

# Tax Incentives in Fiscal Federalism: An Integrated Perspective\*

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## Abstract

Models of fiscal federalism rarely account for the multitude of real-world intergovernmental arrangements when assessing the efficiency implications of tax competition; in particular for federal tax policy. This paper takes an integrated view of this issue. It shows that fiscal institutions such that federal tax deductibility, vertical revenue-sharing, and fiscal equalization (being common features of existing federations) encourages taxation locally, but may discourage federal taxation. The fiscal institutions may well overrule the negative effect of capital mobility on local taxes while intensifying the downward pressure on federal taxes. The dichotomy of taxing incentives is consistent with tax policy in Germany.

*Keywords:* Fiscal Federalism; Capital Tax Competition; Intergovernmental Relations; Equalization; Revenue-Sharing

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# 1 Introduction

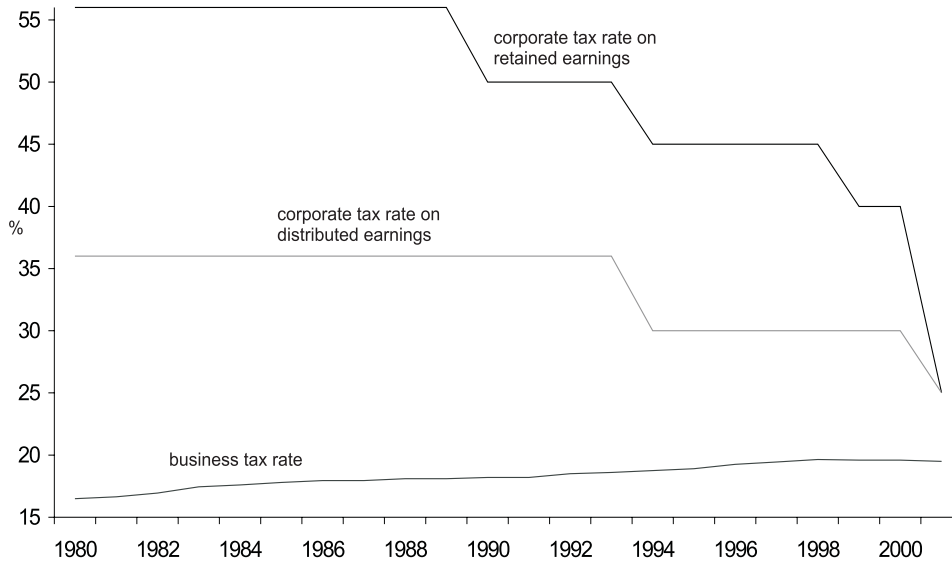
Economic integration has made it increasingly difficult to tax mobile resources. Most notably, the magnified capital mobility has raised the sensitivity of investment and firm location to taxation. High tax rates on capital are difficult to sustain as capital takes advantage of the increased mobility by locating in low-tax countries. The induced downward pressure on capital tax rates either leads to a reduction in public expenditures or a shifting of the tax burden on less mobile resources. The predicted downward trend in tax rates can indeed be confirmed in many OECD countries. Besides statutory tax rates also effective tax rates on capital came down in recent decades (Devereux et al., 2002).

Although the German aggregate tax rate on corporate profits fell as well, the prediction of a “race to the bottom” cannot fully be confirmed when disentangling the aggregate tax rate into its components determined federally and locally (i.e. at the municipal level). The federal corporate tax rate dropped significantly in the 80s and 90s from 56% on retained earnings and 36% on distributed earnings in 1980 to a uniform rate of 25% in 2001.<sup>1</sup> Though levied on the same tax base, local tax rates did not replicate this pattern. Its average increased by nearly 20% from 16.5% in 1980 to 19.25% in 2001. The change in the federal tax rates may well theoretically be underpinned by the notion of fiscal competition. Over the reported period capital mobility tends to have intensified (Devereux et al., 2002, and Sinn, 2003). Puzzling at first sight, tax competition has not dominantly shaped local tax incentives, although capital is more mobile between municipalities than between nation states.

The key to our explanation of the dichotomy of taxing incentives is fiscal federalism. Inter-governmental budgetary ties, inherent in fiscal federalism, may create opposing tax incentives at the federal and local level. The qualitative importance of fiscal federalism is well recognized in the literature, but a comprehensive analytical account of how fiscal federalism changes local and

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<sup>1</sup>This figure does not include the solidarity surcharge. The inclusive federal tax rate is 26.25%.



Source: Statistische Jahrbuch für die Bundesrepublik Deutschland, various years.

Figure 1: The German federal corporate tax rates and the business tax rates from 1980 to 2001.

in particular federal taxing incentives has not been presented. We set up a two-tier federal system where both layers engage in capital tax competition. We furthermore allow for fiscal equalization, tax revenue-sharing, as well as federal deductibility of locally-paid taxes to link public budgets horizontally and vertically. The fiscal environment displays a variety of features characteristic for federal economies. For instance, the German federal and municipal governments occupy (nearly) the same tax base for corporate taxation where the fiscal interdependence is strengthened by a federal tax deductibility provision. Municipal governments share locally collected business tax revenues with the federal level and receive equalizing transfers. Furthermore, provinces in Canada are linked through fiscal equalization and at the same time levy a business tax in addition to the federal government. The federal government furthermore allows the deduction of provincial payroll and capital taxes under the federal corporate tax. Similarly, the U.S. state and federal governments co-occupy the personal income tax base where the U.S. state income taxes (among other state taxes) are deductible from the federal income tax base.

The paper's results are as follows: Horizontal and vertical fiscal ties upwardly distort local tax rate choices. The intuition is that fiscal ties subsidize local taxing effort. The price of taxing capital is reduced since fiscal ties either provide compensating transfers to the local government,

if capital leaves the region, or fiscal ties export part of the local tax burden onto the federal level - most notably realized by vertical revenue-sharing arrangements. Both effects strengthen taxing incentives and may even more than undo the effect of capital mobility on local tax rates. As a mirror image of these effects, the federal government's cost of taxing capital tends to be magnified by fiscal ties which adds to the downward pressure on taxes exerted by capital mobility. Combining both results, fiscal federalism disperses tax incentives enacting a "race to the top" at the local level, while potentially intensifying the "race to the bottom" at the federal level.

We illustrate our findings using data from German municipal finance. We find that the German equalization and revenue-sharing system compensates municipalities for  $\approx 70\%$  -  $100\%$  of the capital outflow at the margin which significantly insulates municipal budgets from capital mobility. Adding the effect of the tax deductibility provision suggests that municipal capital taxes are set at an inefficiently high level.

Though an overprovision of public goods is equally undesirable from an efficiency perspective as the typically-conjectured underprovision equilibrium, the policy implications in both cases differ. For instance, the classical recommendation to assign taxes on mobile tax bases to the highest level in the federation (Musgrave, 1983) needs to be reevaluated carefully in the light of the results. Replacing a local source-based capital tax with a tax on an immobile, but endogenously supplied, tax base is well in line with the classical view, but nonetheless it might not promote efficiency as predicted. Following its implementation, the partial effect of tax competition on tax rates will indeed be eliminated. However, fiscal federalism will still allow for an upward distortion in tax rates. As a result, inefficient tax setting, taking the form of overtaxation, may become more severe.

So far, an integrated analysis of fiscal institutions in public finance has not been presented. Instead, the existing literature adopts a partial perspective by separately analyzing the tax incentives under each fiscal institution - predominantly confining attention to local tax policy. The seminal paper by Gordon (1983) systematically describes the variety of inefficiencies which can arise from lower-level decision-making. A formal analysis of how federal fiscal institutions influence federal

tax policy is not offered. Flowers (1988) and Wrede (1996) show that with Leviathan governments a tax base overlap yields too high tax rates.<sup>2</sup> Keen and Kotsogiannis (2002) argue that the result might extend to the case of benevolent governments even when tax competition operates locally. Addressing two fiscal institutions simultaneously, Dahlby et al. (2000) characterize the Pigouvian-type federal deductibility rate which offsets the local inefficiency rooted in a tax base overlap. The extent to which local tax incentives are influenced by fiscal equalization is investigated in Smart (1998). Therein, schemes which equalize taxing capacities are shown to reduce the perceived elasticity of the local tax base. This effect mitigates undertaxation in horizontal fiscal competition since the tax base elasticity is overestimated with resource mobility; see Köthenbürger (2002) and Bucovetsky and Smart (2002).<sup>3</sup>

The plan of the paper is as follows: The model is presented in Section 2. Section 3 characterizes the local tax policy and Section 4 analyzes federal tax policy in fiscal federalism. Concluding remarks are offered in Section 5.

## 2 Model

Suppose the economy consists of symmetric regions which are assigned to two different federations, each being identically structured. All member regions of a federation are comprised of a private and public sector.

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<sup>2</sup>Dahlby and Wilson (2003) clarify that a tax base overlap may not necessarily lead to overtaxation. If an ad-valorem tax is levied on the supply side of the market, a local tax hike may well increase federal tax revenues provided that the tax-induced market price increase dominates the (negative) quantity response. Inherent in capital tax competition, taxes are levied on a source-basis (i.e. on the demand side of the market) which gives an inverse relation between federal tax revenues and local tax increases both with ad-valorem and unit taxes.

<sup>3</sup>There is a steadily growing empirical literature on the empirical relevance of fiscal federalism for tax setting. For instance, Feldstein and Matclaf (1987) analyze the impact of U.S. federal tax deductibility on state and local tax setting. Besley and Rosen (1998) focus on the interaction between state and federal excise taxes in the U.S. Esteller-Moré and Solé-Ollé (2002) and Hayashi and Boadway (2001) assess vertical and horizontal tax interaction in Canada. In line with the theoretical prediction, the latter two find evidence for fiscal equalization to influence provincial tax setting. Relatedly, Buettner (2005) shows that revenue-sharing systems in Germany exert an up-ward bias in municipal tax-setting.

## 2.1 Private Sector

The private sector is modelled by a representative firm and household. Households receive utility from private consumption,  $c$ , and the public consumption goods  $g$  and  $G$ , according to the well-behaved utility function  $u = U(c, g, G)$ .<sup>4</sup> Each household is endowed with a fixed factor (for example, land) denoted by  $L$  and a capital stock  $\tilde{k}$ . Private consumption thus equals  $c = wL + r\tilde{k}$  where  $w$  denotes the wage rate and  $r$  is the interest payment per unit of capital determined in the international capital market.

The representative firm in each region produces a numéraire consumption good using the production technology  $y = f(L, k)$  where  $k$  denotes regional capital employment. Output can be used on a one-to-one basis either as a private consumption good or as a public consumption good. The technology exhibits a positive and declining marginal productivity,  $f_i(L, k) > 0$ ,  $f_{ii}(L, k) < 0$ ,  $i \in \{L, k\}$ , and inputs are complements in production,  $f_{ij}(L, k) > 0$ ,  $i \neq j$ ,  $i, j \in \{L, k\}$ .<sup>5</sup>

Firms are subject to local capital taxation at a rate  $t$  which yields local tax revenues  $T^l = tk$ . The federal level taxes capital at an ad-valorem rate  $\tau$ .<sup>6</sup> A fraction  $\theta \in [0, 1]$  of locally paid taxes is deductible at the federal level which gives a federal tax liability  $T^f = \tau(rk - \theta tk)$ . The local and overall effective tax rate (marginal and average) the firm faces is  $t(1 - \tau\theta)$  and  $t(1 - \tau\theta) + \tau r$ , respectively.

Firms maximize profits taking prices and tax rates parametrically. Net-of-tax profits read

$$\begin{aligned} \pi &= f(k) - wL - rk - T^l - T^f \\ &= f(k) - wL - (r + \tau r + t(1 - \tau\theta))k. \end{aligned}$$

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<sup>4</sup>As long as no confusion can occur regional indices are omitted. Furthermore, the lower level is interchangeably referred to as “regional” and “local”.

<sup>5</sup>Subscripts denote partial derivatives. For notational simplicity the fixed factor,  $L$ , is subsequently suppressed as an argument of the production function.

<sup>6</sup>The federal tax is modelled as an ad-valorem tax. The modelling choice allows for an expositional clear analysis of how tax deductibility influences local tax incentives.

The first-order condition

$$f_k(k) = r + \tau r + t(1 - \tau\theta) \quad (1)$$

implicitly defines capital demand as a function of the user cost of capital  $\rho := r + \tau r + t(1 - \tau)$  with

$$\frac{\partial k}{\partial t} = \frac{1 - \tau\theta}{f_{kk}(k)} < 0. \quad (2)$$

Federal tax deductibility lowers the capital sensitivity to local taxation since firms can deduct a fraction  $\tau\theta$  of the local tax burden from the federal tax liability. The capital demand response is downwardly adjusted by a fraction  $\tau\theta$  of the value it takes in the absence of a tax deductibility provision.

Following Eq. (1) and the linear homogeneity of the production function, private consumption,  $c = wL + r\tilde{k}$ , can be written as

$$c = f(k) - (r + \tau r + t(1 - \tau\theta))k + r\tilde{k}. \quad (3)$$

## 2.2 Public Sector

The public sector in the federation comprises of a local and a federal layer. The upper level recycles tax revenues by providing the public good,  $G$ , while the lower-level governments provide the public good,  $g$ .  $G$  and  $g$  are only locally consumed. Both layers tax capital at source. Besides the tax base overlap, federal and local budget is embedded in a nexus of fiscal arrangements exemplified next.

### 2.2.1 Local Government

The local budget constraint reads

$$g = tk - \alpha\bar{z}k + \beta\bar{z}(\bar{k} - k). \quad (4)$$

Lower-level governments collect capital tax revenues  $tk$ . They share a fraction  $\alpha \in [0, 1]$  of standardized tax revenues with the federal level. Denoting  $\bar{z}$  as the standardized (the average) tax rate, the public funds transferred to the federal government amount to  $\alpha\bar{z}k$ . The third term in Eq. (4) displays entitlement payments due to fiscal capacity equalization between member regions of the federation. The system is conditioned on the difference between the average and the region's taxing capacity,  $(\bar{k} - k)$ , multiplied by the standardized tax rate,  $\bar{z}$ . The difference is equalized at a rate  $\beta \in [0, 1]$ .

### 2.2.2 Federal Government

The federal budget  $B$  is

$$B = \tau \left( r \sum_i k^i - \theta \sum_i t^i k^i \right) + \alpha \bar{z} \sum_i k^i. \quad (5)$$

Federal funds have two components. The upper level levies a source-based capital tax at an ad-valorem rate  $\tau$ . The tax base is equal to  $\sum_i rk^i$ , net of the amount of locally-paid taxes firms are allowed to deduct from the federal tax base,  $\theta \sum_i t^i k^i$ . When  $r < t\theta$  own-source capital tax revenues are negative with symmetric local tax rate choices. To save on notation, we confine attention to the plausible case that the tax deductibility provision leaves a positive amount of tax revenues in the federal budget:

$$\textbf{Assumption: } r > t\theta, \theta \in [0, 1]. \quad (\text{A})$$

The last term in Eq. (5) gives the fraction  $\alpha$  of standardized local tax revenues transferred to the federal budget. Note, since the fiscal equalization system is budget-balancing, it does not enter the federal budget constraint.<sup>7</sup>

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<sup>7</sup>As  $\bar{k}$  is the average capital employment in the federation, local entitlement payments,  $\beta\bar{z}(\bar{k} - k^i)$ , sum up to zero, i.e.  $\sum_i \beta\bar{z}(\bar{k} - k^i) \equiv 0$ .

Capital demand in the federation is denoted by  $K = \sum_i k^i$ . It is decreasing in the federal tax rate,  $\frac{\partial K}{\partial \tau} < 0$ , and - to a lesser extent - decreasing in the local tax rate,  $\frac{\partial K}{\partial t^i} < 0$ .

### 2.2.3 Efficient Public Policy

Production efficiency requires equal capital tax rates in all regions of the economy; not only within the federation. Allocative efficiency in turn dictates public good levels,  $g$  and  $G$ , satisfying

$$\frac{U_G}{U_c} = 1 \quad \text{and} \quad \frac{U_g}{U_c} = 1. \quad (6)$$

Both first-best allocation rules serve as a benchmark in what follows. Since we confine attention to symmetric equilibria - entailing equal tax rates - production efficiency always holds, leaving the magnitude of  $g$  and  $G$  as the only potential source of inefficiency in local and federal public finance.

## 3 Local Equilibrium Policy

We assume that the federal and local governments choose their tax rates simultaneously (Nash-behavior). The implied sequence of decisions is:

- (i) At a first stage, federal and local governments choose tax rates for given tax rates of other governments. They anticipate how capital demand reacts to tax rate changes.
- (ii) At a second stage, firms optimize profits given federal and local tax rates.

### 3.1 Optimal Tax Policy

Given  $\tau$ , the local government chooses its capital tax rate as to maximize utility of the representative household in the region. Thus,

$$\max_t U(c, g, G) \quad \text{s.t.} \quad \text{Eqs. (2), (3), and (4).}$$

In assuming that each member region is sufficiently small relative to the “rest of the federation” the interest rate  $r$  and the level of  $G$  is given for each region.<sup>8</sup> The first-order condition is

$$-U_c(1 - \tau\theta)k + U_g \left( k + (t - \alpha\bar{z} - \beta\bar{z}) \frac{\partial k}{\partial t} \right) = 0, \quad (7)$$

where the condition has been simplified using Eq. (1). At the optimum, each region balances the marginal benefit of higher public good provision to the marginal cost taking the form of lower private consumption.

Intergovernmental fiscal arrangements influence the optimal tax choice as follows. Since a fraction  $\tau\theta$  of the local tax burden is shifted onto the federal level, local tax finance becomes less costly to the region in terms of forgone private consumption. The federal subsidization of local expenditure scales down the drop in private consumption by the factor  $1 - \tau\theta$ . The marginal benefit of higher public consumption is increased by both transfer programs. Revenue sharing and fiscal equalization mitigate the effect of the negative tax base response,  $\frac{\partial k}{\partial t} < 0$ , on local public funds. Implied by revenue-sharing between the local and the federal government,  $\alpha\bar{z}$  per unit of the tax base outflow lower federal instead of local public funds. Furthermore, since the tax base (i.e. taxing capacity) is reduced relative to the standard  $\bar{k}$ , the equalization program compensates for  $\beta\bar{z}$  per unit of the tax base contraction (Bucovetsky and Smart, 2002 and Köthenbürger, 2002). Combining the effect of both transfer programs, the impact of capital mobility on the local budget reduces to  $(t - \alpha\bar{z} - \beta\bar{z}) \frac{\partial k}{\partial t}$ . Also, firms get a proportion  $\tau\theta$  of the local tax burden reimbursed by the federal level which lowers the equilibrium tax base response  $\frac{\partial k}{\partial t}$  by the factor  $\tau\theta$  (see Eq. (2)).

Following Eqs. (4) and (7), the optimal provision rule for public infrastructure reads

$$\frac{U_g}{U_c} = \frac{1 - \tau\theta}{1 + (1 - \alpha - \beta)\epsilon}, \quad \text{where } \epsilon := \frac{\partial k}{\partial t} \frac{t}{k} \quad (8)$$

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<sup>8</sup>Suppose the federation would encompass  $n$  symmetric regions. Since each region receives an equal share of the federal funds, we have  $\frac{dG}{dt^i} = \frac{1}{n} \frac{dG}{dt^i}$ . In a small open region ( $n \rightarrow \infty$ ) the “seeing through” effect vanishes.

at a symmetric equilibrium,  $t = \bar{z}$ . The right-hand side of Eq. (8) depicts the marginal cost of public funds (henceforth MCPF) as perceived at the local level which is equated to the marginal willingness to pay for the public good,  $\frac{U_g}{U_c}$ . Note, in the absence of federal fiscal arrangements (i.e.  $\alpha = \beta = \theta \equiv 0$ ), the MCPF reduces to  $\frac{1}{1+\epsilon} > 1$ , the familiar “race to the bottom” equilibrium in horizontal tax competition.

Lemma 1 follows from inserting Eq. (2) into the expression for the MCPF and taking the respective derivative.

**Lemma 1:** *The MCPF is decreasing in  $\alpha$ ,  $\beta$  and  $\theta$ .*

Given Lemma 1 the efficiency of the local tax choice can be summarized as follows:

**Proposition 1** *Local public good,  $g$ , might be over-, under- or efficiently provided relative to the first-best allocation rule, i.e.  $\frac{U_g}{U_c} \begin{matrix} \geq \\ \leq \end{matrix} 1$ .*

Proposition 1 suggests that although local government levy a tax on mobile capital, the equilibrium may not feature a “race to the bottom”. Horizontal and vertical fiscal arrangements insulate local tax policy from incentives of strategically choosing a too low tax rate. In fact, public goods may be overprovided if fiscal arrangements are sufficiently pronounced as measured by  $\alpha$ ,  $\beta$  and  $\theta$ .

As an illustration of the efficiency consequences we compute the MCPF in German municipal finance. Municipalities may face marginal sharing and equalization rates whose sum  $\alpha + \beta$  is in the range of 0.74 (Schleswig-Holstein) to 0.99 (Saarland) - see table 1 in the appendix.<sup>9</sup> For municipalities, which are backward in economic development, the combined rate may even exceed 1 with the consequence of  $\text{MCPF} < 1$  for  $\epsilon < 0$ . Taking into account the effect of the tax deductibility provision ( $\theta = 1$ )  $\text{MCPF} < 1$  is more than a theoretical curiosum when  $\alpha + \beta < 1$ . Supposing a sharing rate of  $\alpha = 0.47$  (see table 1), the MCPF proves to be below 1 for any level of  $\beta \in [0, 1]$ .<sup>10</sup>

<sup>9</sup>The appendix also contains a detailed description of the computations.

<sup>10</sup>The underlying user cost of capital elasticity,  $\frac{dk}{dp} \frac{p}{k}$ , is  $-0.42$  (Harhoff and Ramb, 2001). Furthermore, the assumed corporate tax rate is  $(1 - \tau) \frac{k}{r} + \tau = 37\%$  which is the sum of the German federal corporate tax rate  $\tau = 25\%$  and the municipal business tax rate  $(1 - \tau) \frac{k}{r}$  which averages 12% as of 2001 - see the appendix.

## 4 Federal Equilibrium Policy

Let  $V^i(\tau, \mathbf{t})$  represent member region's  $i$  utility where  $\mathbf{t}$  is the vector of local tax rates chosen by member regions of the federations.<sup>11</sup> The federal government sets  $\tau$  so as to maximize the sum of member-regions' utilities,  $\sum_i V^i(\cdot)$ . The federal first-order condition for  $\tau$  is  $V_\tau^i = 0$ . Using Eqs. (1), (3), (4) and (5), rewriting the federal tax as a unit tax, i.e.  $T = \tau r$ , and noting  $\sum_i \beta \bar{z} (\bar{k} - k^i) \equiv 0$ , the first-order condition, evaluated in a symmetric equilibrium, is

$$U_c \left( -1 + t\theta \frac{d\tau}{dT} \right) K + U_g (t - \alpha \bar{z}) \frac{\partial K}{\partial T} + U_G \left( \left( 1 - t\theta \frac{d\tau}{dT} \right) K + (T - \tau t\theta + \alpha \bar{z}) \frac{\partial K}{\partial T} \right) = 0. \quad (9)$$

As a point of reference the first-order condition in the absence of fiscal arrangements (i.e.  $\alpha = \beta = \theta \equiv 0$ ) is  $-U_c K + U_g t \frac{\partial K}{\partial T} + U_G (K + T \frac{\partial K}{\partial T}) = 0$ . A higher federal tax rate reduces private consumption equal to  $K$  and the consumption of the locally-provided good  $g$  by  $t \frac{\partial K}{\partial T}$ . On the benefit side the tax hike increases the consumption of the federally-provided good  $G$  by  $K + T \frac{\partial K}{\partial T}$ . The rearranged first-order condition reads

$$\frac{U_G}{U_c} = \frac{1 - \frac{U_g}{U_c} t \eta}{1 + T \eta} > 1, \quad \text{where } \eta := \frac{dK}{dT} \frac{1}{K} < 0. \quad (10)$$

$\eta$  denotes the semi-elasticity of federal-wide capital demand  $K$ . Capital tax competition upwardly distorts the marginal cost of taxation. The provision rule differs from the expression  $\frac{1}{1+T\eta} > 1$  - arising in standard models of tax competition (Zodrow and Mieszkowski, 1986 and Wilson, 1986). In a two-layer fiscal system the marginal cost of taxation is increased by the negative effect a higher federal tax rate has on public expenditures at the lower level of government. Evaluated in units of private consumption, the marginal effect is given by  $-\frac{U_g}{U_c} t \eta > 0$ .

Taking fiscal arrangements into account, the optimal provision rule for the federal consumption

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<sup>11</sup>For notational simplicity, we do not list the tax rates chosen by non-member regions and the other federal government as arguments of  $V^i(\cdot)$ .

good is

$$\frac{U_G}{U_c} = \frac{1 - t\theta \frac{d\tau}{dT} - \frac{U_a}{U_c}(1 - \alpha)t\eta}{1 - t\theta \frac{d\tau}{dT} + (\tau(r - t\theta) + \alpha t)\eta}. \quad (11)$$

The difference between Eqs. (10) and (11) reflects how fiscal arrangements alter the marginal cost of taxation perceived by the federal government (right-hand side of Eq. (11), FMCPF henceforth). Federal tax deductibility and vertical revenue-sharing affect the federal tax price threefold. A rise in  $\tau$  ( $T$ , respectively) makes the tax deductibility provision fiscally more attractive to firms. The amount of local taxes, regions can thereby export onto the federal level, increases by  $t\theta \frac{d\tau}{dT}$  per unit of capital. The more generous federal subsidization of local expenditure has two effects on the FMCPF. The FMCPF decreases since a marginally higher  $\tau$  lowers the drop in private consumption, associated with local taxation, by  $t\theta \frac{d\tau}{dT}$  (numerator of Eq. (11)). On the other hand, the FMCPF increases since federally-collected tax revenues are lowered by exactly this amount (denominator of Eq. (11)). It is interesting to note, that the tax deductibility provision qualitatively changes the FMCPF independently of the degree of capital mobility.<sup>12</sup> Secondly, fiscal federalism affects the federal budget's exposure to capital mobility. Following the tax base outflow in response to a higher level of  $\tau$ , the amount of local taxes, which are deducted federally, are reduced by  $\tau t\theta\eta < 0$ . Furthermore, the tax base contraction shrinks locally-collected tax revenues, to which the federal government is entitled via the revenue-sharing agreement, by  $-\alpha\bar{z}\eta > 0$ . Thirdly, federal tax policy shrinks the local budget. The upper level government perceives that an outflow of capital, corrected for the drop in transfers to the federal budget, lowers locally provided public consumption by  $(t - \alpha\bar{z})\eta$ . The welfare-equivalent decline in private consumption  $\frac{U_a}{U_c}(1 - \alpha)t\eta$  (evaluated in symmetric equilibrium) positively enters the FMCPF.

Relating the provision rule (11) to the Samuelson condition (6) and inserting  $T = \tau r$  gives:

**Proposition 2** *The federal government chooses an inefficiently low level of taxation, i.e.  $\frac{U_G}{U_c} > 1$ .*

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<sup>12</sup>Without a federal tax base response, i.e.  $\eta \equiv 0$ , the tax deductibility provision would be even immaterial to federal tax incentives. The positive and negative effects exerted on the federal marginal cost of public funds would exactly cancel. In contrast, with  $\epsilon \equiv 0$  the marginal cost of public funds at the local level would still be downwardly biased by the tax deductibility provision.

The rationale is that under assumption (A), which requires federal capital tax revenues to be positive (i.e.  $r > t\theta$ ), we observe  $(\tau(r - t\theta) + \alpha t)\eta < 0$ . On net, the federal budget is negatively affected by capital mobility - see Eq. (11). The underprovision equilibrium, which exists in the absence of revenue-sharing and tax deductibility provisions, is preserved in a fiscal setting with budgetary fiscal arrangements.<sup>13</sup> Proposition 1 and 2 have direct implications for the efficiency of the structure of public consumption. A well received notion is that higher mobility of capital among lower level governments translates into a more severe underprovision of  $g$  relative to  $G$ , i.e.  $\frac{U_G}{U_g} < 1$ . The result may not arise in the current setting. As fiscal institutions at least partly absorb the effect of tax base mobility on local tax policy,  $g$  may in fact be overprovided relative to  $G$ , i.e.  $\frac{U_G}{U_g} > 1$ .<sup>14</sup>

Denoting  $\mathbf{t}(\tau)$  and  $\tau(\mathbf{t})$  as the best responses implicitly defined by Eqs. (7) and (9), respectively, we can formulate:

**Proposition 3** *Suppose  $\frac{d}{d\tau}\mathbf{t}(\tau) < 0$  and  $\frac{d}{d\mathbf{t}}\tau(\mathbf{t}) < 0$ . Then, a marginal increase in  $\beta$  increases the local tax rate  $t$  and decreases the federal tax rate  $\tau$ .*

**Proof.** Observe  $\frac{\partial c}{\partial \beta} = 0$  and by symmetry Eq. (4) yields  $\frac{\partial q}{\partial \beta} = 0$ . Thus  $\frac{\partial}{\partial \beta} \frac{U_g}{U_c} = 0$ . Following Lemma 1 a higher  $\beta$  increases  $t$  for a given level of  $\tau$ . Note,  $\frac{\partial}{\partial \beta} \frac{U_G}{U_c} = 0$ . Thus, keeping  $t$  constant  $\tau$  does not change. Following  $\frac{d}{d\tau}\mathbf{t}(\tau) < 0$  and  $\frac{d}{d\mathbf{t}}\tau(\mathbf{t}) < 0$ , the equilibrium level of  $\tau$  increases and the level of  $t$  decreases. ■

With symmetric capital tax rate choices a higher  $\beta$  exerts no income effect on local policy. It however lowers the tax price of marginal local expenditures which in turn increases  $t$ . Via strategic substitutability of local and federal taxes, the first-order effect translates into a higher local tax and a lower federal tax in equilibrium.

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<sup>13</sup>When federal own-source tax revenues are allowed to be negative ( $r < t\theta$ ), total federal tax revenues (incl. shared local tax revenues) may nevertheless be positive in equilibrium provided  $\tau(r - t\theta) + \alpha t > 0$ . From (11) we then infer that the underprovision equilibrium still exists.

<sup>14</sup>Interestingly,  $g$  may even be relatively “overconsumed” when  $\alpha = \beta = \theta \equiv 0$ . The federal government perceives a lower tax base elasticity as it can influence the interest rate in contrast to local governments (yielding  $\epsilon < T\eta < 0$ ). However, as a counteracting effect it recognizes the reduced local public consumption level when federal taxes rises - see Eq. (10). Comparing Eq. (8), evaluated at  $\alpha = \beta = \theta \equiv 0$ , and Eq. (10),  $g$  is only consumed at an inefficiently low level relative to  $G$  if  $\epsilon < (1 + \frac{t}{T})T\eta$ . The condition may not hold although  $\epsilon < T\eta$ .

A marginal change in  $\alpha$  involves more complex adjustments since a shift in the vertical allocation of tax revenues involves income effects on the choice of taxes. We first present the comparative statics of the FMCPF w.r.t.  $\alpha$ .

**Lemma 2:** *Suppose preferences are weakly separable in  $(c, g)$  and  $G$  and private consumption,  $c$ , to be normal. Then,  $\frac{\partial}{\partial \alpha} \text{FMCPF} \Big|_{\frac{U_g}{U_c} < 1} > 0$ .*

**Proof.**  $\frac{\partial}{\partial \alpha} \frac{U_g}{U_c} = \frac{\partial}{\partial g} \frac{U_g}{U_c} * \frac{\partial g}{\partial \alpha} > 0$  since  $\frac{\partial}{\partial g} \frac{U_g}{U_c} < 0$  when  $c$  is normal in consumption and, given by Eq. (4),  $\frac{\partial g}{\partial \alpha} < 0$ . Note, following Eq. (5)  $\frac{dG}{d\alpha} = \frac{1}{n} \frac{dB}{d\alpha} > 0$  which, by the assumption of weak separability, does not affect  $\frac{U_g}{U_c}$ . Now, differentiating the FMCPF with respect to  $\alpha$  and noting  $\text{FMCPF} > 1$  (Proposition 2) yields  $\frac{\partial}{\partial \alpha} \text{FMCPF} \Big|_{\frac{U_g}{U_c} < 1} > 0$ . ■

When  $\alpha$  increases, the federal expenditures  $G$  increases while local expenditures  $g$  decreases. Therefore, the shift in  $\alpha$  alters the marginal benefit of taxation,  $\frac{U_G}{U_c}$ , in addition to the FMCPF. In order to focus on how federal fiscal institutions influence equilibrium taxes via changes in the tax price of marginal expenditures, we consider the simplified preference structure  $u(c, g, G) = h(c) + v(g) + G$ , where  $h(c)$  and  $v(g)$  and strictly increasing and strictly concave. Note, preferences satisfy the conditions stated in Lemma 2.

**Proposition 4** *Suppose preferences are  $u(c, g, G) = h(c) + v(g) + G$  and the local and federal tax rate are strategic substitutes ( $\frac{d}{d\tau} \mathbf{t}(\tau) < 0$  and  $\frac{d}{dt} \tau(\mathbf{t}) < 0$ ). Then, starting at an equilibrium with  $\frac{U_g}{U_c} < 1$  a marginal increase in  $\alpha$  entails a lower federal tax rate,  $\tau$ , and a higher local tax rate,  $t$ .*

**Proof.** First observe  $\frac{\partial c}{\partial \alpha} = 0$  and  $\frac{\partial g}{\partial \alpha} < 0$ . Thus,  $\frac{\partial}{\partial \alpha} \frac{U_g}{U_c} > 0$ . Furthermore, by Lemma 1 the MCPF decreases. Thus, keeping  $\tau$  constant,  $t$  increases. Also note  $\frac{\partial}{\partial \alpha} \frac{U_G}{U_c} = 0$ . Following Lemma 2 the FMCPF decreases under the condition stated in Proposition 3. Thus, keeping  $t$  constant,  $\tau$  increases. Noting  $\frac{d}{d\tau} \mathbf{t}(\tau) < 0$  and  $\frac{d}{dt} \tau(\mathbf{t}) < 0$ , completes the proof. ■

A higher  $\alpha$  has a positive first-order impact on  $t$  and a negative impact on  $\tau$ . Since local and

federal taxes are strategic substitutes,  $(t, \tau)$  diverge even more from its initial values. The new equilibrium features a lower federal tax rate  $\tau$  and a higher local tax rate  $t$ .

Proposition 3 states sufficient conditions for equilibrium tax rates to diverge when the revenue-sharing component becomes more pronounced. For instance, when taxes are strategic complements<sup>15</sup>, two counteracting effects on local tax incentives emerge. Still by Lemma 2 and Proposition 1 the federal (local) tax will decrease (increase). Now, strategic interaction counteracts the first-order impact of a marginally higher  $\alpha$ . To the extent that the first-order effect dominates the effects of strategic complementarity, the prediction of Proposition 3 is preserved.

At this point it might be interesting to elaborate to what extent the model is capable of reconciling the trend in federal and municipal tax rates displayed in figure 1. The fiscal parameter of interest is the revenue-sharing rate which gradually increased in the last decade in Germany (Buettner, 2005 and Köthenbürger, 2005). In line with Lemma 1, Buettner (2005) empirically shows a positive effect on municipal tax rates. As suggested by Lemma 2, the FMCPF may have increased, in particular when noting that  $\frac{U_g}{U_c}$  is plausibly  $< 1$  in municipal finance. To the extent that the tax price effect is not dominated by strong strategic complementarities between municipal and federal taxes or complex demand-related effects, the federal government may have well chosen a lower tax rate following the gradual increase in the revenue-sharing rate. Undoubtedly, the explanation will not exclusively account for the observed “race to the bottom” in federal taxes, but it may nevertheless complement other factors such as capital market integration.

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<sup>15</sup>Drawing on empirical analyses of tax interaction in Canada and the U.S. provides an ambiguous answer as to whether federal and local taxes are strategic substitutes or complements. Hayashi and Boadway (2001) estimate a negatively-sloped local response function in the case of federal and provincial business taxation in Canada. In contrast, Esteller-Moré and Solé-Ollé (2002) find a positively-sloped reaction of the U.S. state income tax rates to a rising federal income tax rate.

## 5 Conclusion

The analysis shows that capital tax competition in a federal system does not necessarily imply undertaxation. Fiscal arrangements inherent in federal systems such as revenue-sharing, fiscal equalization, and intergovernmental tax deductibility give rise to overly pronounced local taxing incentives. In equilibrium, local tax rates might easily be chosen at an inefficiently high level. Contrary to the standard view, local governments are inclined to engage in a “race to the top” rather than in a “race to the bottom”. In contrast, fiscal federalism might well upwardly distort the federal cost of taxation. It thereby adds to the federal government’s reluctance to tax mobile capital at source. The finding is helpful in understanding recent changes in the German federal corporate tax rate and the local business tax rate, where the former dropped sharply while the latter increased at a time when the revenue-sharing programme gradually expanded.

The classical approach to tax competition (Zodrow and Mieszkowski, 1986; Wilson, 1986) lacks a rationale for source-based capital taxation. Full centralization of taxing powers is the unambiguously-preferred mode of taxation. This is in contrast to tax competition models with Leviathan-type politicians (Brennan and Buchanan, 1980) or a benevolent government, which faces a capital levy problem (Kehoe, 1989). In these two environments, source-based taxation limits fiscal expropriation of constituents and induces a benevolent government to abstain from confiscatory taxation, respectively. Applying the paper’s findings to these augmented settings reveals that fiscal federalism undermines the welfare-enhancing role of tax competition. By limiting the local budget’s exposure to capital mobility, it allows for implicit collusion among Leviathans at the local level<sup>16</sup> or at least partly offsets the beneficial role of tax competition as a commitment substitute in local policy. More specifically, the view of a Leviathan-type government is subsumed in the present analysis. The first-order condition of a self-interested local and federal government is (7) (evaluated at  $U_c \equiv U_G \equiv 0$  and  $U_g = 1$ ) and (9) (evaluated at  $U_c \equiv U_g \equiv 0$  and  $U_G = 1$ ),

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<sup>16</sup>The finding confirms the hypothesis of fiscal cartelization in federal systems put forward by Brennan and Buchanan (1980). The conjecture stipulates that federal fiscal arrangements undermine the boon of fiscal competition, i.e. protecting constituents against fiscal expropriation.

respectively. Collusion among local Leviathans becomes more effective when  $\alpha, \beta$  or  $\theta$  increase. In contrast to the conjecture by Brennan and Buchanan, collusive tax setting does not extend to federal tax policy. Following stronger fiscal ties (as measured e.g. by  $\alpha$ ), the federal Leviathan is more exposed to capital mobility. Being in the interest of the constituents, it is inclined to choose a lower level of fiscal expropriation. Whether constituents may thus prefer to constitutionally anchor vertical fiscal arrangements as a safeguard against fiscal expropriation is an issue left to future research.

## 6 Appendix: Effective revenue-sharing and equalization rate in German municipal public finance

As an illustrative example the appendix evaluates the MCPF for German municipalities. Municipal business taxes are fully deductible under the federal corporate tax code ( $\theta = 1$ ). At the same time municipalities share their standardized business tax revenues with upper level governments and are linked by an equalization scheme which is based on the notion of fiscal capacity equalization. To infer the *effective* equalization and revenue-sharing rate,  $\beta$  and  $\alpha$ , note that fiscal transfers are

$$\bar{z}\tilde{\beta} [\bar{k} - (1 - \tilde{\alpha})k] - \bar{z}\tilde{\alpha}k - \bar{z}\gamma \left\{ (1 - \tilde{\alpha})k + \lambda \left[ \tilde{\beta}(\bar{k} - (1 - \tilde{\alpha})k) \right] \right\}, \quad (12)$$

where  $\tilde{\alpha}$  is the statutory revenue-sharing rate. The first term depicts equalizing transfers where the taxing capacity is computed as standardized tax revenues minus revenue-sharing transfers to the federal government,  $\bar{z}\tilde{\alpha}k$ . The second term represents these transfers and the third term gives municipal public funds shared with the county government at a rate  $\gamma$ . In the latter case the collection rate  $\gamma$  is levied on standardized tax revenues, corrected for transfers to the federal government, and on a fraction  $\lambda$  of equalizing transfers. Rewriting Eq. (12) yields

$$(1 - \gamma\lambda)\tilde{\beta}\bar{z} [\bar{k} - (1 - \tilde{\alpha})k] - [\tilde{\alpha} + \gamma(1 - \tilde{\alpha})] \bar{z}k. \quad (13)$$

Differentiating Eq. (13) w.r.t.  $t$  gives

$$-(1 - \gamma\lambda)(1 - \tilde{\alpha})\tilde{\beta}\tilde{z}\frac{\partial k}{\partial t} - [\tilde{\alpha} + \gamma(1 - \tilde{\alpha})]\tilde{z}\frac{\partial k}{\partial t}.$$

The effective *marginal* equalization rate thus is  $\beta = (1 - \gamma\lambda)(1 - \tilde{\alpha})\tilde{\beta}$  and the effective *marginal* sharing rate becomes  $\alpha = \tilde{\alpha} + \gamma(1 - \tilde{\alpha})$ .<sup>17</sup> Columns (1) - (3) of table 1 display the values for  $\tilde{\beta}$ ,  $\lambda$ , and  $\gamma$  for various states in Germany. Invoking the assumption that the municipalities' tax rate is equal to the standardized tax rate at which deficiencies are compensated ( $\tilde{z} = t$ ), the implied values for  $\alpha$ ,  $\beta$ , and  $\alpha + \beta$  are reported in columns (4) - (6). For municipalities, which are severely economic backward ('poor' municipalities) and are therefore entitled to supplementary equalizing transfers, the combined rate,  $\alpha + \beta$ , may even exceed 1 with the consequence of  $\text{MCPF} < 1$  for  $\epsilon < 0$ .

To shed some light on the scope for overprovision when  $\alpha + \beta < 1$ , we use an average business tax rate,  $\frac{t}{r}$ , of  $\approx 16\%$ . The aggregate tax rate,  $(1 - \tau)\frac{t}{r} + \tau$ , is  $37\%$  which is consistent with the German corporate tax rate of  $25\%$  and an induced effective local tax rate,  $(1 - \tau)\frac{t}{r}$ , of  $12\%$ . The revenue-sharing rate is taken to be  $0.47 (= \alpha)$ ; see table 1. Estimates of the firm-level investment elasticity with respect to the user cost of capital in Germany are reported to be  $\frac{dk}{d\rho} \frac{\rho}{k} = -0.42$  (Harhof and Ramb, 2001). Noting by Eq. (1)  $\epsilon = \frac{dk}{d\rho} \frac{\rho}{k} \frac{(1-\tau)t}{\rho}$ , the parameter values give a  $\text{MCPF} < 1$  for  $\beta \in [0, 1]$ . Assuming a cost of capital elasticity of  $-1$ , being the highest value consistent with U.S. estimates by Cummins et al. (1994)<sup>18</sup>,  $\text{MCPF}$  still falls below 1 for  $\beta \in [0, 1]$ .<sup>19</sup>

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<sup>17</sup>In the theoretical analysis the distinction does not arise. Therein, the taxing capacity relevant for the equalization program coincides with the tax base.

<sup>18</sup>To put the estimate into perspective, Chirinko et al. (1999) find a firm-level user cost of capital elasticity of  $-0.25$  for the U.S.

<sup>19</sup>Sensitivity analysis on the part of the federal tax rate, shows that for  $\beta \in [0, 1]$  overprovision prevails as long as  $\tau > 3\%$ . When lowering  $\tau$  e.g. to  $2\%$ , tax incentives continue to be inefficiently high if  $\beta$  exceeds  $\approx 17\%$ ; a condition which reasonably holds for equalization-grants-receiving regions; see table 1.

State		$\tilde{\beta}$ <sup>2</sup> (1)	$\lambda$ (2)	$\gamma$ <sup>3</sup> (3)	$\alpha$ <sup>4</sup> (4)	$\beta$ <sup>3</sup> (5)	$\alpha + \beta$ (6)
Baden-Württemberg <sup>1</sup>	regular	0.7	1.0	0.29	0.61	0.27	0.88
	poor	1.0	1.0	0.29	0.61	0.39	1.0
Bayern	regular	0.55	0.8	0.46	0.59	0.26	0.85
	poor	0.7	0.8	0.46	0.59	0.34	0.93
Hessen	regular	0.50	0.95	0.5	0.62	0.2	0.82
	poor	1.0	0.95	0.5	0.62	0.4	1.02
Niedersachsen	regular	0.75	0.9	0.5	0.62	0.31	0.93
	poor	1.0	0.9	0.5	0.62	0.42	1.04
Nordrhein-Westfalen	regular	0.9	1.0	0.41	0.55	0.4	0.95
	poor	-	-	-	-	-	-
Saarland	regular	0.9	0.85	0.35	0.51	0.48	0.99
	poor	1.0	0.85	0.35	0.51	0.53	1.04
Schleswig-Holstein	regular	0.5	1.0	0.32	0.48	0.26	0.74
	poor	0.9	1.0	0.32	0.48	0.47	0.95

Source: Various state and federal laws.

<sup>1</sup>In Baden-Württemberg municipalities are additionally required to pay a levy to the state government (Finanzausgleichsumlage). It amounts to 0.2 of the standardized tax revenues, net of revenue-sharing transfers to the federal government, and 0.2 of the equalization payments. Formally, the transfer is  $0.2\bar{z}[(1 - \tilde{\alpha})k + \tilde{\beta}(\bar{k} - (1 - \tilde{\alpha})k)]$  which adds to the transfers in Eq. (12). Thus,  $\beta = [(1 - \gamma\lambda) - 0.2](1 - \alpha)\tilde{\beta}$  and  $\alpha = \tilde{\alpha} + (\gamma + 0.2)(1 - \tilde{\alpha})$ .

<sup>2</sup> Depending on the equalization code municipalities with a taxing capacity sufficiently below the fiscal needs may obtain supplementary equalizing transfers. The depicted statutory equalization rate for poor municipalities is the sum of the regular and the supplementary statutory equalization rate. More information is available from the authors upon request.

<sup>3</sup> The values for  $\gamma$  give the simple average of the county sharing rates in each state; see Der Landkreis (2003), page 123.

<sup>4</sup> The computation uses the 2001 statutory sharing rate,  $\tilde{\alpha} = 0.24$ .

Table 1: Statutory and Effective Equalization and Revenue-Sharing Rates in 2001

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