Taxation and deadweight loss in a system of intergovernmental transfers

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Abstract

Intergovernmental transfer programs in many federal systems, including Canada, attempt to equalize differences in subnational jurisdictions’ tax capacities on the basis of the so-called representative tax system (RTS). It is shown that RTS equalization grants effectively compensate subnational governments for a portion of the deadweight loss associated with taxes, and consequently the grants may tend to increase the distortionary tax rates chosen by subnational governments. This may be the case even when equalization is confined to tax bases which are themselves non-distortionary, such as the taxation of pure economic rents.

I. Introduction

In federal systems, intergovernmental transfer programs are frequently designed and implemented to serve regional equity objectives and promote efficient tax and fiscal policies for subnational governments. Such programs act analogously to systems of redistributive taxation of individual income, targeting transfers to low-revenue regions and, implicitly or explicitly, taxing high-revenue regions. As such, they may create incentives for subnational governments to adopt suboptimal tax policies in order to avoid taxation or to induce transfers through the fiscal federal system. In this paper, we analyze the effects of a system of intergovernmental transfers on the “tax effort” of welfare-maximizing subnational governments, and we explore the implications of the analysis for the optimal design of such transfer programs.

The potential for transfers to distort tax policy incentives of subnational governments is particularly clear when transfers are based on the so-called representative tax system. The RTS approach, which is the basis for equalization in Canada and many other federal systems, is a canonical example of a transfer formula with an explicitly redistributive aspect. Under Canada’s system of equalization, eligible provinces are compensated from federal revenues for the difference between a standard level of tax revenues and the revenue the province is deemed to be able to raise, if

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1 Similar formulas are employed in, for instance, Australia, Denmark and Switzerland (Ahmad and Thomas, 1996), as well as a number of developing countries (Shah, 1994).
it were to apply national average tax rates to its tax bases. Thus the program aims to equalize differences in tax revenue, but implements transfers through an indirect formula, based on differences in observed tax bases. When all provinces choose identical tax rates, the formula does indeed result in revenue equalization. But to the extent that local tax bases are elastic with respect to distortionary tax rates, provinces can induce larger equalization transfers by increasing tax rates. Additional federal transfers then partially offset the deadweight losses resulting from higher tax rates and the consequent distortions. In effect, equalization reduces the notional elasticity of tax bases used by welfare-maximizing governments in calculating second-best distortionary tax rates, and tax rates can rise in consequence.

The pure transfer component of such a policy, however, allows a portion of local government spending to be financed through non-distortionary means and, if private consumption in normal in utility, this income effect tends to reduce distortionary tax rates, offsetting the substitution effect just identified. In Section III of the paper, we consider a partial equilibrium model of a single government that is a recipient of equalization transfers and chooses tax and spending policies to maximize utility of a representative agent, taking the parameters of the equalization formula as given. We explore cases in which the substitution effect of equalization is dominant, so that distortionary tax rates of the receiving jurisdiction must rise as a result of equalization. We conclude that equilibrium with equalization results in a lower level of welfare of the representative consumer than would a lump-sum transfer to the jurisdiction of an equal amount. In Section IV, the analysis is extended to the case of multiple tax bases, including non-distortionary taxes on resource rents, a special case which has received much attention in the previous literature.

II. PREVIOUS LITERATURE AND POLICY ANALYSIS

Economic analysis of equalization in Canada has adduced rationales for the program based on principles of both efficiency and equity. In a federal state, with decentralized tax and fiscal policies, it is argued, federal transfers may be required to correct resource misallocations that result from a variety of fiscal spillovers among jurisdictions. (Such transfers may serve federal objectives of inter-regional equity as well.) While the efficiency analysis of transfers is conducted in a second-best environment in which local government policies may be inefficient, it is typically assumed federal authorities have access to first-best taxes and subsidies to correct interjurisdictional spillovers. Issues of information and implementation, and of the potential response of local authorities to the existence of federal transfers, typically do not arise. In what follows, we review briefly the previous literature on equalization and explain why issues of implementation have not been the primary focus of the analysis.

In a classic contribution, Boadway and Flatters (1982), building on the work of Flatters et al. (1974), construct a model of fiscally-induced migration of labour in a federation. They show that, if labour is freely mobile among jurisdictions and workers locate to maximize utility derived from private income and locally-provided public goods, then labour may be misallocated in decentralized equilibrium, to the extent that jurisdictions differ in their endowments of source-based tax revenues. Labour migrates to regions with high “net fiscal benefits,” reducing the marginal product of labour there below the efficient level. In this view, productive efficiency requires transfers to high-wage regions (which have low net fiscal benefits) in order to equalize the marginal product of labour in all jurisdictions. The fiscal externality in the model is internalized by federally mandated transfers equal to the difference between a region’s actual source-based revenue and the average level for the federation. In the model, such conditional transfers are implementable, because taxes are

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2See also Stiglitz (1983) and Wildasin (1991) for analysis of related issues.
non-distortionary, so that jurisdictions have no incentive to alter tax rates in response to the equalization policy. In the presence of deadweight costs of subnational taxation, however, such transfers calculated on the basis of actual revenues create obvious incentive problems. A system of pure federal revenue sharing induces a free-rider problem, as all jurisdictions have an incentive to reduce tax rates in order to shift the burden of taxation to citizens of other jurisdictions. In this context, issues of implementation in the design of transfer formulas assume primary importance.

More recently, some authors have considered the setting of distortionary tax rates in models of fiscal federalism. Dahlby and Wilson (1994) examine the optimal design of equalizing transfers when subnational governments may impose distortionary taxes on many tax bases. They show that a federal planner that seeks to maximize the sum of utilities of representative citizens of each jurisdiction should design intergovernmental transfers that implement a Ramsey tax rule for the nation—viz. taxes that equalize the marginal excess burden of taxation for each commodity and each region. They examine how transfer formulas can be adjusted for elasticity differences in order to meet this objective. In the model, however, subnational governments do not behave strategically with respect to the transfer formula, and issues of implementation do not arise. (In contrast, this paper considers how the federal planner can elicit the necessary information from sophisticated subnational governments in order to implement tax policies that equalize the marginal cost of public funds in all regions.)

Several authors have considered the potential for distortions in local tax policies resulting from the equalization formula, but previous analysis has been descriptive in its nature and incomplete in its treatment. Such issues were first raised in a theoretical model by Courchene and Beavis (1973), who considered the potential for receiving jurisdictions to manipulate the formula through its dependence on national average tax rates and tax bases. These considerations are also discussed by Bird and Slack (1990) and Usher (1995). Courchene (1994) extended the analysis to endogenize jurisdictions' own tax bases, arguing that, in some cases, equalization might deter receiving jurisdictions from developing new revenue sources, since additional revenues are implicitly “taxed back” through the entitlement formula. He argues that an optimal program would take into account such disincentive effects for local tax effort, and proposes partial equalization of revenue differences. In this paper, these arguments are extended, and it is shown that the potential for local governments to manipulate the formula and distort tax policies is far more general than has previously been recognized.

III. Equalization and local tax policies

For the sake of concreteness, the analysis which follows focusses on the Canadian equalization formula. Equalization entitlements are presently calculated for each of 37 separate revenue categories. A jurisdiction’s per capita entitlement in a revenue category is equal to its per capita tax base “deficiency” in the category, relative to a per capita standard for the category, multiplied by the calculated national average tax rate for the category. (Under the current Representative Five Province Standard (rfps) system, standard tax bases are calculated as the weighted average per capita tax base of the five “standard” provinces of Quebec, Ontario, Manitoba, Saskatchewan, and British Columbia.3) Equalization entitlements are summed over all revenue categories; jurisdictions with positive calculated entitlements receive a transfer from the federal government equal to the entitlement,4 whereas jurisdictions with negative calculated entitlements receive a net transfer

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3The rfps was instituted in 1982, replacing the earlier national average standard.
4Since 1982, the cumulative growth rate of total transfers to jurisdictions under equalization cannot exceed the rate of GNP growth.
of zero. Thus equalization is an asymmetric revenue sharing scheme, raising revenues of deficient jurisdictions to the standard level, but not taxing jurisdictions with larger-than-average tax bases, as would a symmetric scheme.\textsuperscript{5}

1. Basic analytics of equalization

To discuss the analytics of the formula, define $X_{pj}$ as the measured tax base of jurisdiction $p$ in revenue category $j$. Let $P$ represent an index set of all jurisdictions and $S \subseteq P$ represent an index set of standard jurisdictions. Let $n_p$ represent the population of jurisdiction $p$ and $n = \sum_{p \in S} n_p$. Then the per capita equalization entitlement of jurisdiction $p$ for category $j$ is

$$e_{pj} = \bar{t}_j \left( \frac{\sum_{i \in S} X_{ij}}{n} - \frac{X_{pj}}{n_p} \right)$$

$$= \bar{t}_j (\bar{x}_j - x_{pj}), \quad (1)$$

where

$$\bar{t}_j = \frac{\sum_{i \in P} t_{ij} X_{ij}}{\sum_{i \in P} X_{ij}} \quad (2)$$

is the national average tax rate and $\bar{x}_j$ is the weighted-average per capita base of standard jurisdictions and $x_{pj}$ is the per capita base of jurisdiction $p$ for the category. Consider the case of a receiving jurisdiction; viz. one for which

$$\sum_j e_{pj} \geq 0.$$ 

Define the jurisdiction’s own-source revenue for category $j$ as $\tilde{R}_{pj} = t_{pj} x_{pj}$. The per capita total revenue of $p$ in category $j$, net of equalization transfers is

$$R_{pj} = \tilde{R}_{pj} + e_{pj}$$

$$= \bar{t}_j \bar{x}_j + (t_{pj} - \bar{t}_j) x_{pj}. \quad (3)$$

Because receiving jurisdictions’ tax rates and bases influence national average tax rates and, for standard jurisdictions $p \in S$, representative standard bases, local tax policies interact to influence equalization entitlements in complicated ways. In particular, when a receiving jurisdiction has a large share of national revenues in a category, tax rates have strong effects on equalization transfers and receiving jurisdictions have perverse incentives in choosing tax policies. Such effects of the particular accounting treatment of the equalization formula were first analyzed by Courchene and Beavis (1973) and have been stressed by Boadway and Hobson (1993) and Usher (1995), among others. This paper, in contrast, is primarily concerned with the economic effects of equalization, resulting from the elasticity of tax bases with respect to tax rates, and we therefore analyze incentives when $\bar{t}_j$ and $\bar{x}_j$ are invariant to the receiving jurisdiction’s tax rate $t_{pj}$. Unlike the earlier papers, this analysis applies equally to jurisdictions that are small relative to the federation (and which therefore have only negligible effect on national averages) and to large jurisdictions.

\textsuperscript{5}Boadway and Hobson (1993) refers to asymmetric equalization as a “gross” scheme and symmetric equalization as a “net” scheme.
2. A model of optimal taxation

Consider a local economy with two private goods, consumption \( x \) and labour \( l \), and a single public good \( g \). The local government levies a distortionary tax on consumption at specific rate \( t \) in order to finance public sector expenditures, and chooses tax and fiscal policy to maximize welfare of a representative consumer.\(^6\) Suppose that utility of the representative agent is additively separable in \( g \),

\[
U(x, l, g) = u(x, l) + b(g),
\]

where \( u \) is increasing in \( x \), decreasing in \( l \), and concave in both its arguments, and \( b \) is increasing and concave in \( g \). The assumption of separability in (4), while probably excessively restrictive, permits an analysis of governmental transfers that is not complicated by the existence of direct substitution effects between private and public consumption.

Normalize producer prices to unity and define the agent’s indirect utility from private consumption conditional on tax policy as

\[
v(t) = \max u(x, l) \quad \text{s.t.} \quad (1 + t)x = l.
\]

Let \((x(t), l(t))\) solve (5).

As a benchmark for the analysis of equalization, consider initially second-best tax policies for a jurisdiction receiving a lump-sum, unconditional grant \( \bar{e} \geq 0 \). Define \( R(t) = tx(t) \) as local own-source revenue. A tax optimum solves

\[
\max v(t) + b(g) \quad \text{s.t.} \quad g = R(t) + \bar{e}.
\]

If \( t^0 \) solves (6) then

\[
-\frac{v_t}{b_g} = x(t^0) \left( 1 - \frac{t^0}{1 + t^0} \varepsilon(t^0) \right),
\]

where \( \varepsilon = -\partial \log x / \partial \log(1 + t) \) is the elasticity of demand for \( x \). By Roy’s identity, \( v_t = -\lambda x \), where \( \lambda \) is the marginal utility of private income. Hence

\[
\frac{\lambda}{b_g} = 1 - \frac{t^0}{1 + t^0} \varepsilon.
\]

At the optimum, in the absence of transfers, the marginal rate of substitution between public and private spending is set equal to the marginal cost of public funds.

Consider the introduction of a program of revenue equalization that pays the local government a transfer

\[
e(t, \bar{t}) = \bar{t}(\bar{x} - x(t)).
\]

By assumption, the national tax rate \( \bar{t} \) and standard base \( \bar{x} \) are positive. The transfer is financed externally to the jurisdiction, and the local tax authority is assumed to regard \( \bar{t} \) and \( \bar{x} \) as exogenous parameters, invariant to \( t \). In the presence of equalization, the jurisdiction’s optimal tax policy maximizes welfare of the representative agent, subject to the modified budget constraint that public spending equal own-source revenue plus the equalization transfer. Thus a tax optimum under equalization solves

\[
\max v(t) + b(g) \quad \text{s.t.} \quad g = R(t) + e(t, \bar{t}).
\]

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\(^6\)The case of a government maximizing a concave welfare function of the utilities of many heterogeneous consumers is a straightforward but unedifying extension. Alternatively, under some additional conditions, the representative consumer can be regarded as the median voter in the jurisdiction, who is decisive in choosing tax policies under majority rule.
If a tax rate $t^* > 0$ solves (10) then
\[
\frac{\lambda}{b_g} = 1 - \frac{t^* - \bar{t}}{1 + t^* \varepsilon}.
\] (11)

Comparing (11) to (8), it is evident that equalization induces a substitution effect which lowers the effective marginal cost of public funds, if $\varepsilon > 0$ and $\bar{t} > 0$, and leads to ceteris paribus increases in local tax rates. Intuitively, the decline in tax bases associated with distortionary taxation is partially offset through transfers, lowering the burden to local taxpayers of taxation. The effect of equalization on the effective marginal cost of public funds is particularly clear when $t = \bar{t}$: in this event, the right-hand side of (11) reduces to unity, so that the effective marginal excess burden of local taxation is zero when the local tax rate is set equal to the standard level $\bar{t}$. Hence equalization tends to raise tax rates above the chosen standard level.\(^7\)

We formalize this intuition as follows. Unlike more traditional approaches to such comparative static results, the proofs below do not rely on convexity of the optimization problem or differentiability of the optimizer, properties which cannot be guaranteed in second-best optimal tax problems. Instead, a technique similar to the ordinal approach to monotone comparative statics of Milgrom and Shannon (1994) is adopted.

**Proposition 1** Let $t^0$ solve (6) for some $\bar{e}$, and suppose that $e(t^0, \bar{t}) = \bar{e}$. Then $t^* \geq t^0$ if $x(t)$ is non-increasing in $t$.

**Proof.** Since $t^0$ is optimal for (6),
\[
v(t^0) + b(t^0 x(t^0) + \bar{e}) \geq v(t) + b(t x(t) + \bar{e})
\]
for all $t \leq t^0$. Since $x$ is non-increasing in $t$ by assumption, $e$ is non-decreasing in $t$ by (9). Hence $\bar{e} = e(t^0, \bar{t}) \geq e(t, \bar{t})$ for all $t \leq t^0$, so that
\[
v(t^0) + b(t^0 x(t^0) + e(t^0, \bar{t})) \geq v(t) + b(t x(t) + e(t, \bar{t}))
\]
for all $t \leq t^0$. It follows that if $t^*$ solves (10) then $t^* \geq t^0$. \(\square\)

(INSERT FIGURE 1 ABOUT HERE.)

The result is illustrated in Figure 1. The line labelled $tx(t) + \bar{e}$ represents the provincial government budget constraint given the lump-sum grant $\bar{e}$. The line labelled $tx(t) + e(t)$ represents the corresponding budget constraint in the presence of the equalization grant. Since $x(t)$ is non-increasing, this budget constraint is everywhere the steeper of the two, so that the optimal tax rate $t^*$, given by the point of tangency with an indifference curve, lies above and to the right of the optimum $t^0$ in the case of the lump-sum grant.

Proposition 1 states that equalization induces substitution toward higher rates of distortionary taxation by welfare-maximizing local governments. A natural inference is that equalization creates welfare losses relative to a benchmark program paying equal unconditional grants. This inference is indeed correct, although welfare analysis of the program is deferred until Section IV below. Proposition 1 does not however generate empirical predictions about the effect of equalization on observed local tax rates, as the transfers also induce income effects which can lead to reductions in distortionary taxation. In some restrictive cases, however, it is possible to state unambiguously\(^7\) I thank Dan Usher for pointing this out.
that income effects do not offset the substitution effect identified in Proposition 1. The most immediate such case occurs when local social welfare is quasi-linear in public spending, so that by assumption there are no income effects. The following proposition states that, in the quasi-linear case, equalization results in a higher local tax rate than would be chosen for any level of the lump-sum grant \( \bar{e} \).

**Proposition 2** Suppose that \( b(g) = \theta g \), for some \( \theta > 0 \). Then \( t^* \geq t^0 \) for all \( \bar{e} \) if \( x \) is non-increasing in \( t \).

**Proof.** By the definitions of the tax optima (6) and (10) for the case of quasi-linear preferences for public spending,

\[
v(t^0) + \theta(t^0 x(t^0) + \bar{e}) \geq v(t^*) + \theta(t^* x(t^*) + \bar{e})
\]

\[
v(t^*) + \theta(t^* x(t^*) + e(t^*, \bar{t})) \geq v(t^0) + \theta(t^0 x(t^0) + e(t^0, \bar{t}))
\]

which implies, given (9),

\[
\theta \bar{t}(x(t^0) - x(t^*)) \geq 0.
\]

Hence if \( x \) is non-increasing in \( t \) then \( t^* \geq t^0 \). □

In some cases, the income effects of the equalization grant reinforce the substitution effect we have identified, so that equalization leads to unambiguous increases in tax rates. This is the case when the jurisdiction’s undistorted tax rate \( t^0 \) would lead to a negative equalization transfer. (While this might seem unlikely to occur, most recipient provinces in Canada do, in fact, receive negative transfers for particular revenue categories, while the aggregate transfer to the province is positive.) Formally, suppose that, in the absence of equalization, the tax rate \( t^0 \) is chosen such that \( x(t^0) \geq \bar{x} \). Then the following proposition demonstrates that introduction of the equalization grant results in an increase in the local tax rate.

**Proposition 3** Let \( t^0 \) solve (6) for \( \bar{e} = 0 \), and suppose that \( x(t^0) \geq \bar{x} \). Then \( t^* \geq t^0 \) if \( x \) is non-increasing in \( t \).

**Proof.** Note \( x(t^0) \geq \bar{x} \) implies \( e(t^0, \bar{t}) \leq 0 \). Apply the proof of Proposition 1 with \( \bar{e} = 0 \). □

3. Federal taxation

The analysis thus far has abstracted from the source of federal revenues used to finance the equalization grant. If the marginal incidence of federal taxation is at least partially borne by the residents of the jurisdiction receiving equalization, then the incentive of the local government to distort tax policy to induce transfers is clearly attenuated.

Suppose first that the federal government imposes a lump-sum tax \( T \) on the local representative citizen in order to recover some positive fraction \( \alpha \) of the equalization transfer, so that

\[
T(t) = \alpha t(\bar{x} - x(t, T)). \tag{12}
\]

This defines the federal tax as an implicit function of the local tax rate, say \( T = \phi(t) \), with

\[
\phi'(t) = -\frac{\alpha tx_t}{1 - \alpha tx_t}. \tag{13}
\]
Given federal policies, an optimal local tax policy solves \( \max v(t, T) + b(g) \), subject to (12).\(^8\) The first-order condition reduces after some rearrangement to

\[
\frac{\lambda}{b_g} \left(1 + \frac{\alpha \bar{t}}{1 + t} \varepsilon^c\right) = 1 - \frac{t}{1 + t} \varepsilon + \frac{\bar{t}}{1 + t} \left(\varepsilon - \alpha \theta \varepsilon_I\right)
\]

(14)

where \( \varepsilon^c \) and \( \varepsilon_I \) are the compensated price and income elasticities of demand for consumption, respectively, and \( \theta \) is the share of full income spent on consumption.

Since the objective of the analysis remains to identify substitution effects of federal policies, we abstract from income effects by considering the quasi-linear case in which \( b_g \) is constant. Then Proposition 2 establishes that tax rates rise as a result of federal policies if and only if, beginning from the undistorted tax rate \( t^0 \), the local government’s effective marginal cost of public funds in (14) is less than the true marginal cost of funds,

\[
MCPF = 1 \left/ \left(1 - \frac{t}{1 + t} \varepsilon\right) \right.
\]

(15)

Rearranging (14), and using the Slutsky decomposition \( \varepsilon^c = \varepsilon - \theta \varepsilon_I \),

\[
\frac{\lambda}{b_g} = 1 - \frac{t}{1 + t} \varepsilon + \frac{\bar{t}}{1 + t} \left[(1 - \alpha) \varepsilon + \alpha \varepsilon^c \left(1 - \frac{\lambda}{b_g}\right)\right]
\]

(16)

The expression in brackets on the right-hand side of (16) shows the two components of the distortionary effect of equalization in this case. The first effect, proportional to \((1 - \alpha) \varepsilon\), is the increased equalization, net of federal recovery, associated with raising the tax rate. The second effect, proportional to \(\alpha \varepsilon^c(1 - \lambda/b_g)\), is the increased equalization resulting from the suppression of the local tax base when the federal lump-sum tax is increased, net of the income effect of the federal tax. Since our elasticity assumptions guarantee \( \lambda/b_g < 1 \), both these effects decrease the effective marginal cost of funds below its true level, and it follows that equalization increases distortionary local taxation for any recovery rate \( \alpha \) which does not exceed 100 per cent.

In this environment, the equalization grant allows the local government to finance a portion of public spending with non-distortionary federal taxation, by increasing local tax rates. This incentive is most clear when the equalization grant is fully recovered from the local taxpayer through federal taxes \((\alpha = 1)\), so that there is no net fiscal gain from equalization, but the average excess burden of local taxation decreases and public spending rises.

More realistically, federal transfers are also financed with distortionary tax policies. In this case, the incentive for local governments to increase equalization transfers depends on the federal and local marginal costs of public funds, and interactions between the two.\(^9\) In the remainder of this section, we consider the extreme case in which federal and local taxes are “piggybacked” on the same tax base. Since the excess burden of federal and local taxes are equal in this case, there appears to be little scope for local governments to gain by increasing equalization transfers. In addition to these losses, however, marginal increases in federal taxes further depress the local tax base, which further increases equalization transfers. It will be shown that these distortionary effects

\(^8\)While in this case the local government perceives the impact of its decision on federal tax rates, we continue to assume that it regards the parameters of the equalization formula as fixed. For an analysis of the impact of local tax policies on \( \bar{t} \) and \( \bar{x} \), which is outside the scope of this paper, the reader is referred to the papers cited in Section II above.

\(^9\)Brennan and Pincus (1996) employ a model of differences in federal and local costs of funds to explain the “flypaper effect” of federal lump-sum grants, which is somewhat analogous to the effect analyzed here.
of federal tax recovery are offsetting, so that the incentive to increase local taxes depends solely on
the fiscal component of federal policies.

Given an initial federal tax rate \( \bar{t}_F \), suppose again that federal taxes are increased to recover
a constant fraction \( \alpha \) of the equalization transfer. Then the local government faces a schedule of
federal tax rates, say \( t_F = \phi(t) \), implicitly defined by

\[
\alpha \bar{t}(\bar{x} - x(t + t_F)) = (t_F - \bar{t}_F)x(t + t_F).
\]

(17)

An optimal local tax policy solves \( \max v(t + t_F) + b(g) \) subject to \( t_F = \phi(t) \), and is characterized
by the first-order condition

\[
\frac{\lambda}{b_g} = 1 - \frac{t}{1 + \tau} \varepsilon + \left[ \frac{\bar{t}}{1 + \tau} \varepsilon - \frac{\phi'(t)}{1 + \phi'(t)} \right]
\]

(18)

where \( \tau = t + t_F \) is the gross tax rate. The two terms in brackets on the right-hand side of (18)
represent the decrease in the effective marginal cost of funds as a result of equalization and its
recovery through federal taxes. The first term, familiar from earlier equations, shows the marginal
increase in equalization transfers when local taxes rise above optimal levels. The second term
represents the marginal excess burden of the corresponding rise in federal taxes, measured in units
of public spending. The implicit function theorem applied to (17) yields

\[
\frac{\phi'(t)}{1 + \phi'(t)} = \frac{\bar{t}}{1 + \tau} \frac{\alpha \bar{x}}{x} \varepsilon.
\]

Hence (18) can be simplified to

\[
\frac{\lambda}{b_g} = 1 - \frac{t}{1 + \tau} \varepsilon + \frac{\bar{t}}{1 + \tau} \left( 1 - \frac{\alpha \bar{x}}{x} \right) \varepsilon.
\]

The effective marginal cost of funds is reduced below its true level, evaluated at the second-best
tax rate \( \bar{t}_0 \), if and only if \( \alpha \bar{x}/x \leq 1 \) or, equivalently given (17), if and only if \( t_F - \bar{t}_F \leq (1 - \alpha) \bar{t} \).

Federal taxation increases the excess burden incident on the local taxpayer, which is undesirable
for the local government. However, federal taxation also suppresses the local tax base, which further
increases equalization transfers. These excess burden and base-suppression effects of the marginal
federal tax burden associated with equalization are positive on balance, as long as the rate of net
equalization of revenue deficiencies \( (1 - \alpha) \bar{t} \) exceeds the associated increase in federal taxes \( t_F - \bar{t}_F \).

When this is the case, the effective marginal cost of funds to the local government is below its true
level, and public spending rises above the optimum.

IV. Extensions of the model

This section briefly explores tax policy incentives for subnational governments under equalization
in a number of contexts that are related to, but more general than, the simple model of Section
III. Subsection 1 examines the effects of an equalization program when governments have
access to several, inter-related final demand tax bases. Subsection 2 considers the special case of
non-distortionary taxation of rents associated with fixed factors of production, such as resource
rents. The issue of equalization of such source-based, non-distortionary tax bases has been the
subject of much attention in the previous literature (e.g. Boadway and Hobson, 1993), and so the
analysis of Section III is extended to deal with this case. It is shown that equalization of only such
source-based taxes, which is occasionally recommended in the literature, may lead to distortions
related to those described in Section III, even when the tax bases are themselves non-distortionary. Subsection 3 briefly discusses tax competition and fiscal externalities, and shows that the welfare implications of the partial equilibrium model may change when the potential for tax competition exists.

1. Multiple tax bases

In practice, in Canada and other federal systems, equalization is applied not to a single tax base, as assumed in Section III, but to many distinct tax bases. This section extends the analysis of optimal subnational tax policies under equalization to the case of multiple final demand tax bases and shows that the principal conclusions of Section III—that equalization results in higher rates of distortionary taxation and lower levels of consumer welfare than equivalent lump-sum transfers—also obtain in this more general context.

The model is largely the same as that of Section III. There is a single representative citizen resident in the local jurisdiction with preferences $u(x, l) + b(g)$, where $x \in \mathbb{R}^K$ is a $K$-dimensional vector of commodity demands. Producer prices of the commodities are fixed and normalized to unity, and $t \in \mathbb{R}^K$ is a vector of specific tax rates levied by the local government on commodity demands.

Local government tax revenues are subject to a symmetric equalization scheme, given a representative tax system with standard bases $\bar{x} \in \mathbb{R}^K$ and standard tax rates $\bar{t} \in \mathbb{R}^K$. The equalization entitlement of a local government adopting tax rates $t$ is $e(t, \bar{t})$, given by (9) above, where tax and quantity variables are now interpreted as vectors. Define

$W(\bar{t}) = \max_{(t, g)} v(t) + b(g)$ \hspace{1cm} s.t. \hspace{1cm} $t \cdot x(t) + e(t, \bar{t}) \geq g$ \hspace{1cm} (19)

as the optimal level of social welfare in the local jurisdiction given equalization at the standard level $\bar{t}$, and let $(t^*(\bar{t}), g^*(\bar{t}))$ solve (19). As before, comparative static analysis of the effects of equalization on optimal tax rates $t^*$ and social welfare $W$ is complicated by the income effects associated with intergovernmental transfers. For this reason, consider the corresponding compensated optimization problem

$T(w, \bar{t}) = \min_{(t, g)} g - \bar{t} \cdot \bar{x} - (t - \bar{t}) \cdot x(t)$ \hspace{1cm} s.t. \hspace{1cm} $v(t) + b(g) \geq w$. \hspace{1cm} (20)$

Thus $T(w, \bar{t})$ defines the net lump-sum transfer to the local government required to achieve social welfare $w$, given that an equalization standard $\bar{t}$ is in place and that local tax rates are chosen optimally. Define $(t^c(w, \bar{t}), g^c(w, \bar{t}))$ as the optimizers in (20). The function $T$ plays the same role in the analysis as does the consumer expenditure function in the standard analysis of optimal tax policies of a single government. Several properties of $T$, analogous to properties of the expenditure function, are useful for the results that follow. First, by definition, $W$ and $T$ are algebraic inverses given $\bar{t}$, viz.

$T(W(\bar{t}), \bar{t}) \equiv 0$. \hspace{1cm} (21)

Second, if $T$ is differentiable, by the envelope theorem,

$\frac{\partial T(w, \bar{t})}{\partial t_k} = x_k(t^c(w, \bar{t})) - \bar{x}_k \hspace{1cm} k = 1, \ldots, K$. \hspace{1cm} (22)$

Hence $T$ is decreasing in $\bar{t}_k$ if and only if the local jurisdiction is deficient in tax base $k$, given its optimal policy. Third, $T$ is concave in $\bar{t}$.\hspace{1cm} (10)$

\footnote{The proof is standard. Choose any $\bar{t}_1$ and $\bar{t}_2$ and let $\bar{t}_0 = \lambda \bar{t}_1 + (1 - \lambda)\bar{t}_2$ for $\lambda \in [0, 1]$. Let $(t_i, g_i)$ solve (20) for}
When \( \bar{t} = 0 \), the transfer formula (9) reduces to the case of no equalization transfer, which is taken to be the benchmark case against which outcomes under equalization are compared. Let \( w^0 = W(0) \) be social welfare in the absence of equalization and \( t^0 = t^e(w^0, 0) \) be the associated vector of tax rates. When government has access to many tax bases, it is not possible to establish conditions under which individual tax rates are greater under equalization than under an equivalent lump-sum transfer, as it was in the case of a single tax base, because substitution effects among commodities can offset the direct tax-increasing effect of equalization. It can be established, however, that equalization results in greater aggregate deadweight loss for the citizen of the receiving jurisdiction than would an equivalent lump-sum grant. Thus, while individual tax rates may rise or fall as a result of a compensated change to an equalization system, the level of taxation must rise in the aggregate. The proof of this proposition is simple. By definition, \( T(w^0, \bar{t}) \) is the net transfer to the region required to attain benchmark welfare level \( w^0 \). Equivalently, \( T(w^0, \bar{t}) \) is the consumer’s compensating variation for the introduction of equalization at standard tax rates \( \bar{t} \). The actual transfer to the local government under equalization is

\[
\bar{t} \cdot (\bar{x} - x(t^e(w^0, \bar{t}))) = \bar{t} \cdot DT(w^0, \bar{t}),
\]

where \( DT(w, \bar{t}) = (\partial T(w, \bar{t})/\partial t_k) \) is the vector of partial derivatives of \( T \). Since \( T \) is concave in \( \bar{t} \) and \( T(w^0, 0) = 0 \) by construction,

\[
\bar{t} \cdot DT(w^0, \bar{t}) \leq T(w^0, \bar{t}) \tag{23}
\]

for all \( \bar{t} \geq 0 \). Conversely, suppose that the distortionary effects of taxation are not higher under equalization, so that (23) holds as an equality for all \( \bar{t} \). Then \( DT \) is independent of \( \bar{t} \), so that (22) implies \( x \) is independent of \( t \). Thus equalization does not result in higher deadweight loss than the lump-sum transfer only if market demands for commodities are perfectly inelastic with respect to prices. The result is stated formally as follows.

**Proposition 4** The representative citizen’s compensating variation for the introduction of equalization is never less than the associated transfer. Moreover, the compensating variation equals the actual transfer if and only if tax bases are perfectly price-inelastic.

It is in this sense that equalization unambiguously increases the distortionary effect of local government taxes and reduces welfare of the representative citizen.

2. **Resource taxes**

Theoretical literature studying federal fiscal equalization has frequently given special attention to resource tax bases or, more generally, taxation of rents accruing to fixed factors of production within a jurisdiction. From the perspective of equalization policy, such taxes have two special features. First, taxation of economic rents is in principle non-distortionary. Thus it might be expected that the tendency for equalization transfers to enhance the distortionary effects of local taxation would
not apply to such taxes. Second, resource revenues are source-based taxes. To the extent that the size of source-based tax bases differ and workers are mobile among jurisdictions, labour may be misallocated in decentralized equilibrium, as migrants move in response to differences in net fiscal benefits, rather than differences in the gross marginal product of labour. This observation has led some analysts to adduce efficiency arguments in favour of equalization of source-based taxes in particular (Boadway and Hobson, 1993).

When the tax policy decisions of local governments are regarded as endogenous to the equalization policy, this conclusion may be reversed. Equalization has the potential to correct fiscal externalities associated with interjurisdictional differences in net fiscal benefits, but the greater excess burden of taxation associated with the policy may more than offset the welfare gains resulting from improved interjurisdictional allocation. This observation remains true even when equalization is confined to source-based resource revenues, and we adopt the (probably extreme) assumption that such taxes are non-distortionary.

To establish this, consider again the three-good model of Section III, extended to incorporate equilibrium producer surplus, which may be interpreted as resource rents. The representative citizen in the local jurisdiction chooses consumption \( x \) and labour supply \( l \) to solve

\[
v(\tau, w) = \max_{(x,l)} u(x, l) \ \text{s.t.} \ \ x = (1 - \tau)wl \tag{24}\]

given the gross wage rate \( w \) and income tax rate \( \tau \). Let \( l((1 - \tau)w) \) solve (24). The competitive production sector hires labour to produce the consumption good with the decreasing-returns-to-scale technology \( y = f(l) \), so that \( f' > 0 \) and \( f'' < 0 \) by assumption. Profit-maximizing labour demand \( l^d(w) \) solves

\[
F(w) = \max_l f(l) - lw. \tag{25}\]

Producer surplus \( F(w) \) accrues in the first instance as a rent to owners of a fixed factor of production, but all the rent is taxed by the local government to finance a portion of public spending \( g \). Notice that this fixed-factor levy is per se non-distortionary, and that it is always optimal for a welfare-maximizing government to tax away 100 per cent of the rent.

A competitive private market equilibrium given tax policy \( \tau \) is therefore described by a labour supply function \( l((1 - \tau)w) \) and demand function \( l^d(w) \) solving (24) and (25) respectively, and a gross wage rate \( w^*(\tau) \) such that

\[
l((1 - \tau)w^*(\tau)) = l^d(w^*(\tau)). \tag{26}\]

Let \( l^*(\tau) = l((1 - \tau)w^*(\tau)) \) be equilibrium labour supply and \( F^*(\tau) = F(w^*(\tau)) \) be the equilibrium fixed-factor tax base. Observe that

\[
\frac{dF^*(\tau)}{d\tau} = -l^*(\tau) \frac{dw^*(\tau)}{d\tau} \leq 0 \ \text{if and only if} \ \frac{dw^*(\tau)}{d\tau} \geq 0. \tag{27}\]

so that local increases in income tax revenue “crowd out” fixed-factor tax revenue.

An optimal local tax policy equates the marginal rate of substitution between public and private consumption to the effective marginal cost of public funds, given the transfer formula, so that

\[
\frac{v_\tau}{b_g} = \frac{dg}{d\tau}. \tag{28}\]

Consider first the case of an unconditional lump-sum transfer \( \bar{e} \) to the local jurisdiction. The government budget constraint is

\[
g(\tau) = \tau w^*(\tau) l((1 - \tau)w^*(\tau)) + F(w^*(\tau)) + \bar{e}. \tag{29}\]

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Total differentiation of (26) yields
\[
\frac{dw^*(\tau)}{d\tau} = \frac{w \varepsilon^s}{1 - \tau \varepsilon^s + \varepsilon^d}
\]
(30)
where \(\varepsilon^s\) and \(\varepsilon^d\) are the wage elasticities of supply of and demand for labour, respectively.

Differentiating (29) and substituting (30) leads to the following expression for marginal tax revenue under the lump-sum federal grant:
\[
\frac{dg}{d\tau} = w\left(\varepsilon^d \left(1 - \frac{\tau}{1 - \tau \varepsilon^s}\right) + \frac{\varepsilon^s}{\varepsilon^s + \varepsilon^d}(1 - \tau)\right).
\]
(31)
In this case, optimal tax policy takes account of the effect of the wage tax on fixed-factor rents accruing to the local government, and the marginal cost of public funds is increased proportionally to \((\varepsilon^s + \varepsilon^d)/\varepsilon^d\).

When fixed-factor rents are equalized among jurisdictions in the federation, the feedback from distortionary local taxes to rents is eliminated, the effective marginal cost of public funds is reduced, and distortionary tax rates may rise in consequence. Consider a transfer formula \(e(\tau) = \bar{F} - F(w^*(\tau))\), which equalizes source-based taxes at some exogenous level \(\bar{F}\). The government budget constraint is
\[
g(\tau) = \tau w^*(\tau)l((1 - \tau)w^*(\tau)) + \bar{F}.
\]
(32)
Differentiating (32) and substituting (30),
\[
\frac{dg}{d\tau} = w\left(\varepsilon^d \left(1 - \frac{\tau}{1 - \tau \varepsilon^s}\right) + \frac{\varepsilon^s}{\varepsilon^s + \varepsilon^d}(1 - \tau)\right).
\]
(33)
Comparing (31) and (33), it can be seen that equalization increases the tax-responsive of net local revenues, relative to the lump-sum federal grant, and decreases the effective marginal cost of public funds. Hence, compensating for income effects, equalization results in higher optimal tax rates than an equivalent lump-sum grant. The techniques applied in the proof of Proposition 1 also establish the following formal statement of the result. Let \(\tau^0\) maximize welfare subject to (29) and \(\tau^*\) maximize welfare subject to (32).

**Proposition 5** Suppose that \(e(\tau^0) = \bar{e}\). Then \(\tau^* \geq \tau^0\) if \(l((1 - \tau)w)\) is non-increasing in \(\tau\) and \(l^d(w)\) is non-increasing in \(w\).

When labour is elastically supplied and demanded, the income-compensated effect of equalization is to increase distortionary taxes. This is so even if equalization is confined to a revenue category, such as rents to fixed factors of production, which is itself non-distortionary.

3. **Fiscal externalities and tax competition**

The analysis of the paper has been conducted in a partial equilibrium context of a single local jurisdiction and a federal authority. In this environment, undistorted local government tax policy is second-best optimal, so that an equalization grant results in welfare losses, relative to an equivalent lump-sum grant. More generally, however, it is well understood that strategic interactions among governments may lead to equilibrium tax policies that are inefficient in decentralized equilibrium. In such circumstances, the welfare implications of the analysis may be undermined and possibly reversed.
Fiscal externalities arise in a federation as a result of both “horizontal” interdependencies between subnational governments (e.g., tax exporting and tax competition) and “vertical” interdependencies between federal and subnational governments (e.g., overlapping tax bases, deductibility, piggy-backing). In the presence of such externalities, the marginal cost of public funds perceived by governments will deviate from the true or total MCPF, and Nash equilibrium tax rates will be non-optimal.

In general, these effects may lead to equilibrium tax rates that are either higher or lower than optimal levels. Overlapping of tax bases between federal and subnational governments reduces the perceived MCPF of “shared” taxes and hence induces subnational governments to levy higher taxes (see, e.g., Boadway and Keen, 1996). On the other hand, tax exporting and tax competition leads to fiscal spillovers among subnational governments. In some circumstances, it can be established that in the presence of such spillovers Nash equilibrium tax rates are below second-best levels. When this is the case, RTS equalization can reduce the effective tax responsiveness of local government revenues, raise equilibrium tax rates, and result in welfare gains, relative to Nash equilibrium. In effect, equalization serves partially to “cartelize” local governments, inducing them to internalize a portion of the fiscal externalities resulting from their tax policies. This observation echoes the casual argument of many authors (e.g., Brennan and Buchanan, 1980) that fiscal federal systems tend to centralize authority in a federation and may result in higher levels of taxation. What this paper demonstrates, however, is that this phenomenon can be attributed to the direct substitution effects of an equalization grant, which may not exist for other forms of federal transfer arrangements.

V. Conclusion

In a federal system of government, subnational governments are ceded authority to collect taxes and determine levels of public spending. When this is so, attempts by federal authorities to promote regional equity through transfers may be hampered by the distortions in incentives for tax authorities at the subnational levels that such transfers create. Fiscal federalism therefore creates conflicts between efficiency and equity analogous to those existing in personal tax systems. An equalization policy based on the representative tax system attempts to address these incentive problems by calculating transfer entitlements indirectly, using differences in revenues calculated at deemed rather than actual tax rates. But this formula may induce higher levels of distortionary taxation in receiving jurisdictions than is second-best optimal.
References


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Figure 1: Increase in distortionary taxation under an equalization grant