Cities in Fiscal Equalization

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Abstract: Redistributive grants schemes, such as revenue sharing and fiscal equalization, are a common characteristic of local finances in several countries. Fiscal redistribution, however, conflicts with the spatial structure of the economy if tax revenue is systematically higher in agglomerations. In countries with local fiscal equalization, such as Austria, Germany, and Spain, the grant schemes exhibit a preferential treatment of cities. The paper provides a theoretical analysis showing that this preferential treatment might be explained by efficiency considerations. More specifically, we show that an efficient grant scheme allows large cities to provide more public services than small towns. In a setting with local capital taxation an efficient grant scheme would also tend to favor cities by lowering the degree to which own revenues will be accounted for in the grant scheme.

Keywords: Revenue Sharing; Fiscal Equalization; Agglomeration; Tax Competition; Municipal Finance

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1 Introduction

As the local public sector operates under constraints of mobility and fiscal competition local governments in several countries engage in revenue sharing which tends to reduce the marginal cost of public funds and provides some insurance against revenue shocks. A common approach to revenue sharing, referred to as fiscal equalization, uses an indicator of the fiscal capacity of jurisdictions – a measure of tax revenue at standardized tax rates – and compares it to fiscal need, which is, basically, a conceded per-capita level of spending multiplied by the number of residents. If its capacity falls short of the fiscal need the jurisdiction is a recipient of grants such that grants partly compensate for the gap between fiscal need and fiscal capacity. If a jurisdiction displays a fiscal capacity above fiscal need, however, it will not receive equalization grants, and in some settings, it may even be a net contributor to the fiscal equalization system. Fiscal equalization in this fashion often entails a quite significant redistribution of funds.

The redistributive nature of fiscal equalization gives rise to various distortions and incentive effects which call for an appropriate design of equalization schemes. One of the problems usually encountered is related to the spatial structure of the economy. In general, jurisdictions strongly and systematically differ in size and productivity. The most striking implication is that they typically show a rather skewed distribution in terms of population size and density. Often, this goes along with a skewed distribution in terms of tax revenue both in absolute value and on a per-capita basis such that tax revenue is dis-proportionally higher in large cities as compared to small municipalities. Hence, fiscal equalization tends to systematically redistribute from large cities to small and, perhaps, peripheral jurisdictions. This could potentially have important consequences for the spatial structure of the economy. However, in practice, municipal fiscal equalization systems often treat cities differently in the sense that cities are allowed to retain more of their own revenues since their fiscal need is assumed to be higher; or, if own funds are small, cities
receive more funds than small municipalities.\footnote{A common approach in countries such as Austria, Germany, and Spain is to base the distribution of funds on fictitious or weighted rather than actual population numbers. Formally, fiscal need $fn_i$ is defined as

$$fn_i = z \times n_i \times w_i,$$

where $z$ is the basic figure of fiscal need per capita, $n_i$ is the number of inhabitants, and $w_i$ is a weight or factor that is unity for small municipalities but larger than unity for cities depending on population size. For instance, in Austria the weights for municipalities are unity if population is below 10,000 inhabitants and are increasing with population size up to a figure of $2\frac{1}{3}$ for municipalities with more than 50,000 inhabitants. In Spain, the weight is unity for the calculation of the fiscal need of jurisdictions with less than 5,000 inhabitants, the weight of cities with more than 500,000 is 1.85. In Germany, different rules apply across states. For example, the largest state, North-Rhine Westfalia, displays weights that vary between unity for municipalities below 25,000 inhabitants and a figure of 1.57 for cities with more than 634,000 inhabitants.}

Figure 1 gives an impression of the relationship between per-capita tax revenue and population size for the municipalities that receive equalization grants in North Rhine-Westfalia, the largest German state. The actual degree of redistribution implied by this state’s system of fiscal equalization is substantial: a typical jurisdiction would have to transfer more than 80 cents of an additional Dollar of own tax revenue into the system. Given this remarkable degree of redistribution the much higher tax revenue per capita in larger cities would cause a redistribution of funds from cities to small municipalities. However, this is not the case as is documented by Figure 2 which displays the budget size in per-capita terms for the majority of jurisdictions that receive fiscal equalization grants. As can easily be seen, spending per-capita is substantially larger in large cities as compared to small municipalities. This is mainly the consequence of the provisions in the equalization system mentioned above which allow for a larger fiscal need of cities.

Cities in North-Rhine Westfalia, as well as in most other German states, also benefit from another preferential treatment that is related to the fiscal capacity dependent component of the fiscal equalization system. This is depicted in Figure 3 which displays the marginal degree of redistribution with regard to tax revenue. As can be seen, while still substantial
Figure 1: Municipal Tax Revenue in North Rhine-Westfalia (2005)

2005 figures, € per capita, own calculations. Sample consists of municipalities that receive equalization grants.
Figure 2: Municipal Budget in North Rhine-Westfalia

€ per capita, 2005 figures, own calculations. Sample consists of municipalities that receive equalization grants.
Figure 3: Marginal Degree of Redistribution in North Rhine-Westfalia

Implicit marginal contribution out of an additional € of tax revenue.
the degree of redistribution is significantly lower for larger municipalities.

Not surprisingly, the apparent inconsistency of a heavily redistributive equalization mechanism which, however, systematically favors cities has triggered critical discussion both in the political sphere and in the public finance literature (e.g., Boes, 1970, Peffekoven, 1987, Homburg, 1994). The traditional justification for the special treatment of large jurisdictions in the German case goes back to Johannes Popitz (1932) and Arnold Brecht (1932) who observed that public spending per-capita rises with population size and density and argued that this points at an increase in fiscal need even in per-capita terms. However, although this stance has been highly influential in German public finance and apparently has motivated the design of fiscal equalization schemes in Germany and other countries, the theoretical grounds have not been explored thoroughly and the empirical evidence presented is controversial (e.g., Kuhn, 1983, Buettner, Schwager, Stegarecu, 2004). Moreover, theoretical discussion shows that subsidizing cost differentials may induce excess agglomeration, hence incurring welfare losses (Fenge and Meier, 2002).

The contribution of the current paper is to close the gap between theory and institutional practice. In a first step, we analyze the role of city size differences for the supply of public services in a setting with an efficient set of tax instruments. While in most countries local governments do not have access to a complete set of tax instruments, the efficient case serves as a benchmark that is useful in order to discuss the allocation of funds across municipalities. In a second step, we focus on the role of intergovernmental revenue in a setting with inefficient tax instruments. Here the analysis builds on the literature on tax competition and fiscal equalization (e.g., Koethenbuerger, 2002, and Bucovetsky and Smart, 2006). Taking account of differences in productivity as the underlying force driving interregional size differences our results support a preferential treatment of larger jurisdictions with regard to both the lump-sum and the fiscal capacity-dependent component of a typical equalization scheme.
The paper is organized as follows. The next section discusses the implications of city size differences for an efficient allocation with public and private goods. Section 3 then is concerned with the role of equalization transfers in a setting with a distortive capital tax. Section 4 provides conclusions.

2 City Size and Public Goods Provision

Consider an economy with \( N \) regions, \( i = 1, 2, ..., N \). Each region employs \( K_i \) units of mobile capital, hosts \( n_i \) households, and has an endowment of land \( T_i \). Capital and labor are employed by local firms according to a production function \( F_i(n_i, K_i) \). Production takes place in a central business district. Households inelastically supply one unit of labor to local production at a competitively determined wage and have a stock of savings of \( s_i \). Households derive utility from the consumption of a private \((x_i)\), a public good \((z_i)\), and of housing space \((q_i)\).

\[
u_i = \tilde{u}(x_i, z_i, q_i).
\]

To keep the analysis simple let us assume that each household consumes the same amount of housing \( q_i = 1 \) and we can simplify the utility function

\[
u_i = u(x_i, z_i) = \tilde{u}(x_i, z_i, 1).
\]

Consider a household located at the urban fringe which is in distance \( b \) to the city center. This household has commuting cost of \( kb \) and direct housing cost corresponding to the opportunity cost of land \( \rho \). Since differences in the direct costs of housing within the city would only capture differences in the commuting cost, we know that the costs of housing, \textit{i.e.} direct housing cost plus commuting cost, are constant across the city. However, the costs of housing vary across cities if the population size differs. To see this, consider the case of a monocentric city. If all households commute to a central business district we have
the following equilibrium condition for the housing market:

\[ n_i = \int_0^{b_i} T_i(\delta) \, d\delta, \]

where \( T_i(\delta) \) captures the available housing space at distance \( \delta \) from the city center.\(^3\) Hence, the distance from the urban fringe to the city center is an increasing function of the total population size \( b_i = b(n_i) \). As a consequence, the costs of housing in the city are

\[ h_i \equiv h(n_i) = \rho + kb(n_i), \]

which is increasing in population size.

2.1 Efficient Provision of Local Public Goods

The public good is provided at cost \( C_i(n_i, z_i) \). With regard to financing the provision of local public services, let us start with the assumption that there is a fully efficient set of tax instruments. Hence, we do not distinguish between the public and the private budget. In this setting, the private households’ budget constraint is

\[ F_i(n_i, K_i) - \iota K_i + \iota s_i n_i - (x_i + h(n_i)) n_i - C_i(n_i, z_i), \]

where \( \iota \) is the common return to savings, and \( s_i \) denotes total savings of a resident household.

Consider the choice of jurisdiction \( i \) that aims at maximizing

\[ \mathcal{L}_i = u_i(x_i, z_i) + \mu_i \left[ F_i(n_i, K_i) - \iota K_i + \iota s_i n_i - (x_i + h(n_i)) n_i - C_i(n_i, z_i) \right]. \]

\(^3\)In the simple case of a circular city we have \( T_i(\delta) = 2\pi\delta. \)
The optimality conditions are

\[ \frac{\partial L_i}{\partial x_i} = u_{ix} - \mu_i n_i = 0 \]
\[ \frac{\partial L_i}{\partial z_i} = u_{iz} - \mu_i C_{iz} = 0. \]

This can be arranged to obtain the familiar Samuelson condition

\[ n_i \frac{u_{iz}}{u_{ix}} = C_{iz}, \]

where the marginal cost of public funds are unity. Only the provision of additional public services itself provides some extra cost.

Under conditions of household mobility, however, this policy is not necessarily efficient. From the viewpoint of a central planner an efficient optimal policy would maximize the following Lagrangian

\[ L^{cp} = u_i (x_i, z_i) + \sum_{j \neq i} \nu_j [u_j(z_j, x_j) - u_i(z_i, x_i)] 
+ \mu \sum_{j=1}^{M} [F_j (n_j, K_j) - \iota K_j + \iota s_j n_j - (x_j + h (n_j) n_j) - C_j (n_j, z_j)] 
+ \varphi \left[ N - \sum_{j=1}^{M} n_i \right]. \]

While the first-order conditions (FOC) with respect to public and private consumption are the same as above, we have an additional constraint requiring\(^4\)

\[ \frac{\partial L^{cp}}{\partial n_i} = \mu (F_{in} - x_i - h_i - h_{in} n_i - C_{in}) - \varphi = 0. \]

Because this efficiency condition holds for all jurisdictions, it implies that a reallocation of

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\(^4\)Further requirements for the existence of an efficient equilibrium relate to the second order conditions. In particular, \(\frac{\partial^2 L^{cp}}{\partial n_i^2}\) needs to be negative.
labor cannot increase welfare

\[ F_{in} - x_i - h_i - h_{in} n_i - C_{in} = F_{jn} - x_j - h_j - h_{jn} n_j - C_{jn}, \]

and is, therefore, called the locational efficiency condition (Wildasin, 1980). Accordingly, differences in marginal productivity are fully compensated by the remuneration of the households.

An important issue in local public economics is what kind of tax instruments would allow to ensure that a decentralized equilibrium will actually meet locational efficiency. If a head tax is set equal to the marginal crowding cost \( \tau_{in} = C_{in} + h_{in} n_i \) we see from the private household budget constraint that the locational efficiency condition is fulfilled. At the same time, however, another tax instrument is needed that would help to meet the local government’s budget constraint.

### 2.2 Size Differences

Now suppose, region \( i \) has a higher productivity. As a consequence, \( F_{in} > F_{jn} \). But also the population increases. To see why, consider the locational efficiency condition. If, \( n_i = n_j \), housing cost and the cost of public goods provision are unchanged. Hence, private consumption would have to be higher \( x_i > x_j \). This would, however, imply that the marginal rate of substitution would be higher. In order not to violate the Samuelson condition, \( z_i \) would also have to rise. With more consumption of \( x_i \) and \( z_i \), however, utility would be higher in \( i \) such that the migration equilibrium is disturbed. Hence, the population size in region \( i \) would have to be larger. The optimal allocation of labor would result in higher costs of housing in region \( i \) which ensure that utility is equal across jurisdiction. Thus, we can state the following proposition:
Proposition 1 (Size of Jurisdictions)

*In the migration equilibrium where utility is equal across jurisdictions locations with higher productivity display a larger population size.*

Given some degree of non-rivalry in the consumption of public services, the size of the jurisdiction has implications for the cost or providing public goods. Suppose \( C_{iz} \) is constant in \( z_i \) but is increasing in \( n_i \). If \( z_i \) is not completely rival, \( \frac{C_{iz}}{n_i} \) is declining in the larger jurisdiction. From the Samuelson condition we know that, as a consequence of the productivity effect, the marginal rate of substitution between public and private consumption will also be higher in the jurisdiction with higher productivity. In the locational equilibrium, \( x_i \) would have to be smaller in order to compensate for higher \( z_i \). This effect can be summarized by another proposition:

Proposition 2 (Cost-Advantage of Cities)

*If the per-capita marginal cost of providing public services is decreasing with population size, more productive regions will tend to provide more public services.*

The consequences of productivity differences are illustrated in Figure 2.2. At a given population size, the productivity increase would shift the budget constraint upwards and to the right such that at given \( z_i \) each household would consume more of the private good.

The corresponding increase in utility will result in an inflow of population. If we assume a constant marginal cost of providing public services, \( C_{iz} \) would decline in per-capita terms. A population increase would also result in larger housing cost, and, as a consequence, the budget constraint would shift back down. The budget line also becomes flatter, since the marginal cost of providing public services is increased. Provided the jurisdiction is small relative to the country, this process would come to an end if tangency is obtained with respect to the initial indifference curve.
Figure 4: Comparative Static Effects of Productivity

\[ x_i = \frac{F_n}{n_i} - h(n_i) - \frac{C_i(n_i, z_i)}{n_i} \]
Figure 5: Fixed Cost in the Provision of Public Services

Budget: \( x_i = \frac{E_i}{n_i} - h(n_i) - \frac{c_0}{n_1^{\gamma_0}} - z_i \frac{c_1}{n_1^{\gamma_1}} \)
While our analysis shows that under some relatively weak assumptions the more productive region will provide more public services it is not obvious that public spending is larger in per capita terms. If $z_i$ would stay constant, per-capita cost $\frac{C_i}{n_i}$ would decline. However, $z_i$ is increasing and, hence, per capita cost of public service provision would go up. If $z_i$ is strongly increasing, the latter effect would dominate and the budget might actually be larger even in per-capita terms. In fact, the budget response can be characterized in terms of the Hicksian price elasticity of demand. If demand for public services responds rather strongly to a cost-reduction the per-capita budget will be higher in the more productive jurisdiction.

**Proposition 3 (Budget-Size of Cities)**

*If the Hicksian demand for public services is elastic, the more productive region will show a larger budget size.*

This argument of demand effects might be reinforced in the presence of heterogeneity between households. Consider a case, where two types of households exist, which differ in the preferences for public services. If larger jurisdictions have a cost advantage in public service provision, Tiebout sorting would actually result in a concentration of high public service demand in the city.

The cost advantage of cities has also been noted by Oates (1989) who argues that it can explain why the range of government services provided in a large city is larger. A particularly important issue in this regard is the presence of indivisibilities that give rise to strongly decreasing per-capita cost of providing public services. For small municipalities $\frac{C_i}{n_i}$ might be very large; occasionally, depending on the degree of substitutability between private goods and public services, a jurisdiction will decide not to provide certain types of public services if the costs are particularly high.
Proposition 4 (Indivisibilities and Size of Cities)

In presence of indivisibilities and if the utility function allows for complete substitution the larger jurisdiction is more likely to provide the public service.

To see why, consider the following cost function

\[ C(n_i, z_i) = (c_0 + c_1 z_i) n_i^\gamma. \]

As depicted in Figure 2.2 with this cost function the feasible budget constraint becomes non-convex: it has kink at a level of \( z_i = 0 \). Depending on the curvature of the utility function, it might be optimal to choose not to produce \( z_i \) at all. Note that the length of the vertical portion, as well as the slope of the budget constraint (in absolute terms) are decreasing in population size. For a more realistic setting with different public services, this result implies that certain types of public services are not provided at all in small municipalities.

It might seem to be a rather strong assumption that the indifference curves cut the vertical axis as this implies that public services can be substituted entirely by private goods. However, note that a point at the vertical axis only implies that the own provision of public services is zero. In many cases residents of \( i \) could still benefit from the provision of public services provided by a neighboring jurisdiction. But even without indivisibilities, the cost advantage of cities in the provision of public services might contribute to a larger budget in urban agglomerations where households consume public services from different locations. To see this, consider a set of small jurisdictions \( j \) that are all located close to the large jurisdiction \( i \). If the large jurisdiction supplies public services that residents from regions \( j \) might consume as well, the decision problem for the central planner is

\[ L_i^{ext} = u_i(x_i, z_i) + \sum_{j \neq i} \nu_j [u_j(z_j, x_j, z_i) - u_i(z_i, x_i)]. \]
\[ +\mu \sum_{j=1}^{M} [F_j(n_j, K_j) - n_j (x_j + h(n_j)) - C_j(n_j, z_j)] \]

\[ + \varphi \left[ N - \sum_{j=1}^{M} n_j \right]. \]

The optimality condition for the provision of \( z_i \) is

\[ \frac{\partial L_i^\text{ext}}{\partial z_i} = \left( 1 - \sum_{j \neq i}^{M} \nu_j \right) u_{iz} + \sum_{j \neq i}^{M} \nu_j u_{jzi} - \mu C_{iz} = 0. \]

In this case we obtain the following Samuelson condition

\[ n_i \frac{\left( 1 - \sum_{j=2}^{M} \nu_j \right) u_{iz} + \sum_{j=2}^{M} \nu_j u_{jzi} \left( 1 - \sum_{j=2}^{M} \nu_j \right) u_{ix}}{u_{ix}} = C_{iz}. \]

Obviously, due to the benefit spillovers the marginal benefit from public services rises. This suggests that the budget of the large jurisdiction might be larger, provided a mechanism exists, that ensures that the willingness to pay for public services in jurisdiction \( j \) is resulting in effective transfers and that this money is used for an expansion of public services in jurisdiction \( i \).

### 3 City Size and Taxation of Mobile Capital

The previous section has focused on city size differences in a setting with an efficient set of tax instruments. This efficient case serves as a useful benchmark for the allocation of grants across local municipalities in a case where local revenue is substituted by intergovernmental revenue and may justify why fiscal need is higher in cities. However, we have seen above that fiscal equalization not only distributes funds according to fiscal need. Instead, equalization grants are also related to fiscal capacity. This is particularly important in a setting with
inefficient tax instruments as has been emphasized in the literature on tax competition and fiscal equalization. In order to correct inefficiencies from capital tax competition Wildasin (1989) discusses a Pigouvian subsidy to raise tax effort. More recently, Koethenbuerger (2002) shows that redistributive transfers may replicate the Pigouvian solution suggested by Wildasin (1989). Bucovetsky and Smart (2006) determine the key elements of an efficient fiscal equalization system in a setting with capital tax competition and show that the optimal degree of redistribution is inversely related to the tax rate elasticity of capital supply. Against this background, this section considers whether in the presence of size differences cities should be treated differently also with regard to the incentives provided by the fiscal capacity-dependent component of an equalization scheme.

Assume that in order to finance the provision of local public services, the government is constrained to two sources of funds: a capital tax and grants. This allows us to specify the government budget constraint as

\[ \tau_i K_i + G_i = C_i (n_i, z_i) \]

If we add the above objective function we can determine the supply of public services by maximizing utility subject to the budget constraint. However, whereas the private budget constraint does not contain taxes

\[ x_i n_i + h(n_i) n_i = F_i n_i + s_i n_i, \]

we have to take into account that local taxation of capital will affect labor income, indirectly.

In this setting, the optimal policy of the local government maximizes the following Lan-

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5Note that this setting is restrictive in that it can not be ensured that locational efficiency obtains in general. However, since the ensuing discussion focuses on the distortive effects of capital taxation we henceforth assume efficiency with respect to the households’ location choice.
The first-order conditions (FOC) with respect to public and private consumption are

\[ \frac{\partial L_{i}^{\text{loc}}}{\partial x_i} = u_i x_i - \mu_i n_i = 0 \]

\[ \frac{\partial L_{i}^{\text{loc}}}{\partial z_i} = u_i z_i - \lambda_i C_i z_i = 0. \]

This can be arranged to obtain a modified Samuelson condition

\[ n_i \frac{u_i z_i}{u_i x_i} = C_i z_i \frac{\lambda_i}{\mu_i} \]

where \( \frac{\lambda_i}{\mu_i} \) denotes the marginal cost of public funds.

Of course, the marginal cost of public funds is determined by the capital tax rate which is the government’s instrument for transferring private into public funds. We can derive this cost from the first-order condition with regard to the tax rate. Assuming that capital demand is elastic, the FOC with respect to the tax rate is given by

\[ \frac{\partial L_{i}^{\text{loc}}}{\partial \tau_{iK}} = \lambda_i \left[ K_i + \tau_{ik} \frac{dK_i}{d\tau_{ik}} \right] + \mu_i \left[ F_{inK} \frac{dK_i}{d\tau_{ik}} + s_i n_i \frac{dl}{d\tau_{ik}} \right] = 0. \]

What is required here, is a balance between the shadow value of the additional revenue generated by a tax increase and the shadow value of its adverse impact on income.

In order to evaluate this expression we need some more information about the tax sensitivity
of capital demand. Consider the capital demand equation

$$F_iK = \varphi_i$$

where $\varphi_i \equiv \iota + \tau_iK$ is the pre-tax return on capital employed in jurisdiction $i$. Differentiation yields

$$\frac{dK_i}{d\tau_iK} = \frac{1}{F_{iKK}} \frac{d\varphi_i}{d\tau_iK}.$$ 

Hence, the tax rate effect on capital crucially depends on its impact on the gross rate of return on capital. To derive this impact note that there might be a direct as well as an indirect effect as the net-rate of return changes. Thus, for jurisdiction $i$ we obtain

$$\frac{dK_i}{d\tau_iK} = \frac{1}{F_{iKK}} \left(1 + \frac{d\iota}{d\tau_iK}\right).$$

Noting that $F_{inK} = -K_iF_{iKK}$ we can see that if the capital account is balanced $s_in_i = K_i$ the decrease in private consumption resulting from a tax-rate increase is simply proportional to the tax base

$$F_{inK} \frac{dK_i}{d\tau_iK} + s_in_i \frac{dt}{d\tau_iK} = -K_i,$$

and we can rewrite the marginal cost of public funds as

$$\frac{\lambda_i}{\mu_i} = \frac{K_i}{K_i + \tau_iK \frac{dK_i}{d\tau_iK}}.$$

While the numerator states the loss in private consumption resulting from a tax increase due to the incidence of the capital tax, the denominator depicts the tax increase necessary to get an additional dollar of public funds. Accordingly, the larger the adverse effect of a tax increase on the local tax base the smaller is the denominator and the larger is the marginal cost of public funds.

As has been noted by Wildasin (1989) under conditions of interjurisdictional capital mobility the marginal cost of public funds is larger than in a case of coordinated tax policy.
since part of the decline in the adverse tax-base effect reflects an increase in the tax base of other jurisdictions. Hence, equation (1) may be referred to as the marginal cost of public funds in the non-cooperative case. Following Bucovetsky and Smart (2006) we might consider the optimal policy in a fully cooperative outcome by invoking a federal planner who determines the tax policy in one jurisdiction under the condition that all jurisdictions obtain the same level of utility. This federal planner’s decision problem is given by

\[ L^{fed} = u_1(x_1, z_1) \]

\[ + \lambda \left[ \sum_{i=1}^M \tau_i K_i \right] - \sum_{i=1} C_i (n_i, z_i) \]

\[ + \sum_{i=1}^M \mu_i \left[ F_{in} + \tau_i n_i - n_i x_i - h(n_i) n_i \right] \]

\[ + \sum_{j=2}^M \nu_j [u_j(z_j, x_j) - u_1(z_1, x_1)] . \]

While we assume that the federal planner is able to redistribute public funds across locations we follow Bucovetsky and Smart (2006) and assume that the federal planner cannot redistribute private funds.

As is shown in the Appendix (6.1) under these conditions the social marginal cost of public funds (Wildasin, 1989) is

\[ \frac{\lambda}{\mu_i} = \frac{K_i}{K_i + \tau_i K \frac{dK_i}{dn} + \sum_{j \neq i} \tau_j K \frac{dK_j}{dn}} . \]  

(2)

In comparison to expression (1), the marginal cost is lower as the denominator now includes the positive fiscal externality of a tax increase.

As Bucovetsky and Smart (2006) as well as Koethenbuerger (2002) have suggested, an equalization scheme could reduce the gap between the cost of funds in the non-cooperative case (1) and the social cost of funds (2). In our case, what is needed is simply a redistribu-
tive scheme of grants such that

\[ G_i = Z_i - \vartheta_i K_i \]

where \( G_i \) denotes grants allotted to jurisdiction \( i \) and \( Z_i \) represents the amount of grants the jurisdiction would receive if its tax base were actually zero. The marginal contribution rate \( \vartheta_i \) defines the extent to which an increase in the tax base results in lower grants.

With this fiscal equalization scheme, policy in the decentralized setting would aim to maximize

\[
\mathcal{L}^\text{equal}_i = u_i(x_i, z_i) + \lambda_i [(\tau_i K_i - \vartheta_i) K_i + Z_i - C_i(n_i, z_i)] + \mu_i [F_{in} + s_i n_i - n_i x_i - n_i h(n_i)].
\]

The FOC with respect to the tax rate in this case is given by

\[
\frac{\partial \mathcal{L}^\text{equal}_i}{\partial \tau_i K_i} = \lambda_i [K_i + (\tau_i K_i - \vartheta_i) \frac{\partial K_i}{\partial \tau_i K_i}] + \mu_i [F_{in K} \frac{\partial K_i}{\partial \tau_i K_i} + s_i n_i \frac{\partial l}{\partial \tau_i K_i}] = 0.
\]

Following the above analysis, we make use of \( F_{in K} = -K_i F_{i K K} \) and derive the marginal cost of public funds perceived by jurisdiction \( i \) for the case where \( s_i n_i = K_i \) and obtain

\[
\frac{\lambda_i}{\mu_i} = \frac{K_i}{K_i + (\tau_i K_i - \vartheta_i) \frac{dK_i}{d\tau_i K_i}}.
\]

The efficient equalization scheme consists of an appropriate choice of \( \vartheta_1, \vartheta_2, \ldots, \vartheta_i, \ldots, \vartheta_M \) and \( Z_1, Z_2, \ldots, Z_i, \ldots, Z_M \) such that the perceived cost of public funds is equal to the social cost of public funds and the utility level in each jurisdiction is the same.\(^6\) Comparing equations (2) and (3) we see that the marginal change in grants should be such that it is just equal

\(^6\)Taking into account the federal planner’s decision problem on page 20 this implies that additional lump sum funds might be needed in order to balance the federal budget.
to the additional tax revenue that an increase in $\tau_{iK}$ induces in all other jurisdictions, i.e.

$$\vartheta_i^* = - \sum_{j \neq i} \tau_{jK} \frac{dK_j}{d\tau_{iK}} \frac{dK_i}{d\tau_{iK}}. \quad (4)$$

The numerator captures the fiscal externality, the denominator captures the direct impact on the budget. Using the definition of capital demand we can obtain the following expression for the efficient choice of the contribution rate (see Appendix 6.2):

$$\vartheta_i^* = - \left[ \frac{d\iota}{d\tau_{iK}} \right] \left[ \sum_{j \neq i} \tau_{jK} \left( \frac{K_j}{K_i} \right) \left( \phi_i \epsilon_i \phi_j \epsilon_j \right) \right]. \quad (5)$$

The second term in squared brackets captures the consequence of a cost of capital increase on other jurisdictions’ budgets relative to the effect on the own tax base. The first term however, captures the strength of the impact on other jurisdictions’ cost of capital relative to the impact on the own cost of capital.

Consider the case where the overall capital supply is increasing in the net-rate of return $\iota$ with elasticity $\eta$. As is shown in the Appendix (6.3), in the symmetric case where $\epsilon_i = \epsilon$ and $\tau_{iK} = \tau_{jK}$ the condition for the optimal contribution rate simplifies to

$$\vartheta_i = \frac{\iota}{\epsilon + \eta \frac{\epsilon_i}{K-K_i}}. \quad (6)$$

As Bucovetsky and Smart (2006) note in a slightly different setting, the optimal marginal contribution rate declines with the elasticity of capital supply $\eta$. However, the model has another interesting implication regarding the optimal contribution rate under conditions of size differences of the jurisdictions:

**Proposition 5 (Efficient Redistribution and Size Differences)**

*With local taxation of capital an efficient fiscal equalization scheme appropriates a smaller fraction of tax revenues in large jurisdictions and a larger fraction in small jurisdictions.*
To see this, consider the denominator in (6). If jurisdiction $i$ is small, $\frac{K}{K-K_i}$ which is the inverse of the capital share of other jurisdictions, is close to unity. But, if jurisdiction $i$ is large this term increases as the capital share of other jurisdictions declines, and, hence, the denominator increases. As a consequence, $\vartheta_i$ declines.

The intuition of this effect is simply that the effect on the tax-base of a jurisdiction with a large capital market share is to a larger extent determined by the aggregate capital supply elasticity and to a lesser extent related to interjurisdictional mobility. Hence, there is less need to provide an incentive for higher tax rates for large jurisdictions. This is related to the theory of asymmetric tax competition (Bucovetsky, 1991, and Wilson, 1991), where it is shown that with reasonable assumptions the smaller jurisdictions will act more competitively and set lower tax rates.

## 4 Conclusions

This paper has addressed the issue of how a system of fiscal redistribution or equalization should deal with size differences between jurisdictions from an efficiency perspective. If jurisdictions with a larger population tend to show a higher tax-revenue capacity fiscal equalization would result in the redistribution of revenue from large cities to small and, perhaps, peripheral jurisdictions. This potentially has important consequences for the spatial structure of the economy. Existing equalization systems in several countries, however, feature special provisions that favor cities. This is most strikingly illustrated by the practice of municipal fiscal equalization in Austria, Germany, and Spain where funds are distributed based on population numbers that are inflated for larger municipalities and cities.

Using the example of the largest German state we illustrate that the preferential treatment
has important effects: despite a substantial degree of redistribution, cities maintain larger budgets than small municipalities in per capita terms. Furthermore, the degree of redistribution captured by the implicit marginal contribution rate to the equalization systems tends to be lower in cities.

The contribution of this paper is to show that the preferential treatment of cities in systems of fiscal equalization can be justified and, possibly, be explained by efficiency considerations. For this purpose we set up a model where mobile residents consume a public good, a private good, and housing, and where jurisdictions differ in productivity. These productivity differences give rise to size differences in terms of population. We show that large jurisdictions have a cost advantage in public goods provision. This implies that an efficient distribution of funds would allow cities to expand public relative to private consumption. If the demand elasticity for public services is large or in the presence of indivisibilities in the provision of public services, we show, that the larger supply of public services in cities would result in a larger budget even in per-capita terms. This supports the practice of fiscal equalization in several countries where cities are assumed to have a larger fiscal need per-capita.

In a setting with inefficient tax instruments, we show that additional considerations justify a different treatment of cities in accounting for taxing capacity. Following Bucovetsky and Smart (2006) we assume that local governments use a capital tax and equalization grants in order to finance the provision of local public services. The capital tax is assumed to be distortive even if revenue-sharing induces a tax policy that is consistent with the fully co-operative solution. In this setting, it is shown that the system would tend to treat jurisdictions differently: grants would be less responsive to the tax base in jurisdictions that are hosting a relatively large share of the total tax base. This prediction is also supported the practice of fiscal equalization at least in the German system.

Our analysis opens up a new perspective on the special treatment of cities in systems of
local fiscal equalization. While there is a general presumption that the favorable treatment of cities entails a potentially inefficient subsidy (Fenge and Meier, 2002), our results suggest that an assessment of the special treatment of cities might come to a different conclusion if the redistributive nature of fiscal equalization and the resulting incentive effects are taken into account.

5 Appendix

5.1 Taxation in a Co-operative Setting

The federal planner’s choice is to maximize the Lagrangian

\[ L_{fed}^f = u_1(x_1, z_1) \]

+ \lambda \left[ \sum_{i=1}^{M} \tau_i K_i - \sum_{i=1}^{M} C_i(n_i, z_i) \right]

+ \sum_{i=1}^{M} \mu_i \left[ n_i y_i + s_i n_i - x_i n_i - h(n_i)n_i \right]

+ \sum_{j=2}^{M} \nu_j \left[ u_j(z_j, x_j) - u_1(z_1, x_1) \right]

by choosing the tax rate.

The first-order conditions with regard to the choice of public and private consumption are

\[ \frac{\partial L_{fed}^f}{\partial z_1} = \left( 1 - \sum_{j=2}^{M} \nu_j \right) u_{1z} - \lambda C_{1z} = 0 \]

\[ \frac{\partial L_{fed}^f}{\partial z_i} = \nu_i u_{iz} - \lambda C_{iz} = 0 \quad i = 2, \ldots, M. \]
\[ \frac{\partial L^{fed}}{\partial x_1} = \left( 1 - \sum_{j=2}^{\nu} \right) u_{1x} - \mu_1 n_1 = 0 \]
\[ \frac{\partial L^{fed}}{\partial x_i} = \nu_i u_{ix} - \mu_i n_i = 0 \quad i = 2, \ldots, M. \]

The FOC with respect to the tax rate is
\[ \frac{\partial L^{fed}}{\partial \tau_{iK}} = \lambda \left[ K_i + \tau_{iK} dK_i d\tau_{iK} \right] + \mu_i \left[ F_{iK} \frac{dK_i}{d\tau_{iK}} + S_i \frac{du}{d\tau_{iK}} \right] + \sum_{j \neq i} \lambda \tau_{jK} dK_j d\tau_{iK} + \mu_j \left[ F_{jnK} \frac{dK_j}{d\tau_{iK}} + S_j \frac{du}{d\tau_{iK}} \right] = 0. \]

Noting that \( F_{iK} = -K_i F_{iKK} \) we can rewrite this condition to obtain the social marginal cost of public funds
\[ \frac{\lambda}{\mu_i} = \frac{K_i + (K_i - S_i) \frac{du}{d\tau_{iK}} + \sum_{j \neq i} \frac{\mu_j}{\mu_i} (K_j - S_j) \frac{du}{d\tau_{iK}}}{K_i + \tau_{iK} \frac{dK_i}{d\tau_{iK}} + \sum_{j \neq i} \tau_{jK} \frac{dK_j}{d\tau_{iK}}}. \] (7)

In order to facilitate the interpretation of this expression we consider the case where all jurisdictions have a balanced capital account, such that \( K_j = s_j n_j \). In this case
\[ \frac{\lambda}{\mu_i} = \frac{K_i}{K_i + \tau_{iK} \frac{dK_i}{d\tau_{iK}} + \sum_{j \neq i} \tau_{jK} \frac{dK_j}{d\tau_{iK}}}. \] (8)

### 5.2 Derivation of Equation (5)

Let us rewrite expression 4 in terms of the elasticity of capital demand
\[ \phi_i = -\frac{\sum_{j \neq i} \tau_{jK} K_j \left( \frac{d \log K_i}{d \log \tau_{iK}} \right)}{K_i \left( \frac{d \log K_i}{d \log \tau_{iK}} \right)}. \]
From our analysis of the capital demand we know

\[
\frac{d \log K_i}{d \log \tau_iK} = -\frac{\tau_iK}{\varphi_i \epsilon_i} \left( 1 + \frac{dt}{d\tau_iK} \right)
\]

\[
\frac{d \log K_j}{d \log \tau_iK} = -\frac{\tau_iK}{\varphi_j \epsilon_j} \left( \frac{dt}{d\tau_iK} \right)
\]

This allows us to describe the efficient choice of \( \vartheta_i \) with

\[
\vartheta_i = -\sum_{j \neq i} \tau_j K \left[ \left( \frac{K_j}{K_i} \right) \left( \frac{\varphi_i \epsilon_i}{\varphi_j \epsilon_j} \right) \right] \left[ \frac{dt}{d\tau_iK} \right] \left( 1 + \frac{dt}{d\tau_iK} \right).
\]

### 5.3 Derivation of Equation (6)

Consider a symmetric case where \( \tau_iK = \tau_jK \), let the production elasticity of capital be equal across jurisdictions \( \epsilon_i, \epsilon_j = \epsilon \), and let the overall capital supply be increasing in the net-rate of return with an elasticity of \( \eta > 0 \). The relative strength of capital cost effects becomes

\[
\left[ \frac{dt}{d\tau_iK} \right] = \frac{-K_i \epsilon}{\epsilon (K - K_i) + \eta \epsilon_i K}.
\]

To interpret this condition suppose the overall capital supply is fixed (\( \eta = 0 \)). Then, the relative strength of capital cost effects becomes

\[
\left[ \frac{dt}{d\tau_iK} \right] = \frac{-K_i}{K - K_i}.
\]

This indicates that the relative size of the jurisdictions matters for the extent to which the net-rate of return is affected: the larger jurisdiction has a stronger impact on the net rate of return of others. If, however \( \eta \) is positive, the impact of the local tax rate on the net-rate return \( \epsilon \) is smaller.
References


POPITZ, J. (1932), Der künftige Finanzausgleich zwischen Reich, Laendern und Gemeinden, Berlin.
