65 |
| Standardized Tax Rate (LBT) | 0.71 | 1.20 | 0.00 | 2.82 |
| Standardized Tax Rate (LPT) | 1.46 | 2.98 | 0.00 | 10.18 |
| Population | 0.75 | 0.97 | -3.36 | 6.80 |
| Lump-Sum Grants | 1.25 | 20.76 | -154.01 | 154.46 |
| Government Spending | 2.04 | 11.67 | -72.17 | 61.26 |
| Observations | 4,356 | | | |

The sample consists of all North Rhine-Westphalian municipalities over the years 1992 to 2002. Variables are expressed as year-on-year log-changes multiplied by 100.

# 4 Results

**Baseline.** The empirical estimates point to a highly significant and economically sizeable response of both tax instruments to changes in their respective standardized tax rates (see Table 3). For the local business tax, with its fairly flat pre-reform trend in both groups of municipalities, the estimated coefficient on the standardized tax rate is similar to that from the exploratory specification in levels: according to the most parsimonious specification, which includes only the year- and municipality-fixed effects as controls, the elasticity stands at 37%,

as compared to 45% in the corresponding specification in levels (see Table 3 column 1 vs. Table 1 column 6).

For the local property tax, by contrast, the coefficient almost doubles compared to the levels specification (see Table 3 column 2 vs. Table 1 column 7). This higher impact estimate is consistent with the presumption that failing to account for pre-existing trends would lead us to underestimate the property tax rate effect of an increase in the respective standardized tax rate in the levels specification. This is because the slope coefficient would capture not only the causal upward impact, but also the countervailing influence of the steeper pre-existing trend in the municipalities unaffected by the reform. The comparison of the estimated β-coefficients across tax instruments in the first-difference specification points to a markedly stronger acceleration of the baseline trend in the property than the business tax rate in response to an increase in the respective standardized tax rates (Table 3, columns 1 vs. 2). The greater responsiveness of the property tax is striking and would favour the Pigouvian model of the tax structure proposed in Section 2.3.[33]

The inclusion of further municipality-specific control variables barely alters the estimated coefficients on the standardized tax rates (columns 3 and 4). The coefficients on the controls are mostly insignificant, with the exception of lump-sum grants in the business-tax specification. The latter shows a counterintuitive positive coefficient, which would suggest that an increase in the funds a municipality receives from the fiscal equalization scheme would 'crowd-in' own-source revenue generation through higher business taxation. Since the size of the coefficient is negligible however, implying an elasticity of less than 1%, I do not explore this issue further. Moreover, the coefficient switches sign, while staying negligible in size, when lagging the lump-sum grants and the other control variables by one year (an approach that may help mitigate within-year endogeneity between tax policy, government spending, and grant volumes; see *e.g.* Büttner (2006) and Fuest et al. (2018)); also in this specification, the coefficients on the standardized tax rates again remain essentially unchanged, hence further confirming the robustness of the results (see columns 6 and 7).

[33] While the point estimates for the coefficients on the standardized property tax rate all exceed 1, this difference is not statistically significant. For instance, for the specification in column 2, we cannot reject $H_0 : \beta = 1$ at significance levels up to 46%. The estimates are thus consistent with the model predictions for $d\tau_i^b / d\vartheta_i^b$ from Section 2, which would indicate an elasticity of 1 if $\tau_i^b = \vartheta_i^b$, which indeed corresponds to the constellation during the sample period for the treatment group (when the actual and the standardized property tax rate both averaged around 11.4%).

Table 3: Baseline estimates

| | (1) LBT | (2) LPT | (3) LBT | (4) LPT | (5) LPT | (6) LBT | (7) LPT |
|---|---|---|---|---|---|---|---|
| Standardized Tax Rate | 0.367** | 1.558** | 0.341** | 1.525** | | 0.386** | 1.651** |
| | (0.161) | (0.755) | (0.157) | (0.752) | | (0.155) | (0.758) |
| Population | | | -0.146 | -0.064 | -0.282 | | |
| | | | (0.142) | (0.324) | (0.268) | | |
| Lump-Sum Grants | | | 0.008** | 0.009 | 0.008 | | |
| | | | (0.003) | (0.008) | (0.005) | | |
| Government Spending | | | -0.001 | -0.012 | -0.002 | | |
| | | | (0.007) | (0.020) | (0.015) | | |
| Standardized Tax Rate (LPT) | | | | | 1.572** | | |
| | | | | | (0.713) | | |
| Standardized Tax Rate (LBT) | | | | | 0.701 | | |
| | | | | | (1.019) | | |
| Population (t-1) | | | | | | -0.165 | 0.271 |
| | | | | | | (0.102) | (0.200) |
| Lump-Sum Grants (t-1) | | | | | | -0.009*** | -0.026** |
| | | | | | | (0.003) | (0.012) |
| Government Spending (t-1) | | | | | | 0.003 | -0.001 |
| | | | | | | (0.007) | (0.016) |
| Observations | 1584 | 1188 | 1584 | 1188 | 1584 | 1584 | 1188 |

The table reports estimates of Equation 11. LBT (LPT) denotes specifications with the local business (property) tax as dependent variable. Variables are defined as in Table 2. The sample includes all municipalities in NRW over the period 1995-1998 (1996-1998) for the LBT (LPT) specifications. Standard errors are clustered at the county level. Asterisks indicate statistical significance at 10% (*), 5% (**), and 1% (***) levels. Coefficients for municipality- and year-fixed effects are not reported.

**Exclusion restrictions.** The rich experimental set-up also allows me to test an important exclusion restriction on the cross-elasticities between actual and standardized tax rates that is implicit in the theoretical models from Section 2. Given the additively separable household utility function, the comparative statics impose, by assumption, a zero impact of changes in the standardized tax rate of one tax instrument on the actual tax rate of the other.

For the actual property tax rates, the sequence of changes in standardized tax rates provides an avenue to directly test this hypothesis. In 1996, the group of small jurisdictions faced a differential treatment only with regard to the standardized *business* tax rate (which, to recall, increased by 0.5 percentage points while remaining constant for the large jurisdictions; see Figure 4). While also the standardized property tax rate increased in 1996, it did so for both groups of municipalities. Accordingly, it is possible to re-run the regression for the property tax rate over the period 1996-1998 and augment it with the standardized business tax rate as an additional explanatory variable. In this specification, any potential impact of the uniform increase in the standardized property tax rate in 1996 would be largely absorbed by the fixed effects and the coefficient for the standardized business tax rate can be estimated due to the differential change between municipality-groups in this year.[34] As visible from the statistically insignificant coefficient on standardized business tax rate in this specification, the results do not refute the hypothesis of a zero cross-elasticity between actual and standardized tax rates of the different tax instruments. Meanwhile, the coefficient on standardized property tax rate remains unchanged compared to the baseline specification.

**Falsification tests.** The comparison of coefficients in Tables 1 and 3 confirms that, in the case of the local property tax, the choice of dependent variable (in levels versus first-differences) yields materially different impact estimates. It thus appears warranted to take a closer look at whether first-differencing is an effective strategy to deal with pre-existing trends in the level of tax rates.

Table 4 presents falsification tests of whether the estimations reject the $H_0$ of no effect for 'placebo treatments' in the pre-reform period. The tests are based on difference-in-difference regressions, stretching over the entire sample period and including a full set of year-group

[34] The uniform percentage point increase in the level of the standardized property tax rate in 1996 translates into a slightly unequal change in log-levels across groups. But also the log of the standardized property tax rate is highly collinear with the fixed effects in 1996.

interactions, such that:

$$\Delta\tau_{it}^{j} = \alpha_{i}^{j} + \gamma_{t}^{j} + \sum_{t=k+1}^{\Gamma} \beta_{t}^{j}(T_{i}^{j} \times \gamma_{t}^{j}) + \varepsilon_{it}^{j} \tag{12}$$

where the base year ($k$) is 1992; the last sample year ($\Gamma$) is 2002; $T_i$ is a treatment group dummy that equals 1 for municipalities with up to 150,000 inhabitants and 0 otherwise; and all other variables are defined as in Equation 11 (for a similar approach, see for instance Autor (2003)).

For the local property tax, the results confirm the first-differencing as adequate and necessary to deal with pre-existing tends. With the dependent variable in first-differences, none of the coefficients on the pre-reform interaction terms is significant, thus passing the falsification test. Consistent with the theoretical predictions, the coefficients on the interaction terms only turn significant starting in 1997, when the treatment group first experienced a differential change in the standardized property tax rate (column 1). For the dependent variable in levels, the estimates instead point to a clear violation of the parallel trends assumption, as visible from the significant coefficients on most of the pre-reform interaction terms (see column 2, where $\tau_{it}^{b}$ replaces $\Delta\tau_{it}^{b}$ as dependent variable).

For the local business tax, by contrast, neither the specification in levels nor in first-differences features significant pre-reform 'placebo' effects (columns 3 and 4), thus confirming the visual pattern emerging from Figure 5 (see also Rauch and Hummel (2016) in support of this conclusion); the coefficients on the reform-year interaction terms are less precisely estimated for the tax rates in first differences, however, turning significant only in one of the reform years, 1997, and only at a 10% level.

In terms of point estimates, the difference-in-difference coefficients are similar to those from the baseline specifications using standardised tax rates as a continuous explanatory variable.[35] In terms of adjustment patterns, the results further indicate that the reform-induced

[35] To compare the DID coefficients in Table 4 with the baseline coefficients in Table 3, we can calculate $\tilde{\beta}_{t}^{j} = \hat{\beta}_{t}^{j}/(\Delta\bar{\tau}_{t}^{j} - \Delta\bar{\tau}_{1992}^{j})$, where $\hat{\beta}_{t}^{j}$ is the estimated coefficient on the treatment-group interaction with year $t$; $\Delta\bar{\tau}_{t}^{j}$ is the year-on-year change in the standardized tax rate for treated municipalities in year $t$; and 1992 is the base year for the DID estimations (in that year, standardized tax rates remained constant so that $\Delta\bar{\tau}_{1992}^{j} = 0$ for $j = k, b$ in all municipalities). Inserting the values for 1997, for instance, this yields $\tilde{\beta}_{1997}^{b} \approx 0.050/0.032 = 1.56$ and $\tilde{\beta}_{1997}^{k} \approx 0.012/0.027 = 0.44$.

acceleration in property tax rate dynamics was strongest in 1997, the first year in which small municipalities faced a differential change in the respective standardized tax rate. Afterwards, the impact estimate declines but stays significant at a 5% level in 1998, the second year of reform implementation for the standardized property tax rate, and a significant effect even remains visible (albeit only at a 10% level) in 1999, the first post-reform year, thus pointing to some sluggishness in the adjustment of tax policy; the tax rate trends then return to baseline in the second year after the reform was fully implemented.[36]

**Alternative clustering.** The baseline specification follows the recommendation from the related DID literature to cluster standard errors at an aggregation level above that of the cross-sectional observations (see Bertrand et al. (2004); Angrist and Pischke (2009)). Table 5 presents tests on whether the results are robust to alternative clustering choices. It starts from an agnostic approach that simply changes the variable at which clustering takes place, including the municipality, year $\times$ municipality, and year $\times$ county level (columns 1 to 3). None of these alternatives changes the main conclusions concerning the significance of the estimates. Given the moderate number of (54) county-level clusters in my preferred specification, column 4 applies the *Wild Cluster Bootstrap-t* procedure, as proposed by Cameron et al. (2008). This procedure provides an effective means to account for within-group dependence when the number of clusters is limited and the number of observations per cluster differs. Again, the main conclusions on the significance of the coefficients remain valid.

**Heterogeneous responses.** As a final exercise, the estimates in Table 6 explore whether the impact of changes in standardized tax rates on actual tax rates varies across sub-groups of municipalities that differ with regard to relevant economic characteristics – namely, their status in the fiscal equalization scheme and their business tax base.

As to the former aspect, the results shown so far have been based on the entire universe of municipalities in NRW – including the 'abundant' municipalities that do not receive fiscal equalization grants and therefore would not be directly affected by changes in fiscal equaliza-

[36]The DID coefficients, per se, do not reveal whether the sluggish adjustment pattern is due to a gradual response of municipalities choosing to stretch the tax rate increase over more than one year; or whether municipalities tended to implement the tax rate increase in one year, but different municipalities chose different years for this adjustment. A simple comparison based on treatment-group municipalities that chose to adjust tax rates in any of the reform years suggests that the former constellation tends to dominate for the local property tax: for instance, of the roughly 250 (210) municipalities that raised property tax rates in 1997 (1998), 60% (70%) also raised them in 1998 (1997). At the same time, of the roughly 150 municipalities that raised rates in both years, about 70% decided a higher increase in the first than in the second year.

Table 4: Falsification tests and adjustment patterns

| | (1) $LPT^{DFF}$ | (2) $LPT^{LVL}$ | (3) $LBT^{DFF}$ | (4) $LBT^{LVL}$ |
|---|---|---|---|---|
| Treatment × Y1993 | -0.004 | -0.019 | -0.003 | 0.001 |
| | (0.017) | (0.011) | (0.009) | (0.004) |
| Treatment × Y1994 | -0.005 | -0.039** | -0.003 | 0.003 |
| | (0.013) | (0.015) | (0.008) | (0.004) |
| Treatment × Y1995 | -0.027 | -0.081*** | -0.003 | 0.005 |
| | (0.021) | (0.022) | (0.008) | (0.006) |
| Treatment × Y1996 | 0.004 | -0.093*** | 0.005 | 0.014** |
| | (0.020) | (0.025) | (0.007) | (0.006) |
| Treatment × Y1997 | 0.050*** | -0.058** | 0.012* | 0.031*** |
| | (0.015) | (0.022) | (0.007) | (0.006) |
| Treatment × Y1998 | 0.033** | -0.039* | 0.004 | 0.039*** |
| | (0.015) | (0.022) | (0.008) | (0.006) |
| Treatment × Y1999 | 0.020* | -0.035 | -0.004 | 0.040*** |
| | (0.012) | (0.022) | (0.007) | (0.006) |
| Treatment × Y2000 | 0.010 | -0.040* | -0.005 | 0.040*** |
| | (0.014) | (0.022) | (0.008) | (0.006) |
| Treatment × Y2001 | 0.020 | -0.034 | 0.001 | 0.045*** |
| | (0.014) | (0.022) | (0.007) | (0.006) |
| Treatment × Y2002 | 0.008 | -0.040** | -0.002 | 0.048*** |
| | (0.016) | (0.020) | (0.007) | (0.007) |
| Observations | 4356 | 4356 | 4356 | 4356 |

The table reports estimates of Equation 12. LBT (LPT) denotes specifications with the local business (property) tax as dependent variable. Superscript DFF (LVL) denotes the year-on-year difference (level) of the respective tax rate in logs. Treatment × Y1993 is an interaction term between a treatment group dummy and a year dummy for 1993; the other explanatory variables are defined analogously. The sample includes all municipalities in NRW over the period 1992-2002, with 1992 acting as base-year for the DID estimation. Standard errors are clustered at the county level. Asterisks indicate statistical significance at 10% (*), 5% (**), and 1% (***) levels. Coefficients for municipality- and year-fixed effects are not reported.

tion parameters (see Section 3). This approach may be justified by two lines of argumentation. The first is that the status of abundance is typically temporary. In the baseline sample, for instance, the probability for an abundant municipality to become non-abundant in the following year is about 25% and this probability increases further in subsequent years. To account for this non-negligible probability, municipalities may thus adjust their tax policy in response to changes in fiscal equalization parameters, even if the latter do not directly apply to them in a

Table 5: Alternative clustering approaches (*p-values*)

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| LBT | 0.012 | 0.004 | 0.009 | 0.03 |
| LPT | 0.033 | 0.006 | 0.009 | 0.05 |
| Clustering at level of: | muni | muni×year | county×year | county (CGM) |
| Number of clusters | 396 | 1,584 (1,188) | 216 (162) | 54 |

The table presents p-values for the coefficient on the standardized tax rates in Equation 11, based on standard errors clustered at the level indicated in the second-to-last row. LBT (LPT) denotes specifications with the local business (property) tax as dependent variable. Column 4 is based on the *Wild Cluster Bootstrap-t* procedure proposed by Cameron et al. (2008). The corresponding p-values are rounded up to two decimals since at higher levels of precision they tend to vary across simulations. Whenever the number of clusters differs across the specifications for LBT and LPT, the number in parenthesis refers to the latter.

given year.

A second set of arguments derives from a more theoretical perspective, in particular related to 'second-generation theory of fiscal federalism' which has extended the previous literature by introducing information asymmetries and allowing the objective functions of fiscal authorities to differ from those of their constituencies (see Oates (2005) and Weingast (2009) for surveys). In this vein, Kotsogiannis and Schwager (2008) show that, by mitigating or reinforcing existing information asymmetries, fiscal equalization may alter the intensity with which fiscal authorities engage in 'yardstick competition' – which, in turn, determines their trade-off between rent-seeking activities and the quest for political approval. Applied to the current paper, this line of reasoning may imply that changes in standardized tax rates affect local incentives not only via their budgetary implications and their impact on the marginal cost of public funds, but also by changing the signals that local governments choose to emit in the context of yardstick competition. Such considerations may be particularly prevalent in relation to local property taxation, which is not only borne but also paid by large parts of the local electorate and hence is probably more salient than the local business tax.[37]

As a first robustness check in this direction, I follow a similar approach as Rauch and Hummel (2016) by rerunning the baseline regressions but, among the treatment group, only consider the sub-sample of municipalities that were not abundant in any of the sample years

[37] For evidence pointing to tax salience as a relevant factor in the context of the German property tax, see Füss and Lerbs (2017).

1995-1998 (columns 1 to 4 of Table 6). The resultant point estimates are almost identical to those from the baseline regression, albeit being estimated with somewhat lower precision (the *p-values* for the coefficients on the standardized property tax rate are 0.051 (0.053) in the specification shown in column 2 (4)). These sample restrictions are, of course, a rather crude way to evaluate whether abundant municipalities behave differently, especially since the latter account only for a relatively small fraction of the sample. As a more efficient alternative for detecting heterogeneity in the tax responses, Table 6 presents estimates that also include abundant municipalities in the sample, but allow the slope coefficient on the standardized tax rates to differ across abundant and non-abundant municipalities.

Specifically, I rerun Equation 12, augmented by a dummy that equals 1 if municipality $i$ is abundant in year $t$ and zero otherwise, as well as an interaction between this dummy and the standardized tax rates for the respective instrument. A negative coefficient on this interaction term would indicate that the tax rate response to a change in the standardized tax rate is weaker in abundant than in non-abundant municipalities. While indeed negative, the coefficient on the interaction term is not significant for either of the two tax instruments (see columns 5 and 6). At the same time, the comparison of the combined effect for abundant municipalities across tax instruments reveals some interesting patterns. For the business tax, the impact of changes in the standardized tax rate is clearly insignificant in the subset of abundant municipalities, consistent with standard model predictions. For the property tax, by contrast, the combined impact approaches conventional significance levels, with a *t-statistic* of 1.56, thus providing some tentative indications that abundant municipalities do react to changes in standardized tax rates although they are not directly affected by them – a pattern that would indeed be consistent with yardstick competition playing a role property tax setting.[38]

An obvious caveat is that the abundance status may itself be partly driven by tax policy choices, or other unobservable characteristics that interact with tax policy, which in turn would undermine a causal interpretation of the estimated coefficients. Hence, these results should not

[38] In the notation of Equation 11, the combined impact for sub-groups of municipalities is calculated as: $\partial \Delta \tau^{k}_{i,t} / \partial \Delta \bar{\tau}^{j}_{i,t} = \hat{\beta} + \hat{\delta}^{A} A_{i,t}$, where $\hat{\beta}$ is the estimated coefficient on $\Delta \bar{\tau}^{j}_{i,t}$ and $\hat{\delta}^{A}$ is the estimated coefficient on the interaction term between this variable and the dummy indicating the abundance status ($A_{i,t}$). To derive the *t-statistic*, this combined impact is divided by the combined standard error, calculated as: $\sqrt{(\sigma^2_{\hat{\beta}} + \sigma^2_{\hat{\delta}} A^2_{i,t} + \sigma_{\beta\delta} A_{i,t})}$, where $\sigma_{\beta\delta}$ ($\sigma^2_{\hat{\beta}}$ and $\sigma^2_{\hat{\delta}}$) denotes the covariance (variance) of the coefficients. For LBT (LPT), $\sigma_{\beta\delta} = -0.008$ ($\sigma_{\beta\delta} = 0.015$) and the variances can be derived from the standard errors shown in Table 6.

be viewed as identifying causal impact channels but rather as providing an indicative description of heterogeneities in the tax response of different municipality sub-groups, which may point to potentially interesting avenues for further research (for a similar approach, see Fuest et al. (2018)).[39]

Subject to the same caveat, column 7 presents results from a similar regression allowing the slope coefficient on the standardized tax rate to vary across municipalities conditional on their per capita business tax base. The theoretical rationale is that, as a corollary of Equation 9, a higher per capita tax base may mitigate the response of business tax rates to changes in the standardized tax rate – provided capital taxation is driven by Pigouvian motives as assumed in the model and the cost of public service provision rises strongly in response to increases in the local capital intensity.[40] The negative coefficient on the interaction term between the tax base and the standardized tax rate, confirms this prediction of a declining responsiveness of business tax rates to changes in standardized tax rates in jurisdictions with higher per capita tax bases (see Appendix 6.2 for additional, graphical, evidence on the marginal effect and its significance).

**Summary.** Taken together, the estimates provide robust evidence that increases in standardized tax rates cause a statistically significant and economically relevant upward response in actual tax rates with respect to both, business and property taxation. The response of property tax rates is substantially more pronounced than that of business tax rates and, with regard to the latter tax instrument, the responsiveness tends to decline the larger the per capita tax base in the respective municipality. Both patterns are consistent with the predictions of a model that characterises the choice of business tax rates as reflecting Pigouvian efficiency motives.

[39] Fuest et al. (2018) mitigate endogeneity concerns by fixing the characteristics along which they examine heterogeneity (in their case relating to firms or workers) at their values before the start of their relevant sample period. The regressions shown in Table 6 follow a similar approach in that they are based only on the sub-sample of municipalities that did not change their abundance status in any of the sample years.

[40] The equation is estimated in levels rather than first differences since it provides a better empirical fit and the parallel trends assumption is innocuous in the case of LBT (see Section 3.2).

Table 6: Heterogeneous responses

| | (1) LBT | (2) LPT | (3) LBT | (4) LPT | (5) LBT | (6) LPT | (7) $LBT^{LVL}$ |
|---|---|---|---|---|---|---|---|
| Standardized Tax Rate | 0.377** | 1.527* | 0.365** | 1.497* | 0.362** | 1.446* | 0.442*** |
| | (0.164) | (0.764) | (0.162) | (0.755) | (0.161) | (0.787) | (0.086) |
| Population | | | -0.055 | -0.139 | -0.140 | -0.170 | 0.164 |
| | | | (0.127) | (0.333) | (0.144) | (0.334) | (0.102) |
| Lump-Sum Grants | | | 0.011 | 0.016 | 0.013 | 0.012 | 0.017*** |
| | | | (0.007) | (0.021) | (0.008) | (0.023) | (0.005) |
| Government Spending | | | 0.001 | -0.013 | 0.000 | -0.013 | 0.018** |
| | | | (0.007) | (0.024) | (0.007) | (0.022) | (0.008) |
| Abundant | | | | | 0.023* | 0.013 | |
| | | | | | (0.012) | (0.036) | |
| Standardized Tax Rate × Abundant | | | | | -0.478 | -0.159 | |
| | | | | | (0.459) | (0.171) | |
| Standardized Tax Rate × Tax Base | | | | | | | -0.009** |
| | | | | | | | (0.004) |
| Tax Base | | | | | | | 0.051** |
| | | | | | | | (0.023) |
| Observations | 1408 | 1056 | 1408 | 1056 | 1527 | 1149 | 1584 |

Columns 1 to 4 report estimates of Equation 11, removing from the sample those municipalities in the treatment group that did not receive fiscal equalization grants in one or more years over the period 1995-1998. Columns 5 and 6 are based on the full sample and report estimates of Equation 11 augmented by a dummy variable (Abundant), which equals 1 if municipality $i$ is abundant in year $t$ and zero otherwise, as well as an interaction between this dummy and the standardized tax rates for the respective instrument. Column 7 adopts an analogous approach, but instead includes the per capita business tax base and its interaction with the standardized tax rate in the regression. The superscript $LVL$ indicates variables in log levels. All other variables are expressed as year-on-year log-changes multiplied by 100. Standard errors are clustered at the county level. Asterisks indicate statistical significance at 10% (*), 5% (**), and 1% (***) levels. Coefficients for municipality- and year-fixed effects are not reported.

# 5 Conclusion

This paper shed light on the factors and motives shaping tax structures at the local layer of government. As a key ingredient, the paper studied the impact of redistributive fiscal equalization grants in this regard. Much of the related literature has focused on how intergovernmental grant schemes of this type may alter tax policy when governments have access to a single tax instrument to finance public spending. But the institutional reality in many federal countries places more than one tax instrument at the disposal of sub-national governments and these tax instruments tend to differ with respect to their incidence, as well as the strength and type of distortions they induce. If fiscal equalization affects the relative incentive to use these different instruments, it may not only change the level of tax effort but also alter the tax structure – and thereby influence the distributional outcomes, efficiency properties, and competitiveness implications of tax policy in the federation as a whole. Accordingly, the analysis of tax structures may serve as an important complement to existing studies of the incentive effects of intergovernmental transfers.

As I demonstrate in a standard fiscal competition model, the tax rate response to changes in the degree of fiscal equalization may differ across tax instruments, depending on the elasticity of the respective tax base. However, the direction of the resultant impact on the tax structure hinges on the rationale for governments to engage in distortionary taxation in the first place, rather than entirely relying on the non- (or less-) distortionary tax instruments that they have access to. If the use of distortionary tax instruments mainly originates from distributional motives, an increase in the degree of fiscal equalization tilts the tax structure towards more distortionary taxation. If distortionary taxation acts as a Pigouvian intervention to correct externalities emanating from mobile tax bases, greater fiscal equalization induces a less distortionary tax structure.

To discriminate between these theoretical predictions, I further analyse the issue in a natural experiment from municipal finance in Germany. In this context, I present robust empirical evidence that the response of relatively nondistortionary property taxation to changes in fiscal equalization is significantly stronger than that of highly distortionary business taxation. Accordingly, in the context of German municipal finance, fiscal equalization may act as a tool to

induce a less distortionary tax structure and it favours the interpretation of capital taxation as being driven by Pigouvian efficiency motives.

A natural question is whether the relevance of these findings may extend beyond the specific institutional context of German municipal finance – for instance to the ongoing deliberations on deeper fiscal integration in the euro area, which have triggered renewed interest in the implications of intergovernmental grant schemes involving nation states. While these deliberations have yet to converge on a specific institutional set-up, the establishment of a 'fiscal capacity' (or 'stabilisation function') has received particular prominence (see *e.g.* European Commission (2017) and Bénassy-Quéré et al. (2018)). As a common feature, related proposals envisage a temporary reallocation of fiscal resources to countries affected by particularly severe economic downturns; and the resultant negative relation between the net-recipient status of a country and indicators of the state of its economy gives rise to certain parallels with the type of intergovernmental transfer schemes studied in the current paper.

In this regard, the ambiguous predictions of the theoretical model provide an interesting perspective on the external validity of the empirical findings and point to avenues for further research. In particular, the correction of externalities appears as a plausible motive for capital taxation at the local level, where the incidence of certain adverse side effects of production, such as noise and pollution, are directly felt by large parts of the electorate. At the national level, however, this motive is less likely to play a major role in determining the tax structure, as localized externalities of production would only affect a small subset of the electorate that lives in the vicinity of the respective production sites; and, consistent with this reasoning, the related literature has emphasized distributional motives as an explanation for the observed reliance of countries on highly distortionary capital taxation (see Persson and Tabellini (2000)).

Hence, the empirical evidence on the impact of redistributive fiscal grants on the tax structure may not carry over from local to national fiscal policies. But the theoretical framework developed in the current paper may help rationalize the choice of tax structures at national level and guide potential future research on how different types of federal institutions at the European level may influence this choice.

# 6 Appendix

## 6.1 Explicit expressions for optimal choice of capital and land tax rates

In the model with distributional motives, the optimal capital tax rate from the perspective of local governments follows from Equation 6 as:

$$\tau_i^k = k_i f_{ikk} \left( \frac{1}{\xi_i} - 1 \right) + \vartheta_i^k.$$

Substituting this expression into the budget constraint and using Equation 5 then yields the optimal land tax rate:

$$\tau_i^b = \left[ v_{iz}^{-1}(1 + e_i^m) - y_i - k_i^2 f_{ikk} \left( \frac{1}{\xi_i} - 1 \right) \right] b^{-1} + \vartheta_i^b.$$

In the model with externalities, the optimal capital tax rate from the perspective of local governments follows from Equation 7 as:

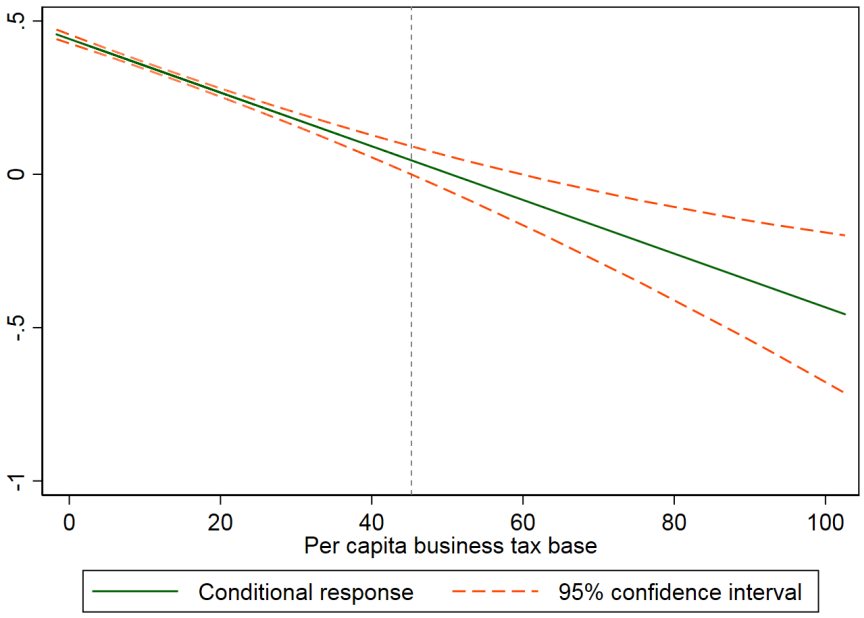
$$\tau_i^k = \vartheta_i^k + c_{ik}$$

Substituting this expression into the budget constraint and using Equation 3, this yields the optimal land tax rate:

$$\tau_i^b = \left[ v_{iz}^{-1} - y_i - c_{ik} k_i \right] b^{-1} + \vartheta_i^b.$$

### 6.2 Response of the local business tax rate conditional on the tax base

The below figure presents point estimates (solid line) and 95% confidence intervals (dashed lines) for the response of the actual business tax rate to changes in the standardized business tax rate conditional on the local business tax base (corresponding to the estimates in column 7 of Table 6). The construction of confidence intervals follows Brambor et al. (2006); see footnote 38 for further detail.

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**Fédéric Holm-Hadulla**
European Central Bank, Frankfurt am Main, Germany; email: federic.holm-hadulla@ecb.europa.eu



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