Tax Incentives in Fiscal Federalism: An Integrated Perspective*

Christian Kelders and Marko Koethenbuerger†

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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 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. Furthermore, the structure of public spending is skewed towards local spending in fiscal federalism. We also show that, when considering Leviathan governments, fiscal institutions reduce confiscatory taxation by the federal government. The result is contrary to the Cartelization Hypothesis (Brennan and Buchanan, 1980). Finally, we characterize the efficient design of intergovernmental fiscal ties.

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

JEL Classification: H7; H1; H20

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†Mailing Address: Department of Economics, University of Copenhagen, Studiestraede 6, DK 1455 Copenhagen, Email: marko.koethenbuerger@econ.ku.dk.
1 Introduction

Intergovernmental budgetary ties are widely observed in federally organized states. 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. 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 for 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.

Despite its fiscal importance the way intergovernmental fiscal ties influence federal taxing incentives has received little attention so far. Existing literature on fiscal federalism (to be reviewed in detail below) either resorts to taxing incentives by local governments or, when a federal level is explicitly considered, generically abstracts from intergovernmental fiscal relations. The present paper tries to fill the gap. In doing so, we set up a two-tier federal system where both layers engage in capital tax competition. Importantly, we allow for fiscal equalization, vertical tax revenue-sharing, as well as federal deductibility of locally-paid taxes to link public budgets horizontally and vertically.

The paper’s results are as follows: Horizontal and vertical fiscal ties upwardly distort local tax rate choices. Fiscal arrangement either insulate the local budget from capital mobility or allow the local tax burden to be exported onto the federal level. Both effects manipulate the local cost of taxation downwards; possibly leading to an overprovision of local public services in tax competition. As a mirror image, federal public services will be unambiguously underprovided in the presence of fiscal ties. In fact, they tend to reinforce the effect of tax competition to raise the federal government’s cost of taxing capital. The rationale is that fiscal ties additionally expose the federal
budget to capital mobility and reduce federal funds due to the partial export of the local tax burden onto the federal level. We further look into the issue of how the structure of government spending (federal vs. local spending) responds to intergovernmental fiscal ties. As budgetary linkages become fiscally more important, the structure of public spending becomes more skewed towards local spending. In fact, the local public services may well be overprovided relative to the federal service. The result is contrary to the general notion that in the presence of tax competition local governments will more strongly underprovide public services relative to the federal level. We further find that fiscal ties tend to induce a strategic complementarity between local and federal taxes. The result is of relevance when, e.g., the federal level is able to pre-commit towards local governments. Now, if the federal government views local taxes to be too high, it will generically decrease the federal tax rate below the level which it finds optimal in the absence of a pre-commitment capacity; a tendency which further reduces federal service provision. Our findings bear an interesting relation to the literature on Leviathan-type governments. The dichotomy of taxing incentives inherent to intergovernmental fiscal arrangements implies that stronger interbudgetary links strengthen taxing incentives at the local level, but undermine taxing incentives at the federal level. The latter finding is in contrast to the Cartelization Hypothesis by Brennan and Buchanan (1980) which stipulates the fiscal ties implicitly induces collusion between governments with the consequence of higher confiscatory taxes.

So far, an integrated analysis of how fiscal institutions affect federal taxing incentives has not been presented. Instead, existing literature analyzes local tax incentives in the presence of intergovernmental fiscal arrangements or jointly analyze local and federal tax incentives, but in the absence of intergovernmental fiscal arrangements. In detail, the seminal paper by Gordon (1983) systematically describes the variety of inefficiencies which can arise from lower-level decision-making. 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 Koethenbuerger (2002) and Bucovetsky and Smart (2006).\textsuperscript{1} Grazzini and Petretto (2005) provide a combined analysis of revenue-sharing and fiscal equalization and its impact on local policy.\textsuperscript{2} An explicit analysis of federal decision making is not presented in this body of literature. Differently, Flowers (1988) and Wrede (1996) explicitly model the federal and local government. They show that with Leviathan governments a tax base overlap yields too high tax rates. Keen and Kotsogiannis (2002) argue that the result might extend to the case of benevolent governments even when tax competition operates locally.\textsuperscript{3} Intergovernmental fiscal arrangements make no appearance in these contributions. To the best of our knowledge, the only contributions with an explicit modelling of federal tax policy and intergovernmental fiscal arrangements are Dahlby et al. (2000) and Hatfield (2007). They characterize the Pigouvian-type deductibility rate which corrects for local disincentives to spend on public services.\textsuperscript{4} Differently, we also consider revenue-sharing and fiscal equalization systems and their impact on the efficiency of public service provision in the presence of a mobile tax base. Furthermore, when we analyze the optimal choice of the deductibility rate, then the rate is primarily needed to correct federal rather than local taxing incentives.

The plan of the paper is as follows: The model is presented in Section 2. Section 3 characterizes the local tax policy. Section 4 analyzes federal tax policy in fiscal federalism, while Section 5 discusses some extensions of the basic set-up. Section 6 offers some concluding remarks.

\textsuperscript{1}From the perspective of a benevolent government the optimally chosen equalization rate appropriately insulates local governments from capital mobility; see e.g. Koethenbuerger (2002) and Bucovetsky and Smart (2006). Interestingly, when the federal government’s motivation is more of a Leviathan-type, the federal layer will strategically use the equalization rate to extract revenues from local governments (Buettner et al., 2006).

\textsuperscript{2}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 Bodaway (2001) assess vertical and horizontal tax interaction in Canada. Baretti et al. (2002) find policy incentives to be adversely affected by the equalization system among German states. At the German municipal level, Buettner (2006) and Egger et al. (2007) find revenue-sharing systems and fiscal capacity equalization to exert an up-ward bias in tax-setting.

\textsuperscript{3}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.

\textsuperscript{4}In particular, the disincentives are due to vertical fiscal externalities originating from general equilibrium effects (Dahlby et al.) or the local provision of infrastructure which expands the federal tax base (Hatfield).
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.

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 $u = U(c, g, G)$. Each household is endowed with a fixed factor (for example, land) denoted by $L$ and a capital stock $\bar{k}$. Private consumption thus equals $c = wL + r\bar{k}$ where $w$ denotes the wage rate and $r$ is the interest payment per unit of capital.

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, $f_{ij}(L, k) > 0$, $i \neq j$, $i, j \in \{L, k\}$.

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 $\tau$. 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.

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

6 Subscripts denote partial derivatives. For notational simplicity the fixed factor, $L$, is subsequently suppressed as an argument of the production function.

7 To adopt a symmetric form of local and federal capital taxation, we could, e.g., levy the local tax on an ad valorem basis as observed in practice. The modification would not quantitatively affect local tax policy. Since regions are price-takers in the international capital market (small open regions) competition in unit and ad valorem capital taxes is equivalent (Lockwood, 2004). For expositional reasons the local tax is levied per-unit of capital.
Firms maximize profits taking prices and tax rates parametrically. Net-of-tax profits read

\[ \pi = f(k) - wL - rk - T^l - T^f \]
\[ = f(k) - wL - (r + \tau r + t (1 - \tau \theta)) k. \]

The first-order condition

\[ f_k(k) = r + \tau r + t (1 - \tau \theta) \]

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

\[ \frac{\partial k}{\partial t} = \frac{1 - \tau \theta}{f_{kk}(k)} < 0. \] (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, \( c = wL + r\bar{k} \), can be written as

\[ c = f(k) - (r + \tau r + t (1 - \tau \theta)) k + r\bar{k}. \] (3)

\[ 2.2 \text{ Public Sector} \]

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 below.
2.2.1 Local Government

The local budget constraint reads

\[ g = t_k - \alpha \overline{z}k + \beta \overline{z} (\overline{k} - k). \tag{4} \]

Lower-level governments collect capital tax revenues \( t_k \). They share a fraction \( \alpha \in [0, 1] \) of standardized tax revenues with the federal level. Denoting \( \overline{z} \) as the standardized (the average) tax rate, the public funds transferred to the federal government amount to \( \alpha \overline{z}k \). 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, \( (\overline{k} - k) \), multiplied by the standardized tax rate, \( \overline{z} \). The difference is equalized at a rate \( \beta \in [0, 1] \).

2.2.2 Federal Government

The federal budget \( B \) is

\[ B = \tau \left( r \sum_i k^i - \theta \sum_i t_k^i \right) + \alpha \overline{z} \sum_i k^i. \tag{5} \]

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 \( \sum_i r_k^i \), net of the amount of locally-paid taxes firms are allowed to deduct from the federal tax base, \( \theta \sum_i t_k^i \). 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:

**Assumption:** \( r > t \theta, \theta \in [0, 1]. \) \tag{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.\footnote{As $\bar{k}$ is the average capital employment in the federation, local entitlement payments, $\beta \pi \left( \bar{k} - k^i \right)$, sum up to zero, i.e. $\sum_i \beta \pi \left( \bar{k} - k^i \right) \equiv 0$.}

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, $\frac{\partial K}{\partial t^i} < 0$. This is due to the fact that each of the two federal governments is large enough to influence the capital market interest rate through its tax choice. Indicating variables pertaining to the neighboring federation by asterisks, the capital market equilibrium is $K + K^* = \sum_i \bar{k} + \sum_i \bar{k}^*$. The market clearing condition together with the first-order condition (1) implicitly defines capital employment and the interest rate as a function of federal and local tax rates.

Unless otherwise stated, we assume that federal and local governments choose their tax rates simultaneously (Nash-behavior).\footnote{Since each local government is small relative to the rest of the economy, it is natural to assume that it takes other governments’ taxes as given. The absence of a commitment capacity is less straightforward for the upper level. In Section 5.2 we allow the federal government to pre-commit toward local governments.} The implied sequence of decisions is:

(i) At a first stage, each federal and local government chooses its tax rate for given tax rates of other governments. Governments anticipate how capital demand reacts to tax rate changes.

(ii) At a second stage, firms optimize profits given federal and local tax rates.

Applying backward induction we subsequently solve for a symmetric subgame-perfect equilibrium. Hence, we characterize the local tax rate $t$ (applied in all regions of the two federations) and the federal tax rate $\tau$ (applied by both federal governments) at which no single government has an incentive to deviate and markets are in equilibrium.

2.2.3 Efficient Public Policy

Before characterizing equilibrium taxes, we turn to the tax rate choices a unified government (unifying both federations) would implement. 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

\[
\frac{U_G}{U_c} = 1 \quad \text{and} \quad \frac{U_g}{U_c} = 1. \tag{6}
\]

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. Straightforwardly, the efficient structure of public spending (local vs. federal spending) follows from \( \frac{U_G}{U_g} = 1 \).

3 Local Equilibrium Policy

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

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

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.\(^\text{10}\) The first-order condition is

\[
-U_c(1 - \tau \theta)k + U_g \left( k + (t - \alpha \tau - \beta \tau) \frac{\partial k}{\partial t} \right) = 0, \tag{7}
\]

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

\(^{10}\)Suppose the federation would encompass \( n \) symmetric regions. Since each region receives an equal share of the federal funds, we have \( \frac{\partial G}{\partial t} = \frac{1}{n} \frac{\partial B}{\partial t} \). In a small open region (\( n \to \infty \)) the “seeing-through” effect vanishes.
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, $\alpha\zeta$ 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 $k$, the equalization program compensates for $\beta\zeta$ per unit of the tax base contraction (Bucovetsky and Smart, 2006, and Koethenbuerger, 2002). Combining the effect of both transfer programs, the impact of capital mobility on the local budget reduces to $(t - \alpha\zeta - \beta\zeta) \frac{\partial k}{\partial t}$. 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 reads

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

(8)

at a symmetric equilibrium, $t = \zeta$. The right-hand side of Eq. (8) depicts the marginal cost of public funds (henceforth SMCPF) 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. $\alpha = \beta = \theta = 0$), the SMCPF reduces to $\frac{1}{1 + \epsilon} > 1$, the familiar “race to the bottom” equilibrium in horizontal tax competition. 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. $\frac{U_g}{U_c} \geq 1$. In particular, an overprovision equilibrium is more likely the higher $\alpha$, $\beta$ and $\theta$.

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 \( \theta \).

We illustrate our findings using data from German municipal finance. We first rewrite the local tax base elasticity as \( \epsilon = \frac{dK}{\partial \rho} \frac{(1-\tau)}{\rho} \). The assumed user cost of capital elasticity, \( \frac{dK}{\partial \rho} \), is \(-0.42\) (Harhoff and Ramb, 2001).\(^{11}\) Furthermore, the aggregate tax rate is \( \rho = (1-\tau)\frac{z}{r} + \tau = 31.825\% \) which is the sum of the federal corporate tax \( \tau \) of 15.825\% as of 2009 and the average municipal business tax rate \( (1-\tau)\frac{z}{r} \) of 16\%. Finally, noting that local capital taxes are fully deductible at the federal level \( (\theta = 1) \) we find local public goods to be overprovided even when \( \alpha + \beta = 0 \).

4 Federal Equilibrium Policy

Let \( V^i(\tau, t) \) denote member region’s \( i \) utility where \( t \) is the vector of local tax rates chosen by member regions of the federations.\(^{12}\) 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 \( V^i_i = 0 \). Using Eqs. (1), (3), (4) and (5), rewriting the federal tax as a unit tax\(^{13}\), i.e. \( T = \tau r \), and noting \( \sum_i \beta \pi (K - k^i) \equiv 0 \), the first-order condition, evaluated in a symmetric equilibrium, is

\[
U_c \left( -1 + t\theta \frac{dT}{dT} \right) K + U_g(t - \alpha \pi) \frac{\partial K}{\partial T} + U_G \left( 1 - t\theta \frac{dT}{dT} \right) K + \left( T - \tau t\theta + \alpha \pi \right) \frac{\partial K}{\partial T} = 0. \tag{9}
\]

As a point of reference the first-order condition in the absence of fiscal arrangements (i.e. \( \alpha = \beta = \theta \equiv 0 \)) is

\[
-U_c K + U_g t \frac{\partial K}{\partial T} + U_G \left( K + T \frac{\partial K}{\partial T} \right) = 0.
\]

A higher federal tax rate reduces private consumption equal to \( K \) and the consumption of the

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\(^{11}\)To put the estimate into perspective, Chirinko et al. (1999) find a firm-level user cost of capital elasticity of \(-0.25\), while Cummings et al. (1994) report a firm-level user cost of capital elasticity of \(-1\) for the U.S.

\(^{12}\)For notational simplicity, we do not list the tax rates chosen by non-member regions and the other federal government as arguments of \( V^i(\cdot) \).

\(^{13}\)We are grateful to Jay Wilson for suggesting the change in notation which simplifies the expression for the federal marginal cost of taxation. Importantly, since \( T = \tau r \) is obeyed at each step of the derivation of (9), the change in notation does not affect federal taxing incentives. This is different to the literature on the comparison of unit and ad valorem capital taxation; see, e.g., Lockwood (2004).
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

\[
\frac{U_G}{U_c} = \frac{1 - \frac{U_G}{U_c}^t \eta}{1 + T \eta} > 1, \quad \text{where} \quad \eta := \frac{\partial K}{\partial T} \frac{1}{K} < 0. \tag{10}
\]

\( \eta \) 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 federal government “sees through” the budget of local governments in the federation. Hence, 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 “seeing-through” 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 good is

\[
\frac{U_G}{U_c} = \frac{1 - t \theta \frac{d\tau}{dT} - \frac{U_G}{U_c}^t (1 - \alpha) t \eta}{1 - t \theta \frac{d\tau}{dT} + (\tau (r - t \theta) + \alpha t) \eta}. \tag{11}
\]

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)). 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 $-\alpha \pi \eta > 0$. 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 $(t - \alpha \pi) \eta$. The welfare-equivalent decline in private consumption $U_e \pi (1 - \alpha) t \eta$ (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 federal public good provision; i.e. $U_G > 1$.

The rationale is that under assumption (A), which requires federal capital tax revenues to be positive (i.e. $r > t \theta$), we observe $(r (r - t \theta) + \alpha t) \eta < 0$. 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.\textsuperscript{14}

Proposition 1 and 2 have direct implications for the efficiency of the structure of public spending in the federation. 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. $U_G < 1$. The result may not arise in the current setting. To isolate the effect of fiscal arrangements on the efficient composition of public good provision we first evaluate $U_e$ for $\alpha = \beta = \theta \equiv 0$. Comparing Eq. (8), evaluated at $\alpha = \beta = \theta \equiv 0$, and Eq. (10), $g$ is consumed at an inefficiently low level relative to $G$ if and only if $\epsilon > (1 + \frac{\epsilon}{\tau}) T \eta$. Hence,

**Proposition 3** In the absence of fiscal ties ($\alpha = \beta = \theta \equiv 0$), the federal public good will be under

\textsuperscript{14}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.
provided relative to the local public good if the tax base elasticities at both levels of government are not too distinct, i.e. $1 > T\eta/\epsilon > \frac{T}{T+t}$.

Interestingly, $g$ may be relatively “overconsumed” although the federal tax base is relatively less elastic, $\epsilon < T\eta < 0$. As a counteracting effect to the less elastic tax base, the federal government recognizes the reduced local public consumption level when federal taxes rises - see Eq. (10). To the extent that the “seeing-through” effect is sufficiently strong, we find $\frac{U_G}{U_g} > 1$. To gauge on the empirical plausibility of the condition, we compute the share of the federal statutory tax in the sum of the local and the federal statutory tax $\frac{T}{T+t}$ for Germany. The statutory federal corporate tax rate is 15.825% and the statutory local business tax is approx. 16% as of 2009. Hence, $\frac{T}{T+t} \approx 0.5$. Provided the local tax base elasticity is not more than twice as large as federal tax base elasticity, $g$ is overprovided relative to $G$.

We now turn to the effect of $\alpha$ and $\beta$ on $\frac{U_G}{U_g}$. Comparing Eq. (8), evaluated at $\alpha, \beta > 0$ and $\theta = 0$, and Eq. (10), we get

**Proposition 4** Assume $\theta = 0$ and $\alpha, \beta > 0$. The equalization rate and revenue-sharing rate reinforce the tendency that local public goods are overprovided relative to the federal public good. In particular, $\frac{U_G}{U_g} > 1$ iff $1 > T\eta/\epsilon > (1 - \alpha - \beta) \frac{T}{T+t}$.

Intuitively, a higher $\beta$ lowers the SMCPF - see Eq. (8). Hence, local spending $g$ will become more pronounced relative to federal spending $G$. Similarly, the revenue-sharing rate $\alpha$ insulates the local budget from capital mobility; strengthening local taxing incentives. Consequentially, both fiscal arrangements skew the structure of fiscal spending towards local spending.

Finally, we consider the effect of $\theta$ on relative taxing incentives for $\alpha = \beta = 0$. Denoting $\omega$ as the elasticity of the effective capital tax rate with respect to the federal tax rate, i.e. $\omega := \frac{d(T+(1-\theta)T)}{dT} \frac{T}{T+(1-\theta)T} > 0$, Eqs. (8) and (10) imply

\[ \frac{U_G}{U_g} = \frac{1+(1-\alpha-\beta)\theta - (1-\alpha)\eta}{1+(1-\alpha)\eta} \] for $\theta = 0$. Hence, $\alpha \eta$ drops out when determining $\text{sign}(U_G/U_g - 1)$.

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15The extent to which $\alpha$ influences the impact of capital mobility on the FMCPF is not decisive for $\text{sign}(U_G/U_g - 1)$. Note, following Eqs. (8) and (10) $\frac{U_G}{U_g} = \frac{1+(1-\alpha-\beta)\theta - (1-\alpha)\eta}{1+(1-\alpha)\eta}$ for $\theta = 0$. Hence, $\alpha \eta$ drops out when determining $\text{sign}(U_G/U_g - 1)$. 
Proposition 5 Assume \( \alpha = \beta = 0 \) and \( \theta > 0 \). Local public goods are overprovided relative to the federal public good iff \( \omega \left( 1 / \text{SMCPF} - 1 \right) > T \eta \).

Not surprisingly, given the underprovision of \( G \) (see Proposition 2) the condition is satisfied when \( g \) is overprovided (SMCPF < 1). The more interesting case arises when \( g \) is underprovided (SMCPF > 1). The elasticity of the effective capital tax rate \( \omega \) captures the various impacts the deductibility rate \( \theta \) has on relative tax setting. First, \( \theta \) lowers the cost of local taxation, however at the same time reduces fiscal revenues at the federal level - see the second term in the numerator and denominator of the FMCPF (11). Since FMCPF > 1 in equilibrium (see Proposition 2), the positive effect on the FMCPF dominates. The effect can be represented by the term \( 1 - t \theta \frac{dT}{dT} \) which is the derivative of the effective tax rate on capital \( T + (1 - \tau \theta)t \) with respect to \( T \). Next, the impact of federal capital mobility on tax policy can be summarized by \( (T + (1 - \tau \theta)t) \eta \) which is the sum of the effect of capital mobility on local choices, as measured by \( t \eta \), and the federal budget’s exposure to capital mobility \( (T - \tau \theta t) \eta \). The effective capital tax rate \( T + (1 - \tau \theta)t \) thus serves as a proxy for this effect. This effect becomes smaller the higher \( \theta \). If the increase in the effective tax rate following a rise in \( T \) is not too large relative to the initially prevailing effective capital tax rate (in the sense that the elasticity \( \omega \) is sufficiently small), \( g \) will be overprovided relative to \( G \).

5 Extensions

In the subsequent analysis we will modify the model in three respects. We first consider a federal government which moves prior to the local governments, analyze then the optimal design of fiscal institutions, and finally consider Leviathan-type governments.

\[ \frac{dG}{dT} = \frac{(1 - \tau \theta) T + 1 + \eta - t \eta}{1 - \tau \theta T + \tau (\tau \theta - \tau \theta) \eta}. \]

The way federal capital mobility affects the spending structure can be characterized by \( (T + (1 - \tau \theta)t) \eta \).
5.1 Federal Government as a First-Mover

If the federal government acts as a Stackelberg leader towards local governments the sequence of decisions is:

(i) At a first stage, each federal government chooses its tax rate for given tax rates of governments other than local governments under its jurisdiction. Federal governments anticipate the tax rate choice of local governments of the same federation and how capital demand reacts to tax rate changes.

(ii) At a second stage, each local government chooses its tax rate for given tax rates of other governments. Local governments anticipate how capital demand reacts to tax rate changes.

(iii) At a third stage, firms optimize profits given federal and local tax rates.

Local governments continue to select \( t \) according to the provision rule (8). Let \( t^*(\tau) \) denote the local tax rate in a symmetric stage-2 equilibrium. At stage 1, the upper level realizes that it can strategically influence tax rate choices of member regions through their best-response \( t^*(\tau) \). Invoking the envelope theorem, and imposing symmetry, the first-order condition for \( \tau \) reads

\[
V^i_\tau + \sum_{j \neq i} V^j_{i\tau} t_{\tau} = 0.
\]

It differs from the optimality condition under Nash-behavior \( (V^i_\tau = 0) \) by the second term, reflecting strategic tax incentives. The term \( V^j_{i\tau} \) captures the effects of local tax setting on other regions within the federation. The effect is external to the tax-raising local government. For instance, if local taxes are too high from the perspective of the federal government, a local tax rise causes utility in other regions of the federation to drop, i.e. \( V^j_{i\tau} < 0 \).\(^{17}\) Now, if \( t \) and \( \tau \) are strategic substitutes (complements), the federal government finds it optimal to increase (decrease) the federal tax so as to alleviate the too pronounced local taxing incentives. Using the terminology by Keen and

\(^{17}\) It would be a tedious exercise to disentangle the different countervailing fiscal externalities which exist in the economy. A complete list of fiscal externalities is available upon request.
Kotsogiannis (2002), there is “overtaxation” (“undertaxation”) at the federal level.18

The way the federal tax influences local taxes is endogenous and, in particular, is influenced by intergovernmental fiscal arrangements. Differentiating the local first-order condition (7) w.r.t. the federal and local tax rates, imposing symmetry, and rearranging yields

\[
\frac{dt(\tau)}{d\tau} = -\frac{1}{\Delta} \left[ U_c,\theta - U_g (1 - \alpha - \beta) \epsilon_{\tau} + U_{gg} ((1 - \alpha - \beta) t_{k,\tau} ) (1 + (1 - \alpha - \beta) \epsilon) \right],
\]

where \( \Delta < 0 \) is the second-order condition of the local tax rate choice. In general, the way federal taxes affect local taxes is multi-faceted; being positive or negative in sign. Despite the ambiguity, fiscal arrangements impact on the “top-down” tax interaction is some systematic way. To see this, note that in absence of fiscal arrangements only the two last terms in brackets shape the sign of tax interaction. These terms become less important the higher \( \alpha + \beta \) and vanish completely if \( \alpha + \beta = 1 \). In this case federal and local taxes are disconnected without federal deductibility of locally paid taxes. As depicted by the first term in brackets, the tax deductibility provision positively influences “top-down” tax interaction and, when \( \alpha + \beta \) are sufficiently high, it will likely induce strategic complementarity between federal and local tax choices, i.e. \( \frac{dt(\tau)}{d\tau} > 0 \). Thus,

**Proposition 6** For sufficiently pronounced intergovernmental ties \( (\alpha + \beta \rightarrow 1, \theta > 0) \) a rise in the federal tax implies a rise in local taxes. In this case, a first-moving federal government will generically reduce the federal tax below its Nash-level in order to reduce local capital taxes.

If fiscal ties are sufficiently pronounced, the SMCPF will be close to unity and the federal government views local taxes to be too high. In response, it will generically decrease the federal tax rate below the level it finds optimal in the absence of a pre-commitment capacity; a tendency which reduces federal service provision relative to the Nash outcome. Finally, note that a federal Stackelberg leadership may not improve efficiency over all decision margins. When local public

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18The terminology “overtaxation” (“undertaxation”) refers to a level of federal taxes which are higher (or lower) relative to those which are optimal when maximizing welfare for given local taxes; see Keen and Kotsogiannis (2002). Welfare consequently rises following an isolated change in \( \tau \). Specifically, with overtaxation \( (V^i_j, t^l_j > 0) \) we have \( V^i_j < 0 \). Keeping local taxes (including those of the other federation) constant, a lower federal tax improves welfare.
good provision was efficient initially (due to the existence of fiscal ties), the deviation from Nash tax rates impairs efficiency in local public finance.

5.2 Optimal Fiscal Institutions

In this section we ask the question of how the fiscal parameters $\alpha$, $\beta$, and $\theta$ need to be chosen in order to implement the first-best allocation characterized by the Samuelson conditions (6). We characterize the optimal choice of parameters by first assuming that the SMCPF equals unity and solve for the deductibility parameter $\theta$ which gives a FMCPF equal to unity. Given the optimal parameter $\theta$ we solve for the revenue-sharing and equalization rate which yields SMCPF = 1.

Following Eq. (11), the deductibility rate which yields FMCPF = 1 when assuming SMCPF = 1 is

$$\theta = \frac{\tau r + t}{\tau t} > 1. \quad (12)$$

The optimal deductibility rate is positive. It must be sufficiently positive so as to align the “seeing-through” term in (11) to the marginal effect of capital mobility on the federal budget, i.e. $-(1 - \alpha)t\eta = (\tau (r - t\theta) + \alpha t) \eta$ which guarantees FMCPF = 1.\textsuperscript{19} Inserting (12) into the effective federal tax on capital $\tau (r - t\theta)$ shows that the revenues the federal government collects from taxing capital become negative; contrary to what we assumed so far - see assumption (A).

Turning to the SMCPF, Eqs. (8) and (12) give

$$\alpha + \beta = 1 + \frac{\theta t}{c} < 1. \quad (13)$$

In order to neutralize the too pronounced local taxing incentives due to the generous deductibility rate (12) the local governments’ budget must be partially exposed to capital mobility at the margin. For instance, with a full equalization of fiscal capacities ($\beta = 1$) the required revenue-sharing rate is $\alpha = \frac{\theta t}{c} < 0$, i.e. the local level receives a federal subsidy on locally-collected capital

\textsuperscript{19}Note, in this case the term $-t\theta \frac{\partial}{\partial \tau}$ in Eq. (11) is immaterial for federal taxing incentives.
tax revenues. Irrespective of the combination of $\alpha$ and $\beta$ chosen so as to satisfy condition (13) the allocation of expenditures across levels of government will generically not allow an implementation of the first-best allocation. For instance, for $\beta = 1$ conditions (12) and (13) imply that federal total revenues are negative. Hence, the first-best allocation can only be decentralized with appropriately chosen lump-sum transfers.\textsuperscript{20}

**Proposition 7** The first-best allocation (6) can be decentralized (i) when $\theta > 1$ and $\alpha + \beta < 1$ (according to (12) and (13)) and (ii) when a system of intergovernmental lump-sum transfers is available.

We close this subsection by relating the result more firmly to the literature. First, the local budgets are not fully insulated from capital mobility, although capital is in fixed supply in the economy. The finding differs from the optimal choice of fiscal institutions when only local government incentives are concerned. As shown by Koethenbuerger (2002) and Bucovetsky and Smart (2006), local governments should be fully insulated from capital mobility at the margin provided capital is in fixed supply in the economy. The finding is reproduced here in the absence of a federal layer ($\alpha = \theta = 0$) in which case the optimal choice of the equalization rate is $\beta = 1$. However, the interplay of local and federal taxing incentives require a deviation from the well-established result (as exemplified above). Second, Dahlby et al. (2000) and Hatfield (2007) characterize the optimal deductibility rate in the absence of capital mobility. Therein, the rationale for a federal deductibility of local taxes is to correct for the effects of local decisions on the federal budget which are external to local governments. Here, it is primarily needed to correct for the inefficiency in federal public good provision due to capital mobility and, thereby, the fiscal externality federal policy imposes on residents outside the federation. Note, in order to align the FMCPF (11) to the social cost of public good provision ($= 1$) the revenue-sharing rate $\alpha$ is ineffective. It is left to adjustments in the deductibility rate $\theta$ to ensure efficiency in federal decision-making.

\textsuperscript{20}In Bucovetsky and Smart (2006) lump-sum transfers are generically needed to implement the desired allocation when regions are asymmetric. Here, regions are symmetric and the need originates from a vertical imbalance of revenues.
5.3 Leviathan Governments

In Section 4 we have assumed that governments are benevolent. An alternative view of government motivation is that politicians seek to maximize tax revenues. Capital tax competition is a boon in the presence of Leviathan governments. The magnified tax base elasticity effectively constrains the Leviathan in expropriating constituents (Brennan and Buchanan, 1980). In such an environment intergovernmental fiscal programs are argued to be opposed on the grounds that they implicitly establish a cartel among competing Leviathans, undermining the boon of decentralized taxation. In the following we analyze whether the “cartelization hypothesis” applies to taxing incentives at both levels of government.

Differentiating Eq. (4) w.r.t. the local tax rate $t$ and evaluating terms in symmetric equilibrium, a local Leviathan government chooses a tax rate satisfying

$$(1 - \alpha - \beta) \epsilon = -1,$$

where the first-order condition has been simplified using $\tau = t$.\(^{21}\) In the absence of fiscal arrangements ($\alpha = \beta \equiv 0$) the local government operates at the peak of the locally-perceived Laffer curve, $\epsilon = -1$. Revenue-sharing and fiscal equalization limit the local budget’s exposure to capital mobility. The consequence is that taxing incentives are strengthened the higher $\alpha$ and $\beta$. Hence, the two fiscal arrangements undermine the bane of tax competition at the local level - a finding which is line with the Brennan-Buchanan “cartelization hypothesis”.

Using Eq. (5) and rewriting the federal tax as a unit tax, i.e. $T = \tau r$, the first-order condition for a federal Leviathan government, evaluated in a symmetric equilibrium, is

$$\left(1 - t\theta \frac{d\tau}{dT}\right) + (T - \tau t\theta + \alpha t) \eta = 0.$$  \hspace{1cm} (14)

\(^{21}\)Different to a benevolent government, the federal deductibility rate does not enter the first-order condition. As with benevolent governments, the rate lowers the constituents’ cost of local taxation. However, the effect does not enter the cost-benefit calculus of Leviathan governments.
In the absence of intergovernmental fiscal arrangements the first-order condition becomes $T\eta = -1$. The federal government takes the economy to the peak of the federally-perceived revenue hill. For ease of exposition we subsequently analyze the impact of the fiscal parameters $\alpha$ and $\theta$ on federal taxing incentives separately. Rearranging Eq. (14) for $\alpha \equiv 0$ and $\theta > 0$, we find

$$T\eta = -\frac{T - Tt\theta \frac{d\tau}{dT}}{T - \tau t\theta} > -1. \quad (15)$$

The deductibility provision has two counteracting effects on federal taxing incentives. It reduces federal tax revenues by $t\theta \frac{d\tau}{dT}$ per unit of capital, while limiting the exposure of the federal Leviathan to capital mobility at a rate $\tau t\theta$. Since the former effect dominates, the deductibility scheme provides less of an incentive to fiscally expropriate constituents.\(^{22}\)

When $\theta \equiv 0$ and $\alpha > 0$ Eq. (14) yields

$$T\eta = -\left(1 + \alpha \frac{t}{T}\right)^{-1} > -1. \quad (16)$$

As becomes evident from (16), the revenue-sharing system exposes the federal budget to more capital mobility which undermines federal taxing incentives. Contrary to the conjecture by Brennan and Buchanan, collusive tax setting does not extend to federal tax policy. Hence, we can summarize:

**Proposition 8** With Leviathan-type governments, fiscal arrangements strengthen local taxing incentives, while weakening federal taxing incentives.

The revenue-sharing system exerts counteracting effects on local and federal taxing incentives, while the deductibility rate lowers federal taxing incentives and has no first-order impact on the local tax choices. From that perspective constituents may well favor the deductibility provision over the revenue-sharing system as a safeguard against fiscal expropriation.

\(^{22}\)Concretely, following Eq. (15) the federal tax base elasticity exceeds $-1$ if and only if $Tt\theta \frac{d\tau}{dT} - \tau t\theta > 0$. Noting $\frac{d\tau}{dT} = \frac{r - T\tau}{r^2}$ and inserting $\tau = \frac{T}{r}$ we find $Tt\theta \frac{d\tau}{dT} - \tau t\theta = -r_T \frac{T}{r}$. Since $r_T < 0$ the difference is positive.
Related to our finding, Keen and Kotsogiannis (2003) point to the welfare-enhancing role of a revenue-sharing mechanism. Therein, tax coordination may benefit both levels of government (as well as constituents) provided a transfer system is available which ex-post distributes tax revenues among governments appropriately. The transfer system is not explicitly modelled. Here, taxes are still set non-cooperatively and the revenue-sharing system is explicitly modelled. The latter feature allows us to analyze the tax-price effect inherent to such an institutionalized arrangement and its effect on taxing incentives. As shown above, Leviathan governments will generically have non-aligned interests as to the existence of such an institutionalized arrangement. Whether constituents wish to constitutionally anchor a sharing system depends on whether the local or the federal effect on the effective capital tax rate dominates - an issue which we do not formalize here.23

6 Conclusion

The effect of intergovernmental budgetary ties on federal taxing incentives has not received too much attention in the literature. In this paper we analyze how fiscal arrangements inherent in federal systems such as revenue-sharing, fiscal equalization, and intergovernmental tax deductibility influence federal policy. While fiscal ties give rise to overly pronounced local taxing incentives in tax competition (with the consequence of a local overprovision of public goods), federal public goods will be underprovided in their presence. Fiscal federalism might well upwardly distort the federal cost of taxation and thereby add to the federal government’s reluctance to tax mobile capital at source. As to the structure of public spending, when budgetary linkages become fiscally more important, the structure of public spending will be skewed toward local spending. In fact, the local public services might be overprovided relative to the federal service. Further, we show that the optimal design of fiscal institutions entails that, e.g., local budgets are only partially insulated from capital mobility although capital is in fixed supply.

In the paper we have primarily analyzed how fiscal arrangements affect the marginal cost of

23In principle, such an analysis can be performed along the lines suggested in Keen and Kotsogiannis (2003).
public funds and, hence, the public good provision rule at both levels of government. In particular, we have characterized how federal (local) taxes are influenced by fiscal institutions for a given level of local (federal) taxes. Accounting for vertical tax interaction would allow us to pursue an analysis of how tax levels are affected in equilibrium. In general, the characterization of equilibrium tax levels is analytically involved, in particular in the type of model considered here.\footnote{One way to reduce the complexity of models of fiscal federalism is to consider Leviathan-type governments in the absence of explicit fiscal arrangements. See, e.g., Wrede (1996) and Keen and Kotsogiannis (2003) for a characterization of tax levels in such a framework.} Albeit being interesting we leave the issue to future research.

Finally, the finding might be helpful in understanding recent changes in the German federal corporate tax rate and the municipal business tax rate, where the former dropped sharply to a level of about 15\% as of 2009, while the latter increased to an average level of 16\% at a time when the revenue-sharing programme gradually expanded (Der Landkreis, 2003, and Koethenbuerger, 2005). The paper’s findings suggest that the increase in the revenue-sharing rate has increased municipal taxes, while the federal budget has been further exposed to capital mobility. Federal taxing incentives may thus have been undermined. Undoubtedly, the gradual expansion of the revenue-sharing system will no exclusively account for the convergence of tax rates, but may well have contributed to it.

References


