Fiscal Externalities and Asymmetric Information in an Economic Federation*

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Abstract

This paper analyzes optimal taxation and provision of public goods in an economy where tax and expenditure decisions are being made by both central and local governments. The main contribution of the paper is to address the implications of informational asymmetries, such that the central government cannot fully observe differences in local preferences. In case the differences across localities only refer to their preferences for local public goods, we show how the central government can implement the socially optimal resource allocation by means of subsidizing local provision of the federal (or central) public good. We also examine the welfare effects of such subsidies, when the socially optimal resource allocation is not a feasible policy option.

Keywords: Fiscal externalities, informational asymmetries, optimal taxation and provision of public goods.

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1 Introduction

This paper analyzes optimal taxation and public good provision in an economy where tax and expenditure decisions are being made by both the local and central levels of government. The main purpose is to examine how the central government can improve the resource allocation by means of policies designed to affect the behavior of local governments.

It has been recognized in previous studies that if the local (lower level) governments act as Nash competitors to one another, then the resulting outcome in terms of taxes and public expenditures are generally suboptimal from society’s point of view. One reason for this to occur is the presence of horizontal fiscal externalities: the decisions made by one locality affect the residents in other localities either because of mobility across localities or benefit spillovers. Wildasin (1991) addresses horizontal externalities arising from mobility and shows how these can be internalized by means of a system of matching grants from the central to the local governments.

A second reason is the presence of vertical fiscal externalities, which arise from co-occupancy of a common tax base. Typically, the local authorities do not recognize that their tax policies affect the central authority’s tax base. This was first pointed out by Johnson (1988) and has been further elaborated on by Boadway and Keen (1996) and Boadway et al. (1998). In the paper by Boadway and Keen, both levels of government use labor income taxation to finance their expenditures on public goods, and the central authority can reallocate resources lump-sum within the public organization. Their most important result is that the central government should choose its labor income tax rate to equal zero if it wants to internalize the vertical externality, meaning that all revenues from distortionary taxation are collected by the local governments. As a consequence, the authors argue that pure efficiency considerations may call for a negative fiscal gap - measured by the difference between the central government’s tax revenues and its expenditures on public goods.

We shall extend earlier work in at least three directions. The first is by showing that efficiency per se has no obvious implications for the sign or size of the fiscal gap. The second is to introduce informational asymmetries into the analysis, such that the localities differ with respect to their preferences for local and federal (or
central) public goods, whereas these differences are not fully observed by the central government. Finally, the third contribution is to introduce horizontal spillover effects among the localities and show that the local governments themselves may have incentives to incorporate these effects into their decision problems.

The outline of the paper is as follows. In Section 2, we analyze a 'benchmark' version of the model in which all localities are identical, and the preferences of local residents are fully observed by the central and local governments. The tax instrument available to each level of government is a proportional tax on the labor income. By replacing the lump-sum instrument used by Boadway and Keen (1996) with a policy rule, the nature of which the local governments will understand, one can show that the central government’s labor income tax rate becomes a redundant policy instrument. Therefore, the central government can implement the socially optimal (second best) resource allocation independently of its labor income tax rate, which suggests that the decision to internalize vertical externalities has no obvious implications for the sign or size of the fiscal gap.

A frequent argument in favor of local decision making relates to informational asymmetries: after all, this is the main efficiency argument for local tax and expenditure decisions. A natural next step, therefore, will be to relax the assumption that the central government has perfect information about the preferences of local residents. We begin Section 3 by assuming that the preferences for local public goods differ across localities, and that these differences are not observed by the central government. This makes the problem of implementing the socially optimal resource allocation more complicated than in the benchmark version of the model, since the central government does not have access to all information required to solve the social optimization problem by itself. We show how an incentive scheme involving subsidized local provision of federal public goods can be designed to obtain the socially optimal resource allocation.

Horizontal interaction among the localities will be addressed in terms of spillover effects from local public goods. At first glance, such interaction may appear to cause horizontal externalities. Since the central government does not observe how the localities differ in preferences for local public goods, a system of matching grants from the central to the local governments will not internalize the horizontal externality. It
is shown that the second best optimum can be attained by a scheme that combines subsidized local provision of the federal good with voluntary cross-subsidization of local public goods among the localities.

A final concern of Section 3 will be to add the assumption that the localities also differ with respect to their preferences for federal public goods, and that these differences are not observed by the central government. This means that it is no longer possible for the central government to implement the second best resource allocation by subsidizing local provision of the federal good (or, for that matter, by choosing the federal good itself). We shall, nevertheless, analyze the policy options available for the central government by means of cost benefit analysis. Among other things, we show how the central government can improve the resource allocation in comparison with the case of unsubsidized local provision of federal goods. Section 4 concludes the paper.

2 The Benchmark Model

In the benchmark version of the model to be described below, all decisions are made under perfect certainty and there are no horizontal spillover effects of local public goods. The federation consists of \(N\) localities, each of which is populated by one immobile resident. The utility function of the resident in locality \(i\) is written\(^1\)

\[
 u^i = u(c^i, l^i) + \phi(x^i) + \zeta(G) \tag{1}
\]

where \(c\) is private consumption, \(l\) labor supply, \(x\) a local public good provided by the local government and \(G\) a federal public good provided by the central (or federal) government. We shall suppose that the utility increases in \(c^i\), \(x^i\) and \(G\), decreases in \(l^i\), and that the utility function is strictly concave. The private agent chooses consumption and labor supply such as to maximize the utility subject to the budget constraint

\(^1\)To simplify the analysis, we follow Broadway and Keen (1996) and Broadway et al. (1998) by assuming that public goods are additively separable from other goods.
\[ w^i (1 - \tau^i - \tau_e) l^i = c^i \]  
(2)

where \( w \) is the real wage rate, which for simplicity will be assumed to be exogenous. Equation (2) also contains a local income tax rate, \( \tau_i \), and an income tax rate set by the central government, \( \tau_c \). The outcome of private optimization will be \( c^i = c(w^i (1 - \tau^i - \tau_e)) \) and \( l^i = l(w^i (1 - \tau^i - \tau_e)) \). The conditional indirect utility is written\(^2\)

\[ V^i = v(w^i (1 - \tau^i - \tau_e)) + \phi(x^i) + \zeta(G) \]  
(3)

which is assumed to be the objective function of the local government. In a similar way, we assume that the objective of the central government is the sum of all local conditional indirect utility functions. We shall begin by deriving the socially optimal tax and expenditure policies, and then continue by analyzing how the central government can implement these policies in a decentralized framework, where each local government makes its own expenditure and tax decisions.

### 2.1 Command Optimum

Suppose, to begin with, that the tax and expenditure decisions are made by the central government, who is acting as a social planner. In this case, there will be no need to distinguish between local and federal income tax rates, so we can define \( \tau^i = \tau^i + \tau_e \) to be the income tax rate facing the resident in locality \( i \). To simplify the analysis as much as possible, we assume that all localities are identical. This assumption will be relaxed in the next section. We can then drop the superindex \( i \) (for locality) and write the social optimization problem as follows:

\[ \max_{\tau, x, G} N[v(w(1 - \tau)) + \phi(x) + \zeta(G)] \]  
(4)

subject to

\(^2\)We use the term "conditional indirect utility" to indicate that the private optimization problem is defined conditional on \( \tau^i, \tau_e, x^i \) and \( G \).
\[ N[\tau wl(w(1 - \tau)) - x] - G = 0 \] (5)

In addition to equation (5), which is the resource constraint of the social optimization problem, the necessary conditions become

\[ -\nu_\omega w + \lambda[wl - \tau w^2 l_w] = 0 \] (6)

\[ \phi_x - \lambda = 0 \] (7)

\[ N\zeta_G - \lambda = 0 \] (8)

where \( \omega = w(1 - \tau) \), \( l_w = \partial l/\partial \omega \), \( \nu_\omega = \partial v/\partial \omega \), \( \phi_x = \partial \phi/\partial x \) and \( \zeta_G = \partial \zeta/\partial G \). The variable \( \lambda \) is the Lagrange multiplier associated with the resource constraint. For further reference, we shall denote the outcome of the social utility maximization problem by \((\tau^*, x^*, G^*)\).

### 2.2 Decentralized Policy Decisions

In this subsection, we assume that tax and expenditure decisions are made at both levels of government. The budget constraint facing each local government is written

\[ \tau wl(w(1 - \tau) + T - x = 0 \] (9)

where \( T \) is a subsidy (positive or negative) from the central government to the local government. Similarly, the budget constraint facing the central government takes the form

\[ N[\tau_c wl(w(1 - \tau_c)) - T] - G = 0 \] (10)

which means that the central government has three policy instruments at its disposal; \( \tau_c, G \) and \( T \).

Let us begin by analyzing the local decision problem, when the central government does not try to influence the local tax and expenditure decisions, i.e. when
Each local government is assumed to take the policy decisions made by other local governments and those made by the central government as exogenous. The local government behaves as if it chooses \( \eta \) and \( x \) such as to maximize

\[
v(w(1 - \eta - \tau_c)) + \phi(x) + \zeta(G)
\]

subject to equation (9). The additional necessary conditions become

\[
-v_{w}w + \mu[w - \tau w^{2}l\omega] = 0 \tag{11}
\]

\[
\phi_{x} - \mu = 0 \tag{12}
\]

where \( \mu \) is the Lagrange multiplier associated with equation (9). Equations (11) and (12) will, in general, differ from their counterparts in the social optimization problem. The reason is that the local governments do not take into account that their decisions to tax affect the central government’s tax base.

How can the central government act in order to internalize the vertical fiscal externality and thereby implement the socially optimal resource allocation? Broadway and Keen (1996) suggest that the central government should choose its labor income tax rate to be zero and then collect revenues lump-sum from the local governments. By choosing the federal tax rate to be zero, all distortionary taxes are collected by the local level of government and the source of the externality will vanish. This has a strong implication: if the central government internalizes the vertical fiscal externality, the fiscal gap - measured as the difference between the tax revenues collected by the central government and its expenditures on public goods - will be negative.

Contrary to Broadway and Keen, we will argue that efficiency per se does not impose any particular restrictions on the sign or size of the fiscal gap. If the central government designs the subsidy in a particular way, it is possible to implement the socially optimal resource allocation for any value of \( \tau_c \). The idea is that, instead of using a lump-sum subsidy, the central government may announce a subsidy rule, the nature of which the local decision makers will understand. When the central government has perfect information about the preferences of local residents, it is actually able to solve the (hypothetical) social optimization problem described in
the previous subsection in order to determine $G^*$. Given that the central government knows $G^*$, it can use this information to design a subsidy rule, such that the local governments will behave as if they solve the social optimization problem. This is described in Proposition 1;

**Proposition 1** Suppose that the central government chooses $G = G^*$ by solving the command optimum problem. Then, if the central government announces that the subsidy to the local governments will take the form $T^* = \tau_c w l(w(1 - \eta - \tau_c)) - G^*/N$, where $\tau_c$ is any income tax rate imposed by the central government, then $\tau^*_I = \tau^* - \tau_c$ and $x^*$ will solve the local governments’ optimization problems.

**Proof.** By substituting $T^* = \tau_c w l(w(1 - \eta - \tau_c)) - G^*/N$ into equation (9), the local optimization problem can be written as

$$\max_{\tau,x} v(w(1 - \tau)) + \phi(x) + \zeta(G^*)$$

subject to

$$\tau w l(w(1 - \tau)) - x - G^*/N$$

where $\tau = \eta + \tau_c$, which is equivalent to the social optimization problem described in the previous subsection. ■

Proposition 1 has an interesting implication for the fiscal gap; it may be either positive or negative. Therefore, if the central government has perfect information about the preferences of local residents and is able to solve the command optimum problem, efficiency does not impose any restrictions on the sign or size of the fiscal gap. For example, the central government may implement the socially optimal resource allocation with $\tau_c = 0$ in which case the local authorities collect all tax revenues with a resulting negative fiscal gap. Similarly, the central government may implement the socially optimal resource allocation with $\tau_c = \tau^*$ in which case the central government collects all tax revenues and the fiscal gap becomes positive. In fact, any combination of local and central tax rates will do as well, meaning that either $\tau_c$ or $\tau_l$ becomes a redundant policy instrument.
3 Optimal Policy Under Informational Asymmetries

In order to make the distinction between different levels of government more interesting, we shall now extend the analysis by assuming that the localities differ with respect to their preferences for local public goods. Each local government knows the ‘local’ preferences, while the differences across localities are not fully observed by the central government. This means that the local governments have an informational advantage over the central government. In subsection 3.1, we begin by analyzing an economy with local provision towards the federal public good. Given the form of the utility function set out in Section 2, we show that the central government can provide ‘correct’ incentives to the local governments, even if the central government is not able to solve the social resource allocation problem by itself. Subsection 3.2 extends the analysis to include horizontal spillover effects from local public goods. In subsection 3.3, we analyze the resource allocation problem arising when the localities also differ with respect to their preferences for the federal public good.

Note finally that, by imposing the assumption of asymmetric information in the way suggested above, Proposition 1 will no longer apply in general. The reason is that, when the local governments are well informed whereas the central government is not, efficiency will require local taxation. However, the central government’s income tax will continue to be a redundant policy instrument. Therefore, in what follows, we shall disregard the central government’s decision to tax by assuming that \( \tau_c = 0 \).

3.1 Local Provision Towards the Federal Good

Following the previous section, the objective function of local government \( i \) is given by

\[
V^i = v(w^i(1 - \tau^i)) + \theta^i \phi(x^i) + \zeta(G),
\]

where the difference in comparison with equation (3) is the parameter \( \theta^i > 0 \) reflecting the preference for the local public good. It is assumed that the central government cannot observe individual \( \theta^i \)'s, whereas each local government knows
the preferences of the local resident. In this case, the main task of the central government will be to find a way of implementing the socially optimal resource allocation, given that it cannot observe the individual θ’s. Since the local governments have an informational advantage over the central government, the central government may want to leave the decisions to determine the public expenditures to the local decision makers in order to reveal their preferences. Thus, we will analyze voluntary contributions to the federal good made by the local governments.\(^3\) The decision problem of the central government is, therefore, to choose a policy such that the local governments will act in accordance with the best interest of society as a whole.

The amount of the federal public good is given by \(G = \sum_{i=1}^{N} g^i\), where \(g^i\) is local government \(i\)'s contribution. The central government is assumed to have two instruments at it’s disposal; a lump-sum transfer to each locality, \(S^i\), and a subsidy proportional to each local government’s contribution towards the federal good, \(s^i\).

Local government \(i\) has a budget constraint
\[
\tau^i w^i t^i - x^i - \left(1 - s^i\right) g^i + S^i = 0.
\] (14)
The local government chooses \(\tau^i\), \(x^i\), and \(g^i\), so as to maximize equation (13) subject to equation (14). The first order conditions are given by
\[
-v_{w^i} w^i + \mu^i [w^i t^i - \tau^i (w^i)^2 l_{w^i}] = 0
\] (15)
\[
\theta^i \phi^s - \mu^i = 0
\] (16)
\[
\zeta_G - \left(1 - s^i\right) \mu^i = 0
\] (17)
where \(\mu^i\) is the Lagrange multiplier associated with equation (14). Let us now turn to the central government’s choice of subsidy rates \(s^i\). In this case, the central government can use the fact that the valuation of the federal public good is uniform across localities. The following result applies:

\(^3\)Among others, Warr (1983) and Bergstrom et al. (1986) study voluntary provision towards a public good. In the context of private charity, Warr shows how to improve the resource allocation by means of a subsidy scheme, which is designed to affect the donors’ marginal willingness to donate. Broadway et al. (1989) places the voluntary provisions in the framework of a federation and studies the empirical implications of different intergovernmental grant systems.
Proposition 2 If the local governments contribute to the federal public good and the objective functions of the local governments take the form of equation (13), then the socially optimal resource allocation can be achieved by a uniform subsidy rate \( s = (N - 1)/N \) on each local government’s contribution towards the federal good.

Proof. The socially optimal resource allocation solves

\[
\max_{\tau^i, x^i, G} \sum_{i=1}^{N} \left[ v(w^i (1 - \tau^i)) + \theta^i \phi(x^i) + \zeta(G) \right]
\]

subject to

\[
\sum_{i=1}^{N} [\tau^i w^i t^i - x^i] - G = 0,
\]

and the first order conditions are

\[
-v_w w^i + \lambda [w^i t^i - \tau^i (w^i)^2 l_{w^i}] = 0 \quad i = 1, ..., N
\]

\[
\theta i^{\phi_{x^i}} - \lambda = 0 \quad i = 1, ..., N
\]

\[
N \zeta_{G} - \lambda = 0.
\]

By substituting the subsidy \( s^i = (N - 1)/N \) into (17) and noticing that \( \mu^i = \mu \) for all \( i \), conditions (15)-(17) reproduce the first order conditions of the social optimization problem.

Therefore, even though the central government has no (or limited) information regarding each locality’s valuation of the local public good, it can still implement the socially optimal resource allocation by the proper choice of tax/transfer policies. However, this result is sensitive to the assumption that localities do not differ regarding their valuation of the federal good. If preferences are allowed to vary also with respect to the federal good, then the optimal subsidies are no longer independent of the valuation of the federal good. As a consequence, the socially optimal resource allocation can no longer be obtained using the type of mechanism described here. We shall return to this issue in subsection 3.3.
3.2 Adding a Horizontal Spillover Effect

Frequently, it is argued that the central government should correct the local authorities’ expenditure and tax decisions because of spillovers among them. Let us, therefore, add the assumption that the locally provided good spills over into other jurisdictions. The local government $i$’s objective function is modified to read

$$V^i = v(w^i(1 - \tau^i)) + \theta^i \phi(x^i, x^{-i}) + \zeta(G),$$

where the utility from local good consumption also depends on the provision by other localities denoted by $x^{-i}$. Let us start by studying the socially optimal resource allocation.

The social optimization problem is written as

$$\text{Max}_{\tau^i, x^i, G} \sum_{i=1}^{N} \left[ v(w^i(1 - \tau^i)) + \theta^i \phi(x^i, x^{-i}) + \zeta(G) \right]$$

subject to

$$\sum_{i=1}^{N} \left[ \tau^i w^i - x^i \right] - G = 0.$$

The necessary conditions with respect to $\tau^i$, $x^i$, and $G$ are given by

$$-v_{w^i} w^i + \lambda \left[ w^i \tau^i - \tau^i (w^i)^2 l_{x^i} \right] = 0 \quad i = 1, ..., N \tag{19}$$

$$\sum_{j=1}^{N} \theta^j \phi_{x^i}^j - \lambda = 0 \quad i = 1, ..., N \tag{20}$$

$$N \zeta_G - \lambda = 0. \tag{21}$$

Condition (20) is interpreted such that the sum of marginal utilities of $x^i$ taken over all localities must equal the marginal cost of public funds in utility terms, and $\phi_{x^i}^j = \partial \phi(x^i, x^{-i}) / \partial x^i$.

At first glance, the spillover effects may seem to create a horizontal fiscal externality. The traditional approach to internalizing such externalities has been to impose a matching grant from the central government to the local governments. However, such a policy is not necessarily desirable here, because the central government does not observe differences in preferences across localities and is, therefore, not able to choose the subsidy rates in an optimal way. In addition, by fully relying
on central government interventions, one would also neglect the incentives facing the local governments. We will argue that, if the central government subsidizes the local provision towards the federal good in an optimal way, then the local governments have themselves incentives to choose the socially optimal resource allocation. This is so because the local governments have incentives to subsidize each others provision of local public goods.

Denote by \( r^{ij} \) a proportional subsidy from locality \( i \) to locality \( j \) on \( j:s \) provision of the local good. Similarly, \( r^{ji} \) is a subsidy from \( j \) to \( i \) on locality \( i:s \) provision of the local good. The budget constraint of local government \( i \) is given by

\[
\tau^i w_i b - \left( 1 - s^i \right) g^i + S^i - \left( 1 - \sum_{j \neq i} r^{ji} \right) x^i - \sum_{j \neq i} r^{ji} x^j = 0
\]  
\( (22) \)

Local government \( i \) chooses \( \tau^i \), \( x^i \), and \( g^i \) to maximize (18) subject to (22). The first order conditions for \( \tau^i \) and \( g^i \) are given by (15) and (17). The condition for \( x^i \) is modified to read

\[
\theta^i \phi_{x,i}^i - \left( 1 - \sum_{j \neq i} r^{ji} \right) \mu^i = 0
\]  
\( (23) \)

Let us now turn to the problem of implementing the socially optimal resource allocation as represented by equations (19)-(21). Consider Proposition 3;

**Proposition 3** Suppose the central government chooses \( s^i = s = (N - 1)/N \) for \( i = 1, ..., N \), and each local government, \( i \), then chooses \( r^{ij} = \theta^i \phi_{x,j}^i / \mu^i \) \( \forall j \neq i \). Equations (15), (17) and (23) will then, together, reproduce the socially optimal resource allocation as given by equations (19), (20) and (21).

The proof of Proposition 3 is straightforward and can be derived in a way similar to the proof of Proposition 2. First, the central government subsidy, \( s \), to the local provision of federal public goods implies that the marginal cost of public funds in utility terms is equalized across localities, i.e. \( \mu^i = \mu \) for \( i = 1, ..., N \). Given this subsidy, the local governments - which are anticipating the Nash-equilibrium - will themselves internalize the horizontal spillover effects. To see this more clearly, note that the term
\[ r_{ij}^x = \frac{\theta^i \phi^j}{\mu} \]

measures local government \(i\)'s marginal willingness to pay out of its tax revenues for locality \(j\)'s provision of local public goods. In other words, provided the central government subsidizes local provision of the federal good in the way suggested by Proposition 3, the local governments have themselves incentives to implement the socially optimal resource allocation by means of a cross-subsidization scheme.

### 3.3 Uncertainty and Federal Public Goods

A natural extension of subsection 3.2 is to add the assumption that the localities also differ with respect to their preferences for federal public goods. Each local government is still assumed to have perfect information about the preferences of 'local residents', whereas the central government cannot fully observe differences in preferences across localities (neither for local nor for federal public goods). In addition, since the local governments have incentives to internalize any horizontal externalities that would otherwise result from benefit spillovers, we simplify by disregarding horizontal spillover effects in what follows\(^4\). The objective function of locality \(i\) takes the form

\[ V^i = v(w^i(1 - \tau^i)) + \theta^i \phi(x^i) + \rho^i \zeta(G) \]  

(24)

where \(\rho^i > 0\) is a 'locality specific' part of the preferences for the federal public good, which is not observed by the central government. By following the approach in subsection 3.1 with subsidized local provision of the federal public good the budget constraint of the local government is given by equation (14). The first order

\(^4\)It is important to observe that the cross-subsidization scheme gives rise to a socially optimal resource allocation only if \(G\) is chosen optimally from society's point of view. However, even if the federal good is not optimally chosen, the local governments have the incentive to subsidize each others provision of local public goods in the way suggested by Proposition 3. Therefore, horizontal spillover effects will not contribute to the welfare analysis to be carried out in this subsection.
conditions for $\tau^i$ and $x^i$ will still take the form of equations (15) and (16), respectively, whereas the first order condition for local provision towards the federal public good changes to read

$$\rho^i \zeta_G - \mu^i (1 - s^i) = 0$$  \hspace{1cm} (25)

Note first that, with the incentives described in subsection 3.1, the local governments will always choose $\tau^i$ and $x^i$ optimally conditional on the subsidy $s^i$. What is causing a social loss here is that the subsidy towards the local provision of the of federal good is likely to be suboptimal, since the central government does not observe the differences in preferences across localities.

The welfare effects of changes in central government policy then become important to consider. More specifically, can we derive any qualitative - and practically useful - results as to when the subsidies towards local provision of the federal public good should be increased or reduced? To answer this question, let us begin by assuming that the initial subsidy rates are $(s^{i,0},...,s^{N,0})$ and the corresponding equilibrium is

$$(\tau^{i,0},...,\tau^{N,0},x^{i,0},...,x^{N,0},G^0)$$

Consider a small increase of the subsidy rates, such that the new rates become $s^{i,0} + \alpha$ for $i = 1,...,N$, where $\alpha$ is a small positive constant. To focus entirely on efficiency consequences, we simplify by assuming that any increase of $s^i$ is financed by a lump-sum payment from locality $i$ to the central government, meaning that the reform is budget neutral for each local authority as well as for the central government. The initial (or prereform) social welfare - or value - function can be written as

$$V^0 = \sum_{i=1}^{N} [v(u^i(1 - \tau^{i,0})) + \theta^i \phi(x^{i,0}) + \rho^i \zeta(G^0)]$$  \hspace{1cm} (26)

where the equilibrium public policy in terms of tax rates and public goods are functions of the parameters of the problem, one of which is $\alpha$. The cost benefit rule can be derived by differentiating the value function with the respect to $\alpha$ and evaluating the derivative at the point where $\alpha = 0$. It is convenient to be able to relate the welfare effect of this policy reform to the initial - and possibly suboptimal - subsidy scheme. This is addressed by Proposition 4;
Proposition 4 If the increase of the subsidy rates is designed to be budget neutral at the local level of government, the cost benefit rule for $\alpha$ can be written as

$$\frac{\partial V^0}{\partial \alpha} = - \frac{\partial G^0}{\partial \alpha} \frac{\partial g^{i,0}}{\partial \alpha} + \frac{\partial G^0}{\partial \alpha} \sum_{i=1}^{N} (1 - s^{i,0}) \mu^{i,0}$$

(27)

where $\frac{\partial G^0}{\partial \alpha} = \sum_{i=1}^{N} (\frac{\partial g^{i,0}}{\partial \alpha})$.

Proof. See the Appendix.

The first term on the right hand side of equation (27) measures the opportunity cost of the resources used to increase the federal public good; note that $\frac{\partial g^{i,0}}{\partial \alpha} > 0$ for $i = 1, ..., N$. The second term on the right hand side measures the marginal benefit, which is understood by observing that $\sum_{i=1}^{N} (1 - s^{i,0}) \mu^{i,0} = \sum_{i=1}^{N} \rho^i \zeta_G(G^0)$. Clearly, the welfare effect of additional subsidies towards local provision of the federal good is dependent upon the preexisting subsidization scheme. It is easy to show that $\frac{\partial V^0}{\partial \alpha} > 0$ if $s^{i,0} = 0, i = 1, ..., N$, meaning that the central government can always improve the welfare level via a subsidization scheme in comparison with the case of unsubsidized local provision of the federal public good. Similarly, if it would be possible to choose $s^{i,0} = \sum_{j \neq i} \rho^j \zeta_G(G^0)/\mu^{i,0}$, which is the optimal second best policy when the individual $\rho$’s are observable, one can show that $\frac{\partial V^0}{\partial \alpha} = 0$.

The practical problem is that the individual $\rho$’s are not observable to the central government. However, the central government may, nevertheless, observe at least part of the distribution function for $\rho$, which provides some basis for policy design. To be able to discuss this situation in detail, consider first the case when the initial (or prereform) subsidy to each locality, $s^{i,0}$, is based on a biased estimate of the correct second best policy in the sense that $s^{i,0} = [\sum_{j \neq i} \rho^j \zeta_G(G^0) + \beta^i]/\mu^{i,0}$, where $\beta^i$ represents the bias. We can then derive\(^{5}\)

Corollary If $s^{i,0} = [\sum_{j \neq i} \rho^j \zeta_G(G^0) + \beta^i]/\mu^{i,0}$ for $i = 1, ..., N$, the cost benefit rule for $\alpha$ reduces to read

$$\frac{\partial V^0}{\partial \alpha} = - \frac{\partial G^0}{\partial \alpha} \sum_{i=1}^{N} \beta^i \frac{\partial g^{i,0}}{\partial \alpha}$$

\(^{5}\)A similar result in the context of an environmental tax reform has been derived by Aronsson and Löfgren (1999). Their analysis is based on the assumption that the prereform emission tax constitutes a biased estimate of the Pigouvian tax.
The derivation of this result is accomplished by substituting the expression for $s^{i,0}$ in the corollary into equation (27) and then using that the first order condition for $g^i$ changes to read $\sum_{i=1}^{N} \beta^i \zeta_G(G^0) + \beta^i - \mu^{i,0} = 0$. Note first that if $\beta^i < 0$ for $i = 1, \ldots, N$, meaning that the marginal utility of the federal good is underestimated in a systematic way, we have $\partial V^0/\partial \alpha > 0$. A consequence of this result is that any subsidization scheme such that $s^{i,0} \in (0, \sum_{j \neq i} \rho^j \zeta_G(G^0)/\mu^{i,0}]$, $i = 1, \ldots, N$, is welfare superior to unsubsidized local provision. This neither depends on utility being separable in goods nor the assumption that $\rho$ enters the utility function multiplicatively.

An interpretation is that one can always design a ‘conservative’ policy - where each local government receives a finite subsidy proportional to its contribution towards the federal good - that is preferable to unsubsidized local provision. The policy options available to the central government depend on, among other things, to what extent it is able to estimate the distribution of the $\rho^i$’s.

Note finally that if the central government chooses a common subsidy rate for all localities, the assumptions about the form of the utility function have strong implications for what the optimal subsidy rate looks like. Such policies are interesting to consider here because, when the central government does not observe the differences in preferences across localities, a common subsidy rate may seem to be a natural choice. This is addressed in Proposition 5;

**Proposition 5** Given the form of the utility function set out above, and if the central government chooses $s^{i,0} = s = (N - 1)/N$, then $\partial V^0/\partial \alpha = 0$.

**Proof.** By choosing $s^{i,0} = s = (N - 1)/N$, equation (27) reduces to read

$$\frac{\partial V^0}{\partial \alpha} = \sum_{i=1}^{N} \frac{\partial g^{i,0}}{\partial \alpha} (\bar{\mu}^0 - \mu^{i,0})$$

where $\bar{\mu}^0 = (\sum_{i=1}^{N} \mu^{i,0})/N$. Then, by observing that the necessary condition for local provision of the federal good becomes

$$N \rho^i \zeta_G(G^0) - \mu^{i,0} = 0$$

for $i = 1, \ldots, N$, we find that $\mu^{i,0}/\rho^i = N \zeta_G(G^0)$ is constant and, as a consequence, $\partial g^{i,0}/\partial \alpha$ is constant across localities. Therefore, $\partial V^0/\partial \alpha = 0$. ■
One can interpret Proposition 5 as reflecting a 'third best' policy. Given that the central government does not observe the differences in preferences across localities and decides to choose a constant subsidy rate, the welfare maximizing choice will be \( s^0 = s = (N - 1)/N \) which is, in turn, equivalent to the optimal second best policy corresponding to the case when the localities have identical preferences for the federal public good. Therefore, the optimal second best policy under identical preferences turns out to be correct on average when the preferences differ across localities.

4 Discussion

In this paper, we have examined optimal public policies in an economy, where policy decisions are being made both by the central government and by the lower level of government. An interesting result which contradicts what has been found in previous studies is that efficiency per se has no obvious implications for the sign or size of the fiscal gap. Underlying this result is, of course, the assumptions that the central government can transfer resources between the two levels of the public organization, and is able to solve the social optimization problem.

Several new insight emerge from the analysis of informational asymmetries. If the localities differ with respect to their preferences for local public goods, and if these differences are not fully observed by the central government, then the central government can no longer solve the social optimization problem by itself. However, as long as the utility function is additively separable in goods, it can implement the socially optimal resource allocation by subsidizing local provision towards the federal public good. Adding horizontal spillover effects in terms of local public goods to the analysis does not change the optimal policy of the central government. The reason is that the local governments have incentives to incorporate these spillover effects into their optimization problems. In other words, as long as the central government subsidizes the local provision of the federal public good in an optimal way, the local governments have incentives to choose the socially optimal resource allocation.

If the localities also differ with respect to their preferences for the federal public good, and these differences are not fully observed by the central government, the
second best equilibrium is no longer feasible. We have analyzed the policy options facing the central government by means of cost benefit analysis, where the policy choice is to increase or decrease the subsidy towards the local provision of the federal good. If the central government has information about the lower support in the distribution of preferences for the federal good and uses this information to design a subsidy to each local government, then this policy will always welfare dominate unsubsidized local provision towards the federal good. In addition, this result is not dependent on the assumption about functional form of the utility function. For the particular form of the utility function discussed in this paper, and if the central government decides to choose a common subsidy rate for all local governments, we also derive the optimal constant subsidy rate. As it turns out, this optimal rate coincides with the second best policy corresponding to the case with identical preferences for the federal good, which means that such a policy is also correct on average (although not second best) when the localities differ with respect to their preferences.

5 Appendix

Proof of Proposition 4

By differentiating equation (26) with respect to \( \alpha \), while using equations (16) and (25), we have

\[
\frac{\partial V^0}{\partial \alpha} = \sum_{i=1}^{N} \left[ -v_i(w_i^0 \frac{\partial \tau_i^0}{\partial \alpha} + \theta_i \phi_{x^i} \frac{\partial x_i^0}{\partial \alpha} + \rho_i \zeta_i \frac{\partial G^0}{\partial \alpha} \right] \tag{A1}
\]

where all partial derivatives are evaluated at the initial (prereform) equilibrium. Since the reform is designed to be budget neutral at both levels of government, it follows that \( \tau_i^0 w_i^0 (w_i^0 (1 - \tau_i^0)) - x_i^0 - g_i^0 \) is constant, so

\[
[w_i^0 \tau_i^0 - r_i^0 (w_i^0)^2 l_{\omega}] \frac{\partial \tau_i^0}{\partial \alpha} - \frac{\partial x_i^0}{\partial \alpha} - \frac{\partial g_i^0}{\partial \alpha} = 0 \tag{A2}
\]

By solving equation (A2) for \( \partial x_i^0 / \partial \alpha \), substituting into equation (A1) and rearranging, we obtain equation (27).
References


