MOBILITY AND FISCAL IMBALANCE

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We study how labor mobility affects optimal transfers in a federation and the fiscal imbalances that arise because of constraints on federal tax-transfer policies. Fiscal imbalance — a deviation from the optimal fiscal gap — occurs when the second-best allocation of resources in a federation cannot be achieved because fiscal transfers do not or cannot undo fiscal externalities among regional and federal governments. Under reasonable circumstances, we find that labor mobility increases the optimal fiscal gap, that is, increases the transfers required to achieve the second-best optimum. In a decentralized federation, the optimal fiscal gap cannot be achieved. In the absence of labor mobility, vertical fiscal externalities will apply. Regional governments will overspend, which will induce the federal government to create a negative fiscal imbalance to contain the size of its tax rate, assuming it can commit to future transfers. If the federal government cannot commit, regions will overspend even more and federal transfers will be excessive, leading to a positive fiscal imbalance. In both cases, mobility of labor mitigates the fiscal imbalance by reducing the tendency of regions to overspend.

Keywords: optimal fiscal gap, fiscal imbalance, labor mobility, fiscal externalities

JEL Codes: H70, H73, H77

I. INTRODUCTION

The assignment of expenditure and revenue-raising functions among governments in a federation is one of the classical problems of fiscal federalism, going back to the work of Musgrave (1959), Oates (1972), and McLure (1983). A key aspect of the assignment problem is finding the correct balance between expenditure and revenue-raising responsibilities on the one hand, and the system of federal-regional transfers used to reconcile them on the other. The term fiscal gap captures the idea that it may be preferable to decentralize expenditure decisions more than revenue-raising responsibilities, and use transfers to facilitate this preference. An optimal fiscal gap will be a set of...
transfers that just enables the two levels of government to pursue their fiscal responsibilities in an ideal way, for example, to achieve some second-best level of efficiency in the federation. Moreover, the optimal fiscal gap may incorporate the need for transfers to differ among regions because of some underlying heterogeneity in their ability to provide desirable levels of local public goods and services. The exact form of the optimal fiscal gap will differ according to the nature of the federation being studied. Factors such as the mobility of goods, factors and households, differences among regions, and the objectives of government will influence both the optimal extent of decentralization and the size of the fiscal gap across regions. The literature on the optimal fiscal gap is relatively small, but includes contributions by Gordon (1983), Dahlby (1996), Boadway and Keen (1996), Dahlby and Wilson (1994), Persson and Tabellini (1996a, 1996b), Sato (2000) and Goodspeed (1995).

Our concern is with a related concept, that of fiscal imbalance. Loosely speaking, fiscal imbalance exists if the allocation of fiscal responsibilities between federal and regional governments on the one hand, and across regional governments on the other, are such that the optimal fiscal gap is not achieved. Equivalently, the size of federal-regional transfers does not coincide with the second-best optimal level. Part of our purpose is to illustrate the concepts of the optimal fiscal gap and fiscal imbalance in a stylized model, and to study how labor mobility affects them.

The problem of fiscal imbalance and its relationship to the optimal fiscal gap have been prominent in the Canadian federation recently and have given rise to much policy debate. The Canadian federation is characterized by a relatively high degree of fiscal decentralization combined with a two-pronged system of federal-provincial transfers that closes the fiscal gap using block grants and provides payments to less well-off provinces to equalize their capacity to finance the provision of public services. These differences in fiscal capacity arise from the fact that provinces have access to the main broad-based taxes, including income, sales, payroll and property taxes, and also own the natural resources in their jurisdictions. During the 1990s, the federation had to deal with two sorts of pressures. On the one hand, governments at all levels were facing relatively large fiscal deficits and accumulating substantial public debts, as well as other unfunded liabilities such as public pensions. At the same time, horizontal imbalances were becoming substantial owing to the increase in natural resource prices, especially oil and gas, that generated especially large revenues for a small number of provinces. This imposed additional fiscal pressures on the federal government, as the size of the formula-based equalization system grew at what was regarded at the federal level as an unsustainable rate. The response of the federal government was to address its fiscal difficulties by preemptively reducing transfers to the provinces, and by capping the rate of growth of the equalization system. The provinces responded vigorously by claiming that the federal government had created a fiscal imbalance by its actions, and a national debate ensued.1 The federal government eventually responded by increasing the size

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1 The concept of fiscal imbalance in the Canadian context was introduced by the Commission on Fiscal Imbalance (2002), which was a study done for the Quebec government. The issue was thoroughly considered by the Council of the Federation (2006), which is a body representing all the provinces and territories.
of transfers to the provinces to eliminate the vertical fiscal imbalance. As well, the equalization system was reformed, largely by reducing the extent to which provincial natural resource revenues were equalized. One of the consequences of the latter has been a significant reallocation of workers to the provinces experiencing resource price shocks, a movement that is seemingly exacerbated by a failure of the fiscal transfer system to address the resulting horizontal imbalance.

More generally, the idea of fiscal imbalance can apply whenever revenue-raising and the transfer system are misaligned with expenditure requirements. This can occur because of an asymmetric shock that the system of transfers is unable to ameliorate. It can also occur because of actions initiated by one level of government or the other in response to jurisdictional needs. Thus, a regional government may over-extend itself financially in anticipation of eliciting a federal transfer (or bailout): the so-called soft budget constraint (Wildasin, 2004; Vigneault, 2007). Alternatively, as in the Canadian case, the precipitous action of the federal government may leave one or more regions with fiscal deficiencies: an excessively hard budget constraint.

As these examples indicate, whether it is initiated by an external shock or by the actions of one level of government, the existence of fiscal imbalance typically presumes some interdependencies among governments in a federation. These can take various forms. There is an established literature on fiscal externalities, carefully surveyed by Dahlby (1996, 2008), that recognizes various ways in which decisions taken in one jurisdiction spill over into other jurisdictions. Regional government fiscal policies can directly affect residents of other jurisdictions, exemplified by expenditures on public goods and services whose benefits transcend borders, or environmental policies that affect residents in neighboring jurisdictions. Alternatively, government policies in one region may indirectly affect residents elsewhere through the effect on government budgets in other regions, giving rise to so-called fiscal externalities. It is this sort of indirect interdependency that is our focus since it gives rise to fiscal imbalances.

In particular, there are two sorts of government-to-government fiscal interactions that can lead to fiscal externalities: horizontal and vertical. Horizontal fiscal externalities arise to the extent that fiscal policies in one region affect the fiscal capacities of other regional governments. This typically results either from mobility of tax bases or from cross-regional ownership of tax bases. Thus, mobility of capital or cross-border purchases of products can give rise to tax competition, as a consequence of which tax rates are driven down below their efficient levels as regions compete to attract scarce tax bases. Cross-border ownership of tax bases can have an offsetting effect. If the tax bases are not highly mobile, regional governments will have an incentive to overuse source-based taxes if some of the owners are non-residents. That is, tax exporting will occur, as in the analysis of McLure (1967).

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2 Tax competition in products is analyzed in Mintz and Tulkens (1986), Kanbur and Keen (1993), and Lockwood (2001). The classic references for capital tax competition are Wilson (1986) and Zodrow and Mieszczowski (1986), with a recent survey provided by Wildasin and Wilson (2004). In some circumstances, tax competition may be efficiency-enhancing, as in Oates and Schwab (1988) for example, where governments can impose taxes on both mobile and immobile tax bases.
The case of labor mobility is less clear since, depending on the model, it may or may not be beneficial to use fiscal policies to attract more labor. In so-called Ricardian models of federalism with costless migration, where each region has a fixed factor (e.g., land) and each provides a regional public good, regional governments choose their tax rates and public goods supplies optimally under reasonable circumstances. This is because free migration makes the per capita utility in each region the same so that maximizing regional per capita utility is equivalent to maximizing national per capita utility, a phenomenon referred to as incentive equivalence by Myers and Papageorgiou (1993). On the other hand, mobility of low-income transfer recipients can give rise to similar tax competition effects as capital or product mobility. In this case, the interests of the regions and their governments typically coincide with those of the non-poor population who are immobile and who finance transfers to the poor based on altruistic motives.

For future reference, one way of characterizing the consequences of fiscal externalities, following Dahlby (2008), is by its effect on the so-called marginal cost of public funds (MCPF). Since a regional government perceives a loss in tax base from an increase in its own tax rate as being a cost to itself (even though the cost is offset by a benefit to another region), it takes its MCPF as being higher than the “social” MCPF. On the other hand, with cross-border ownership of tax bases, tax exporting will lead regions to underestimate the true MCPF since part of the burden of tax increases is borne by non-residents.

Vertical fiscal externalities occur between levels of government, and apply even in the absence of mobility. The basic idea, which goes back to Johnson (1988), occurs in its starkest form when the federal and regional governments use a common tax base, provided it is variable in size, as analyzed by Boadway and Keen (1996), Dahlby (1996), Keen (1998), Boadway, Marchand and Vigneault (1998) and Hoyt (2001). If an increase in a region’s tax rate reduces the size of the tax base, that will not only temper the increase in tax revenues the region will obtain, it will also reduce the tax revenue of the federal government. Regions will have little incentive to take this into account (unless the reduced federal taxes feed back into reduced transfers to the region), and will consequently tend to set too high a tax rate. Put differently, regions will underestimate their MCPFs. Vertical and horizontal fiscal externalities due to tax competition thus tend to work in opposite directions. On balance, either could dominate.

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3 See Boadway (1982) and Myers (1990). This issue is discussed in the recent survey of equalization by Boadway (2004).

4 Boskin (1973), Pauly (1973), and more recently Wildasin (1991) and Kessler, Lülfessman and Myers (2002) study the inefficiencies arising from mobility of low-income households.

5 This presumes that an increase in the regional tax rate reduces the federal tax base. As Dahlby and Wilson (2003) point out, this need not be the case. If the labor income tax base is pre-tax income, a wage tax can cause the pre-tax wage to rise, which increases the federal tax base and federal revenue. See also Keen (1998) for a discussion of cases where vertical fiscal externalities can lead to lower regional tax rates.

6 See for example Keen and Kotsogiannis (2002) for a model where either vertical or horizontal externalities may dominate.
There is ample empirical evidence for both horizontal and vertical fiscal externalities. The case of excise taxes was first examined by Besley and Rosen (1998), who found evidence of vertical fiscal externalities in the case of cigarette and petroleum excise taxes in the United States. Devereux, Lockwood and Redoano (2007) extended the analysis to include both horizontal and vertical interaction, and found both to apply. The extent of horizontal and vertical capital tax competition was estimated for Canada by Hayashi and Boadway (2001), and for the United States by Esteller-Moré and Solé-Ollé (2001). Brülhart and Jametti (2006) studied horizontal and vertical externalities for the case of mobile labor in Switzerland. Winer and Gauthier (1982) and Day and Winer (2001) found some evidence of fiscally-induced migration across Canadian provinces.

The strength of the effect of fiscal externalities on regional behavior depends on the federal-regional transfer system. Indeed, the transfer system is a potentially important policy instrument that the federal government can use to nullify the efficiency effects of fiscal externalities. In the case of identical regions, Boadway and Keen (1996) showed that, in a simple model with distortionary labor taxation, the vertical fiscal gap can be designed to achieve a second-best federal optimum in the presence of vertical fiscal externalities. When regions differ in their fiscal capacities, things are a bit more complicated since horizontal balance must be addressed as well. As Smart (1998) argued, an equalization system that bases federal-regional transfers on the so-called representative tax system (RTS) approach will largely sterilize horizontal fiscal externalities as an influence on regional behavior. Under RTS equalization (used in Australia and Canada), a region’s revenue-raising capacity for a given tax base is measured by the per capita revenues it would raise by applying national average regional tax rates to the region’s actual tax base. Equalization entitlements are then based on differences between a region’s per capita revenue-raising capacity and the national average. Given that, the tax loss arising from changes in the tax base resulting from an increase in a region’s tax rate will be approximately offset by an increase in equalization transfers (and exactly offset if the region’s tax rate is the same as the national average). Thus, not only will the horizontal externality be undone, so will the part of the MCPF that is due to a variable regional tax base. That is, the perceived MCPF will be too low.

At the same time, the vertical fiscal externality will remain to a large extent intact. Bucovetsky and Smart (2006) show that in principle an equalization system can be defined, at least for a given tax base, so that the joint effects of vertical and horizontal fiscal externalities are undone. Such a system might not be viable in practice since a different equalization system would have to be defined for each regional tax base. Moreover, the purpose of equalization transfers is much broader than simply undoing the inefficiencies due to fiscal externalities. More generally, combining matching transfers with equalization can be used to achieve a second-best optimum as long as there are no restrictions on the use of those policy instruments (Sato, 2000).

The literature on federal-regional transfers has also emphasized a related role of equalization, which is to provide insurance against external shocks of various sorts including those affecting productivity, preferences and costs. The empirical role of transfers in stabilizing regions against shocks has been studied by Asdrubali, Sørenson
and Yosha (1996), von Hagen and Hammond (1998), and Méliitz and Zumer (2002), and the literature has been surveyed by von Hagen (2007). The theoretical literature has emphasized adverse selection (Bordignon, Manasse and Tabellini, 2001), moral hazard (Persson and Tabellini, 1996b), and redistribution (Persson and Tabellini, 1996a), and has been surveyed by Lockwood (1999). In this literature, optimality is typically violated by asymmetric information or political economy considerations. Neither vertical nor horizontal fiscal externalities play a role since there are typically no distortionary taxes or mobility. Our notion of fiscal imbalance can be interpreted as indicating how shocks, either permanent or temporary, affect fiscal externalities.

The purpose of this paper is twofold. The first is to study how mobility affects the size of the optimal fiscal gap that would be achieved by a federation of heterogeneous regions when a central government has sufficient policy instruments to implement the second-best outcome. The second is to study how fiscal imbalance is affected by both vertical and horizontal externalities in institutional settings where some policy restrictions apply, and where migration occurs. We do so in a simple model where fiscal imbalance results from regional asymmetries, and where the imbalance reflects purely efficiency considerations. The basic model we use is related to the one developed in Boadway and Tremblay (2006) to formalize the notion of fiscal imbalance. In that model, where there was no migration, a vertical fiscal externality precluded the federal government from making sufficient transfers to achieve fiscal balance among the federal government and the regions. In this paper, we allow for mobility of taxpayers across regions to determine whether that diminishes or worsens both the fiscal gap and fiscal imbalance.

The extent of fiscal imbalance, as well as the effect of mobility, depends on the order in which decisions are made by the various actors, both governments and households. The standard approach in the fiscal federalism literature is to assume that the federal government acts first, followed by the regional governments, followed by households, where the households decide both where to reside and how much to produce and consume. We use this timing in our benchmark setting. It corresponds with optimal (second-best) policy settings in typical public economics approaches. However, as is now well known, outcomes can change significantly when the order of decisions change. Given the multiplicity of decisions and events in federalism models with labor mobility, there are a large number of different timing scenarios we could consider. We focus on those that seem to give the most insight. Our main emphasis is on changing the order of decisions of the governments, allowing the regions to make some fiscal decisions before the federal government. This results in the various forms of soft budget constraints mentioned above whereby the regions are able to exploit the fiscal transfer system to their advantage. In each case we focus on the effect that mobility has on fiscal decisions.

Our analysis is somewhat related to that of Sanguinetti and Tommasi (2004), who examine how transfers may be used to mitigate vertical fiscal imbalances in a setting where transfers serve an insurance motive. Their analysis highlights a trade-off between the insurance benefits associated with ex-post transfers and the greater fiscal discipline of local governments that may result from the commitment of the central government to transfers ex-ante.
and on fiscal imbalance. In a concluding section, we briefly consider the possibility that migration of workers applies before governments make their fiscal decisions. As Mitsui and Sato (2001) have shown, allowing households to migrate before governments choose public goods spending can have dramatic effects on outcomes. We also discuss the consequences of the relative productivity of the regions being revealed only after some decisions are made by the federal and regional governments. Thus, there might be a distribution of shocks to production that hit the regions that affect their ability to raise revenues.

The meaning of fiscal imbalance we adopt is a particular one and deals mainly with the revenue side of government budgets. Expenditure responsibilities for federal and regional governments are taken as given: the federal government provides a national public good while the regions provide a regional public good for which there are no spillover benefits. It is left to the federal and regional tax systems combined with federal-regional transfers to finance the public goods. The issue is how to design the federal tax and transfer system to achieve an efficient allocation of resources in the federation, given that the tax base (labor income) is both variable and mobile.

II. A MODEL OF FISCAL IMBALANCE WITH MOBILITY

The model we use adapts a much simplified version of the model of fiscal imbalance developed in Boadway and Tremblay (2006) to a setting with mobile taxpayers. The attachment-to-home version of mobility introduced by Mansoorian and Myers (1993) is used to capture household mobility in a way that generates an interior solution for the allocation of population across regions. To simplify matters, we assume there are only two regions, referred to as the poor region \( P \) and the rich region \( R \), where the meaning of poor and rich will be defined below. Our notation convention is to denote variables in \( P \) by lowercase Roman letters, those in \( R \) by lowercase Roman letters with a bar, and federal variables by uppercase Roman letters.

The model is designed to capture, in a simple setting, the impact of vertical and horizontal fiscal externalities on the optimal fiscal gap and on fiscal imbalance in a federation where two levels of government share a distortionary and mobile tax base, and make their fiscal decisions sequentially and non-cooperatively. There is a continuum of households with a total population normalized to unity for the federation as a whole. Households are identical except for an attachment-to-home parameter denoted \( a \). They are distributed uniformly over \( a \in [0,1] \), so there is one household of each type \( a \). Utility consists of two components, one involving an identical quasilinear utility function in goods and leisure, and the other an intrinsic attachment-to-home component. For a

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8 Sato (2000) also uses the attachment-to-home framework to study the fiscal gap in a federation with fiscal externalities. His focus is on the type of transfers that would be required to replicate the second-best optimum. The alternative approach is to allow perfect labor mobility, but to assume a fixed factor in each region, which induces diminishing marginal productivity of labor. The analysis would be slightly more complicated in this setting, but would yield similar results.
type $-a$ household, utility in region $P$ is $c - h(y) + b(g) + 1 - a$, while in region $R$ it is $\bar{c} - h(\bar{y}) + b(\bar{g}) + a$, where $c$ is consumption, $y$ is output endogenously supplied and $g$ is a regional public good in $P$, and similarly for $\bar{c}$, $\bar{y}$ and $\bar{g}$. Note that the regional public good benefits all persons in the region and is not subject to congestion for simplicity.\(^9\) The disutility of supplying output $h(\cdot)$ is increasing and strictly convex. This function could be regarded as the disutility of labor supply, and allows us to introduce distortionary taxation in the model in a simple way. The benefit of the regional public good $b(\cdot)$ is increasing and strictly concave. The quasilinear form of utility serves two purposes. It simplifies the analysis by eliminating income and cross-price effects from output supply, and it abstracts from the insurance and redistributive roles of taxes and transfers by making the marginal utility of consumption constant and identical for all households, thereby allowing us to focus on efficiency considerations.

Household $a$ will choose to reside in the region where the highest utility is achieved. We can identify the marginal household, say household $\tilde{a}$, as the one who is just indifferent between the two regions, which gives the migration equilibrium condition:

\begin{equation}
(1) \quad c - h(y) + b(g) + 1 - \tilde{a} = \bar{c} - h(\bar{y}) + b(\bar{g}) + \tilde{a}
\end{equation}

Households with $a < \tilde{a}$ will choose $P$, while those with $a > \tilde{a}$ will choose $R$. Thus, in equilibrium the population in $P$ is $\tilde{a}$, while that in $R$ is $1 - \tilde{a}$.

Production consists not only of output endogenously chosen by households, but also of an exogenous and fixed component of per person production in the two regions denoted $x$ and $\bar{x}$, where $x > \bar{x}$. Therefore, total levels of output in regions $P$ and $R$ are, respectively, $y + x$ and $\bar{y} + \bar{x}$.\(^{10}\) This assumes that the region-specific productive capacities $x$, $\bar{x}$, apply to migrants as well.\(^{11}\) The variables $x$ and $\bar{x}$ capture in a simple way the impact of differences across regions in fixed factor endowments or in technologies, for example. The alternative, more standard, approach of specifying production functions that vary across regions complicates the analysis without affecting the results.

Governments finance their expenditures by proportional taxes on output, denoted $t$ in region $P$ and $\bar{t}$ in $R$. Given the variability of output supplied by households, these taxes will be distortionary. The federal government imposes a proportional tax at the same rate $T$ on output in both regions and makes unconditional transfers of $S$ and $\bar{S}$ to the two regions. Given $\tilde{a}$ from (1), the budget constraints of the federal government and the regions can be written:

\begin{equation}
(2) \quad \tilde{a}T(y + x) + (1 - \tilde{a})T(\bar{y} + \bar{x}) = S + \bar{S}
\end{equation}

\(^9\) We could have included a national public good in the model, but it complicates the analysis slightly without generating additional insights. All the results regarding the impact of mobility on the optimal fiscal gap and on fiscal imbalance would remain intact in the presence of a national public good.

\(^{10}\) In the model of Boadway and Tremblay (2006), production also includes a fixed stochastic component that is determined after fiscal decisions have been made. We do not consider this here, given that it would not affect our main results about the impact of labor mobility.

\(^{11}\) In contrast, in the local taxation model of Goodspeed (1995), poor migrants are assumed to remain poor when moving to a rich region.
In this context where independent decisions are being made by the federal government, the regional governments and households, the timing of decisions is important. We explore some consequences of different timing in what follows. The benchmark case used for comparison is what we refer to as the full commitment case where the federal government makes all its decisions before the regions. The timing for this case consists of the following stages:

1. Households are initially equally allocated between P and R, so $\bar{a} = 1/2$.
2. Nature chooses permanent shocks $x, \bar{x}$.
3. The federal government chooses $S, \bar{S}, T$.
4. The regions simultaneously choose $g, \bar{g}, t, \bar{t}$.
5. Households choose their region of residence.
6. Households in each region choose outputs $y, \bar{y}$.

The equilibrium outcomes are assumed to be subgame perfect. At each of the above stages, agents take as given outcomes from the previous stages and anticipate how their decisions will affect subsequent ones. In particular, the policies chosen by both the federal government and the regions must satisfy their budget constraints, anticipating the output decisions chosen by households. As usual, we solve using backward induction.

We begin by describing household decisions before turning to the two levels of government. Since households always move last, our formulation of household behavior applies to all subsequent scenarios.

### III. HOUSEHOLD BEHAVIOR

Consider households in region $P$ choosing how much output $y$ to supply. Because of the quasilinearity of preferences, their choice of $y$ is not affected by $a$ or $g$. Using the budget constraint $c = (1 - t - T)(y + x)$ to eliminate $c$, each household regardless of their attachment parameter $a$ solves the following problem:

$$\max_y \left\{ (1-t-T)(y+x) - h(y) \right\}.$$

The first-order conditions reduce to $h'(y) = 1 - t - T$, which yields the output supply function $y(1 - t - T)$, with $y'(\cdot) > 0$. The value function for this problem is defined to be $v(t + T, x)$, and the envelope theorem yields:

$$v_t = v_x = -\left( y + x \right), \quad v_x = (1-t-T),$$

where subscripts indicate partial derivatives. In region $R$, the analogous value function is $v(\bar{t} + T, x)$, with the envelope results denoted $v_t = v_x = -\left( y + x \right), v_x = (1-\bar{t} - T)$. 

$$\hat{a}t \left( y + x \right) + S = g, \quad (1-\hat{a})\bar{t} \left( \bar{y} + \bar{x} \right) + \bar{S} = \bar{g}$$
Given these value functions, we can rewrite the migration equilibrium condition (1) as:

\[ v(t + 1, x) + b(\bar{g}) + 1 - \bar{a} = v\bigl(\bar{t} + T, \bar{x}\bigr) + b\bigl(\bar{g}\bigr) + \bar{a}. \]

Recall our assumption that the initial allocation of households is such that \( \bar{a} = 1/2. \) Given that exogenous output in \( R \) exceeds that in \( P (\bar{x} > x), \) we expect that households will reallocate so that \( \bar{a} < 1/2. \) However, it turns out that once federal interregional transfers are chosen optimally so that resources are reallocated from \( R \) to \( P, \) the direction of migration is ambiguous. We return to this below.

IV. THE SECOND-BEST OPTIMUM

A natural benchmark case to consider is a planning problem in which private and public goods in each region can be chosen by a national social planner. To make the planning problem comparable to the decentralized ones considered later, we assume that the planner is subject to four types of constraints. The first is a resource constraint that limits the aggregate quantities of private and public goods. The second is the restriction to the use of distorting taxes on output. The last two involve household decisions, which are assumed to be beyond the dictates of the planner. One of these is the labor supply decision of households, and the other is the choice of region of residence. Although the planner cannot control these directly, it can influence them indirectly through labor taxes and public goods in each region. The planner is also bound by the timing of events set out above. The solution to the planning problem yields the second-best optimum, given that distorting taxes on output cannot be avoided. We begin by setting out the planning problem and characterizing the second-best optimal allocation. Then, we define and identify the optimal fiscal gap implicit in the second-best optimum. Finally, we consider the effect of migration on the optimal fiscal gap.

A. The Planning Problem

Suppose that the planner provides regional public goods out of a national budget financed by national taxes on household in the two regions, denoted \( \tau \) and \( \bar{\tau}. \) The planner’s budget constraint is:

\[ \bar{a}\tau \cdot \bigl(y(1 - \tau) + x\bigr) + \bigl(1 - \bar{a}\bigr)\bar{\tau} \cdot \bigl(\bar{y}(1 - \bar{\tau}) + \bar{x}\bigr) = g + \bar{g}, \]

where the output supply functions \( y(1 - \tau) \) and \( \bar{y}(1 - \bar{\tau}) \) have the same properties as above, and where \( \bar{a} \) is given by the migration equilibrium condition analogous to (5):

\[ v\bigl(\tau, x\bigr) + b\bigl(\bar{g}\bigr) + 1 - \bar{a} = v\bigl(\bar{\tau}, \bar{x}\bigr) + b\bigl(\bar{g}\bigr) + \bar{a}. \]
The objective function of the planner is taken to be the sum of expected utilities, including the attachment-to-home component \( \tilde{a} \). The planner chooses \( g, \bar{g}, \tau \) and \( \bar{\tau} \) to maximize the sum of utilities subject to the budget constraint, where \( \tilde{a} \) is determined by the migration equilibrium condition. It is convenient to allow the planner to use \( \tilde{a} \) as an artificial control variable and to include the migration equilibrium condition as a constraint. The Lagrangian function for the planning problem is then:

\[
\Gamma = \tilde{a} \left( v(\tau, x) + h(g) \right) + \tilde{\alpha} - \int_0^{\tilde{a}} \text{ada} + \left( 1 - \tilde{\alpha} \right) \left( v(\bar{\tau}, \bar{x}) + b(\bar{g}) \right) + \int_0^1 \text{ada} \\
+ \Phi \left[ v(\tau, x) + b(g) - v(\bar{\tau}, \bar{x}) - b(\bar{g}) - 2\tilde{\alpha} + 1 \right] \\
+ \Lambda \left[ \alpha \tilde{\tau} \cdot \left( y(\cdot) + x \right) + \left( 1 - \tilde{\alpha} \right) \bar{\tilde{\tau}} \cdot \left( \bar{y}(\cdot) + \bar{x} \right) - \bar{g} - \bar{\bar{g}} \right].
\]

The first-order conditions can be written as follows, using the envelope conditions (4):

\[
\begin{align*}
(\tilde{\alpha} + \Phi) b'(g) &= 1 - \tilde{\alpha} - \Phi b'(-g) = \Lambda \\
\Lambda &= \frac{\tilde{\alpha} + \Phi}{\tilde{\alpha}} \frac{y + x}{y + \tau y'} = 1 - \tilde{\alpha} - \Phi \frac{\bar{y} + \bar{x}}{1 - \tilde{\alpha} \bar{\tilde{\tau}} y'} \\
v(\tau, x) + b(g) + 1 - \tilde{\alpha} - v(\bar{\tau}, \bar{x}) - b(\bar{g}) - \tilde{\alpha} + \Lambda \left( \tilde{\tau} \cdot \left( y(\cdot) + x \right) - \bar{\tilde{\tau}} \cdot \left( \bar{y}(\cdot) + \bar{x} \right) \right) &= 2\Phi.
\end{align*}
\]

To interpret these conditions, begin with (8), the condition on \( \tilde{\alpha} \). It involves the shadow price of the migration constraint \( \Phi \). The sign of \( \Phi \) can be inferred by considering the hypothetical case in which the planner is not constrained by household mobility and could dictate where persons reside. The mobility constraint would not apply, and the first-order condition for the choice of \( \tilde{\alpha} \), which is equivalent to choosing the number of residents in each region, can be written:

\[
v(\tau, x) + b(g) + 1 - \tilde{\alpha} - v(\bar{\tau}, \bar{x}) - b(\bar{g}) - \tilde{\alpha} = \Lambda \left( \tilde{\tau} - \tilde{\tau} \right),
\]

where \( \tilde{\tau} \) and \( \bar{\tilde{\tau}} \) are per capita tax revenues in the two regions. Suppose that \( \tilde{\tau} > \tilde{\tau} \), which is reasonable since region \( R \) has higher exogenous income than region \( P \). That implies that the unconstrained planner would prefer to allocate persons such that \( v(\tau, x) + b(g) + 1 - \tilde{\alpha} > v(\bar{\tau}, \bar{x}) + b(\bar{g}) + \tilde{\alpha} \) for the marginal person, which violates the migration equilibrium condition. The intuition is that per capita tax revenues are like a fiscal externality along the lines of Buchanan and Goetz (1972) or Flatters, Henderson and Mieszkowski (1974). The benefit of a new migrant to the rest of the community

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12 In Mansoorian and Myers (1993) and Sato (2000), the planner neglects the utility associated with attachment to home as a component of social welfare. Excluding attachment to home in social welfare complicates the analysis slightly, but similar results are obtained.
is the additional tax revenue the migrant generates to help finance the regional public good. If tax revenues per capita are not equal (being determined by the choice of tax rates to satisfy (7)), utilities should not be equalized between regions. That is, the net revenue benefit from moving one person from \( P \) to \( R \) is 
\[
\Lambda(\tau \cdot (y(\cdot) + x) - \bar{\tau} \cdot (\bar{y}(\cdot) + \bar{x})).
\]
Since this is positive, one should be willing to move persons until utility in \( R \) is lower than in \( P \) to offset it. Alternatively, \( v(\tau, x) + b(g) + 1 - \bar{a} + \Lambda \tau \cdot (y(\cdot) + x) \) is the social value of having one more person in \( P \): the utility of the person moving plus the extra revenue the migrant creates to finance the public good.\(^{13}\)

This fiscal externality of migration reflected in per capita tax revenue is well-known and forms one argument for equalization transfers as discussed, for example, in Boadway and Flatters (1982), Goodspeed (1995), and Boadway, Cuff and Marchand (2002).

If the planner must abide by the migration equilibrium constraint, which we are assuming, that constraint will be binding. In particular, since the planner would prefer that utility for the marginal person be higher in \( P \) than in \( R \), we have \( \Phi < 0 \). This is consistent with the first-order condition on \( \bar{a} \), (8), which, using the migration equilibrium condition (5), can be written as:

\[
2\Phi = \Lambda \left( \tau \cdot (y + x) - \bar{\tau} \cdot (\bar{y} + \bar{x}) \right) = \Lambda \left( tr - \bar{r} \right) < 0.
\]

Next, consider the conditions on \( \tau \) and \( \bar{\tau} \) in (7). The term \( (y + x)/(y + x - \tau y') \) can be interpreted as the marginal cost of public funds (MCPF) for region \( P \), and similarly for region \( R \), which we denote by MCPF. Given that \( \Phi < 0 \), taxes in the two regions will be set such that:

\[
\text{MCPF} = \frac{y + x}{y + x - \tau y'} > \Lambda > \frac{\bar{y} + \bar{x}}{\bar{y} + \bar{x} - \bar{\tau} y'} = \text{MCPF}.
\]

If the marginal cost of public funds is increasing in the tax rate, as we reasonably assume to be the case, then \( \tau \) is higher than in the full planning solution and \( \bar{\tau} \) lower.

This attracts more migrants to \( R \) to offset the tax externality. Note that if there were no migration, the migration constraint would not appear, and the planning solution would involve equalizing the MCPF between the two regions in each state of the world. In this case, revenue would be raised efficiently across the federation. With migration, revenue-raising efficiency is sacrificed to deal with the misallocation of households across regions resulting from the externalities of migration. We use the no-migration case as a point of comparison in what follows.

Finally, consider the conditions on \( g \) and \( \bar{g} \) in (6). Combining these with (7), we obtain:

\[
\tilde{a}b'(g) = \frac{y + x}{y + x - \tau y'} = \text{MCPF}; \quad \left( 1 - \tilde{a} \right)b'(\bar{g}) = \frac{\bar{y} + \bar{x}}{\bar{y} + \bar{x} - \bar{\tau} y'} = \text{MCPF}.
\]

\(^{13}\) This finding that the migration equilibrium constraint is binding is a common finding in models of residential choice. It was first pointed out by Mirrlees (1972) in the case of urban migration and discussed by Boadway, Cuff and Marchand (2002) for an interregional model of equalization transfers.
These are precisely the modified Samuelson rules for regional public goods provision, given that the populations of the two regions are $\tilde{a}$ and $1 - \tilde{a}$ in the second-best optimum. The implication is that, while regional tax rates are used as instruments for addressing the misallocation of population resulting from the migration equilibrium constraint, the conditions characterizing the provision of regional public goods are independent of the migration constraint. Nonetheless, the fact that the planner sets a relatively high $\tau$ and a relatively low $\bar{\tau}$ in order to induce more migration towards region $R$ tends to lower $g$ and increase $g - \bar{g}$.

**B. The Optimal Fiscal Gap**

It is useful for comparison purposes to characterize the decentralized equivalent of the planning solution, that is, where regional governments provide regional public goods ($g, g - \bar{g}$), both levels of government have access to a tax on income ($t, \bar{t}, T$), and there is a system of federal-regional transfers ($S, \bar{S}$). Imagine that regional and federal governments behave cooperatively so that all externalities are internalized. In this setting, where vertical and horizontal externalities are irrelevant, the vertical fiscal gap is indeterminate. Regional and federal tax rates are set such that $t + T = \tau$ and $\bar{t} + T = \bar{\tau}$, so the planning tax rate is achieved. Transfers $S$ and $\bar{S}$ are set such that regions are able to finance the planning levels of $g$ and $g - \bar{g}$, given their own tax revenues. The relative size of optimal transfers ($S, \bar{S}$) is determinate but not the absolute level: an increase in both transfers combined with an increase in the federal tax rate and a decrease in both regional tax rates will leave the outcome unchanged.

To pin down the vertical fiscal gap in a way that allows for a comparison with the following sections, we assume that the planner opts for the minimum level of transfers consistent with them being non-negative. This implies that $S, \bar{S} \geq 0$, with at least one equality. In our benchmark setting, where $P$ has the lowest exogenous per capita income, region $P$ will have a positive transfer and region $R$ will have none, so $S > 0$ and $\bar{S} = 0$. This simplifies our analysis in what follows. More generally, if there were more than two regions, all but one would receive positive transfers of varying size.

**C. The Effect of Mobility on the Optimal Fiscal Gap**

To study the effect that mobility has on the optimal fiscal gap, we compare the outcome when there is no mobility with that when households migrate in response to policy choices. Although this involves comparing two discretely different outcomes, we can nonetheless identify the avenues through which mobility affects the fiscal gap by imagining starting in the no-mobility optimum and then allowing mobility to occur with policy adjusting in response. As it turns out, the effect that labor mobility has on the size of the fiscal gap is somewhat ambiguous, though perhaps for unexpected reasons.

Begin with the no-mobility case, and recall that initially population is allocated equally across regions. In the absence of mobility, the MCPF in both regions is identical in the optimum by (7) (since $\Phi = 0$), so the level of public goods will be the same: $g = \bar{g}$ by
since $\hat{a} = 1 - \hat{a}$. Region $R$, where exogenous income is higher, will have the higher tax rate ($\bar{t} > t$) and will generate the highest tax revenue. Region $P$ obtains a positive transfer equal to the optimal fiscal gap.

Starting in this no-mobility optimum, imagine now that migration occurs. The first problem is that it is ambiguous in which region per capita utility is highest. Region $R$ has a higher tax rate, and thus supplies less discretionary income $y$, and may have higher or lower consumption. Therefore, it is not clear whether migration goes from region $P$ to region $R$, or vice versa. Suppose, reasonably, that utility before migration is higher in the region with the higher exogenous income. Then, migration goes from region $P$ to $R$ and has the following effects on the fiscal gap. First, given the no-migration tax rates, tax revenues fall in region $P$ and rise in region $R$. Second, since the aggregate national tax base rises with migration, so do aggregate tax revenues. Thus, the federal government can reduce tax rates. If tax rates were reduced to keep the MCPF the same in both regions, tax revenue in region $P$ would fall. On both counts, tax revenue falls in region $P$, so a higher transfer must be made to enable it to finance the no-migration level of the regional public good. Further, since tax rates have fallen, the level of regional public goods chosen would rise and this would contribute to an additional source of increase in transfers to region $P$. Finally, as we have seen, the planner would want to move away from equalizing the MCPF in the two regions. Given that per capita tax revenues are higher in region $R$, the planner would encourage migration by increasing the tax rate in region $P$. That would both restrict migration and increase tax revenues in the region, thereby reducing the need for transfers.

Overall, migration from $P$ to $R$ combined with the adjustment of regional tax rates and spending would reduce the tax take in region $P$ relative to its expenditures on the regional public good and cause the optimal fiscal gap to rise. In effect, migration would increase aggregate disparities between the two regions thereby requiring a bigger fiscal gap to address the horizontal imbalance. However, as this discussion indicates, even though this effect of migration is reasonable, it is not unambiguous, since it is hypothetically possible that migration goes from region $R$ to $P$.

**D. Summary of Results**

The main results of this section are summarized as follows.

1. The second-best optimal allocation has the following properties:
   a) The tax rates in the two regions are such that the marginal cost of public funds is higher in the poor region.
   b) The tax rate in the poor region is set at a relatively high level in order to induce more migration to the rich region where per capita tax revenues are higher. In effect, the tax rates are used to address the misallocation of population resulting from a fiscal externality.
   c) The levels of provision of regional public goods satisfy modified Samuelson conditions, given the equilibrium population and marginal cost of public funds in each region.
2. The relative size of the transfers to the two regions required to implement the second-best allocation in a decentralized setting is determinate, but not their absolute level. That is, the size of the vertical fiscal gap is indeterminate. With the transfer to the rich region set to zero, the optimal fiscal gap corresponds to the level of transfer to the poor region required to implement the second-best allocation.

3. Under reasonable circumstances, migration goes from the poor to the rich region, and tends to increase the optimal fiscal gap.

Under decentralized decision-making, there will be a fiscal imbalance in the sense that transfers will deviate from the optimal fiscal gap. In the next three sections, we characterize the fiscal imbalances under different assumptions about the order of government decisions.

V. THE NON-COOPERATIVE OUTCOME WITH FEDERAL COMMITMENT

We now turn to decision-making in a decentralized federal setting where regions behave non-cooperatively and therefore possibly non-optimally. In this section, we consider the case in which the same timing of events occurs as in the second-best base case of the previous section. That is, the federal government can commit to the policies it announces before the regions choose their policies and then the households act. Its announcement consists of \( T, S \) and \( S^- \), but these must be consistent with its budget, given subsequent regional and household choices. It suffices to let the federal government choose \( T \), with \( S \) and \( S^- \) being determined endogenously to balance its budget. Given the federal government’s announced policies, the regions choose \( g \) and \( g^- \) to maximize the sum of utilities in their respective regions subject to their budget constraints and taking as given the policies announced by the other region. They anticipate how their policies affect fiscal transfers \( S \) and \( S^- \) and the value of \( \tilde{a} \) in migration equilibrium.

We focus on the benchmark case in which \( S > 0 \) and \( S^- = 0 \). This minimizes the size of the federal tax rate, and therefore the vertical fiscal externality that applies in this case. Given that, the federal budget may be written:

\[
S = T\tilde{a}\left(y(T + T, x) + x\right) + T\left(1 - \tilde{a}\right)\left(\bar{y}(T + T, \bar{x}) + \bar{x}\right).
\]

The effects that regional policies, federal policies and mobility have on transfers are then as follows:

\[
\frac{\partial S}{\partial T} = -T\bar{y}', < 0, \quad \frac{\partial S}{\partial \bar{a}} = -T(1 - \tilde{a})\bar{y}' < 0
\]

\[
\frac{\partial S}{\partial \tilde{a}} = \tilde{a}\left(y + x - Ty'\right) + \left(1 - \tilde{a}\right)\left(\bar{y} + \bar{x} - (T)(\bar{y}')\right)
\]

\[
\frac{\partial S}{\partial \bar{a}} = T\left(y + x - \bar{y} - \bar{x}\right).
\]
To solve for the equilibrium in this case, we use backward induction and start with the region’s choices.

A. The Problem of Region P

Region $P$ chooses $g$ and $t$ to maximize the total utility of its residents subject to its budget constraint, anticipating its population $\tilde{a}$ as determined by migration and the effect of its policy choice on its transfer $S$. Although $\tilde{a}$ is determined endogenously, it is convenient for analytical purposes to let region $P$ use $\tilde{a}$ as an artificial control variable, adding the migration equilibrium condition as a constraint. The Lagrangian expression is:

$$
\Gamma = \int \left[ v(t+T,x) + b(g) + \tilde{a} \left( y(t+T,x) + x \right) + S(\cdot) - g \right] + \mu \left[ v(t+T,x) + b(g) - v(t+T,\bar{x}) - b(\bar{g}) + 1 - 2\tilde{a} \right],
$$

where the properties of $S(\cdot)$ are given by (12). The first-order conditions can be written, using the envelope conditions and (12), as:

$$
(\tilde{a} + \mu) b'(g) = \lambda
$$

$$
\frac{\tilde{a} + \mu}{\tilde{a}} \frac{y + x}{y + x - (T' + t)} = \lambda
$$

$$
v(t+T,x) + b(g) + 1 - \tilde{a} + \lambda t \cdot (y + x) + \lambda T \left( y + x - \bar{y} - \bar{x} \right) = 2\mu.
$$

Start with the interpretation of (16) for $\tilde{a}$. The left-hand side consists of two components. The first is the value of having an additional migrant, composed of the utility of that migrant plus the value of the tax revenue that the migrant adds to the region (the fiscal externality). This term is positive, and reflects the incentive to attract residents facing the region. The second component involving $T$ is the reduction in federal transfers from having another migrant. It reflects the fact that federal tax revenues fall when a migrant moves from $R$ to $P$, and therefore so does the size of the fiscal transfer $S$. Provided that the difference in tax bases is not too large and/or that the federal tax rate is not too high relative to the regional tax rate, $\mu$ will be positive so region $P$ will have an incentive to attract residents from $R$. We assume reasonably that this is the case.

Condition (15) for $t$ indicates region $P$’s perceived MCPF. It consists of the social value of the MCPF multiplied by $(\tilde{a} + \mu)/\tilde{a}$. Two observations are relevant. First, the presence of $\mu$ reflects a horizontal externality, which tends to increase the region’s perceived MCPF. That is because an increase in the region’s tax rate discourages migrants. Second, there is no vertical fiscal externality for region $P$. That is because in the underlying first-order condition for $t$, there is a term $\delta S/\delta t$ that induces region $P$ to take account of the effect of its tax change on the federal budget, given that the latter ends up reducing the transfer to $P$. This absence of a vertical fiscal externality is due
to the fact that only region $P$ receives a transfer. A vertical externality would appear if there were more than one transfer-receiving region. The result is that region $P$ perceives its MCPF to be too high.

Combining (15) for the state’s perceived MCPF with (13) for $g$, we obtain:

$$ (17) \quad \tilde{a}b'(g) = \frac{y + x}{y + x - (T + \bar{t})y'} . $$

This expression is a Samuelson social optimality condition modified to take into account the true distortionary cost of taxation. Therefore, there is no tendency for $g$ to be set too high or too low. Intuitively, a higher $g$ will attract more migrants, but it will also require a higher tax rate which will have the opposite effect. The two exactly offset each other.

The solution to the problem of region $P$ gives a value function representing total utility in $P$, which we denote as $w(T)$. Using the envelope theorem and the properties of $S(\cdot)$ in (12), differentiating the Lagrangian for region $P$'s problem yields the following:

$$ (18) \quad \frac{dw(T)}{dT} = -\left( \tilde{a} + \mu \right)(y + x) - \lambda \tilde{a} \bar{y} y' + \lambda \frac{\partial S}{\partial T} + \mu \left( \bar{y} + \bar{x} \right) $$

$$ = \lambda \left( 1 - \tilde{a} \right) \left( \bar{y} + \bar{x} - (T)(\bar{y}') \right) + \mu \left( \bar{y} + \bar{x} \right), $$

where we have used (15) to obtain (18). Note that $dw(T)/dT > 0$, reflecting the fact that an increase in the federal tax rate results in a higher transfer to region $P$.

**B. The Problem of Region $R$**

Region $R$’s problem is similar except it receives no transfer. Its Lagrangian expression is analogous to (13), except that its population is $1 - \tilde{a}$. From the first-order conditions, we obtain:

$$ (19) \quad v(\bar{T} + T, \bar{x}) + b(\bar{g}) + \tilde{a} + \bar{\lambda}T \cdot (\bar{y} + \bar{x}) = 2 \bar{g} > 0 $$

$$ (20) \quad \frac{\bar{\lambda}}{1 - \tilde{a}} = \frac{1 - \tilde{a} + \bar{\mu}}{1 - \tilde{a}} \frac{\bar{y} + \bar{x}}{\bar{y} + \bar{x} - (\bar{T})(\bar{y}')} $$

$$ (21) \quad (1 - \tilde{a})b'(\bar{g}) = \frac{\bar{y} + \bar{x}}{\bar{y} + \bar{x} - (\bar{T})(\bar{y}')} . $$

These differ from the case of region $P$ by the fact that there is now a vertical fiscal externality that is not offset by a change in transfers. Equation (19) indicates that there is an unambiguous incentive to attract migrants both because of the addition to total utility of the migrant and because of the fiscal externality corresponding to the additional regional tax revenue generated by the migrant. Then, as (20) indicates, there are offsetting effects on the region’s perceived MCPF. The incentive to attract migrants increases the
region’s perceived MCPF by the term involving $\bar{\mu}$. This is to some extent offset by the vertical fiscal externality resulting from the fact that the region understates the social MCPF by ignoring the effect an increase in its tax rate has on federal revenues (i.e., by the absence of the term in $T$ in the denominator). On balance, the region may over- or under-estimate its MCPF. As for region $P$, $\mu$ does not appear in (21), so migration does not itself create a tendency for region $R$ to set $g$ too high or too low. However, the vertical fiscal externality does induce region $R$ to overspend, unlike region $P$.

We define the value function for region $R$ as $w(T)$. Applying the envelope theorem to region $R$’s problem and using its first-order conditions, the derivative of $w(T)$ can be written:

\[
\frac{d\bar{w}(T)}{dT} = -\bar{\lambda}(1 - \bar{a})\left(\bar{y} + \bar{x}\right) + \bar{\mu}\left(y + x\right) .
\]

### C. The Problem of the Federal Government

We continue to assume that federal transfers cannot be negative. This will be a binding constraint in our simple setting, implying that $S > 0$ for region $P$ and $\bar{S} = 0$ for $R$. It also implies a positive value of $T$ to finance $S$, and thus a vertical externality for region $R$. It is this externality that induces the federal government to minimize $T$ and therefore the fiscal gap. The federal government’s problem is simply to choose $G$ and $T$ to maximize the sum of utilities in $P$ and $R$, where the latter are given by the value functions $w(T)$ and $\bar{w}(T)$ defined above. Since these functions take account of migration responses, there is not need to do so again. The problem of the federal government is therefore simply:

\[
\max_{\{T\}} w(T) + \bar{w}(T) .
\]

Using the envelope theorem results, (18) and (22) derived above, the first-order condition can be written as

\[
\bar{\lambda}(1 - \bar{a})\left(\bar{y} + \bar{x} - (T)(\bar{y})\right) + \mu\left(\bar{y} + \bar{x}\right) - \bar{\lambda}(1 - \bar{a})\left(\bar{y} + \bar{x}\right) + \bar{\mu}\left(y + x\right) = 0 .
\]

This equation indicates how the perceived MCPF’s differ between the two regions, and therefore how inefficiently revenues are raised across the two regions. It can be rewritten as follows:

\[
\frac{\bar{\lambda}}{\lambda} = \frac{\bar{y} + \bar{x}}{\bar{y} + \bar{x} - (T)((\bar{y})')} - \frac{\mu\left(\bar{y} + \bar{x}\right) + \bar{\mu}\left(y + x\right)}{\bar{\lambda}(1 - \bar{a})\left(\bar{y} + \bar{x} - (T)(\bar{y})'\right)} .
\]

Consider the two components on the right-hand side. The first component is greater than unity. To interpret it, suppose there were no migration, so $\mu = \bar{\mu} = 0$, and only vertical fiscal externalities apply. To mitigate this, the federal government reduces its tax rate below the second-best optimal value and reduces transfers to region $P$. Region $P$ must increase its tax rate causing its MCPF to be higher than that in region $R$. This might
be interpreted as a negative fiscal imbalance since $S$ is below its second-best optimal value. The second term, which is negative and therefore counters the first term, indicates that migration tends to reduce the MCPF of region $P$ relative to that of region $R$. The reason is that migration from $P$ to $R$ increases the revenue that the federal government obtains from a given tax rate, making possible a higher transfer to $P$.

Note that in the special case of identical regions, $x = \bar{x}$, the equilibrium would correspond to the second-best optimum. Given that there would be no need for transfers if regions behave symmetrically, the federal government could induce the optimum by committing to a zero tax rate and zero transfers before regional governments choose their policies. Without federal taxation, there would be no vertical fiscal externality to distort regional policies. Therefore, regions would choose the second-best optimal level of public good provision.

D. Summary of Results

The main results for a decentralized setting where the federal government can commit to its policies are summarized as follows.

1. There is a negative fiscal imbalance resulting from the desire of the federal government to reduce its tax rate in order to mitigate the vertical fiscal externality. The optimal fiscal gap is not achieved, and regional tax rates are such that the MCPF is too high in region $P$ relative to region $R$.
2. Mobility mitigates the tendency for a negative fiscal imbalance by allowing the federal government to obtain more revenues for a given tax rate $T$.
3. Neither region $P$ nor $R$ is induced to overspend to attract migrants, even though migrants have a positive net benefit, since such overspending must be accompanied by an increase in regional tax rates which discourage migration.

VI. LIMITED FEDERAL COMMITMENT

In this section and the next, we assume that the federal government cannot commit to its tax and transfer policies before the regions choose their fiscal policies. Two different scenarios are considered, which depend on the order in which the federal and regional governments choose their tax and transfer policies. In this section, the federal government chooses its taxes and transfers after regional public goods are chosen, but before regional tax rates are determined to balance regional budgets. In the following section, we take up the more extreme case of a soft budget constraint where regions can choose their taxes first, relying on the federal government to provide sufficient finance to satisfy their budgets.\(^{14}\)

\(^{14}\) If the government provided a national public good, things are complicated somewhat since various timings are possible. Given the long-run nature of expenditure decisions, it might be reasonable to assume that the national public good is chosen before tax and transfer decisions are made. Then, the only issues of commitment concerns federal and regional taxes and transfers. In an earlier version of this paper, this was the timing we assumed. The federal government could use the national public good to mitigate the consequences of its inability to commit to $T, S$ and $\bar{S}$, but the same qualitative results applied.
As in the base case, the initial allocation of households and the determination of permanent shocks are determined first, and household decisions are taken last. The timing of government decisions in this section is as follows:

1. Regions simultaneously choose \( g, \bar{g} \).
2. The federal government chooses \( S, \bar{S}, T \).
3. Regions choose \( t, \bar{t} \) to balance their budgets.

Again, we characterize the subgame-perfect equilibrium. Household behavior is the same as before, so we can start with the federal government’s choice of \( T, S \) and \( \bar{S} \).

### A. The Tax and Transfer Policy of the Federal Government

At this stage, \( g \) and \( \bar{g} \) are given. The federal government maximizes the sum of utilities subject to its budget constraint, anticipating \( \bar{a}, t \) and \( \bar{t} \) from the migration constraint and the regional budget constraints. To take account of the latter, we let \( \bar{a}, \bar{t} \) and \( \bar{t} \) be artificial control variables and add the relevant constraints to the problem. The Lagrangian expression is:

\[
\Gamma = \hat{a} \left( v(t+T,x) + b\left( g \right) \right) + \hat{a} - \int_0^{\hat{a}} ada + \left( 1 - \hat{a} \right) \left( v\left( \bar{T}, \bar{x} \right) + b\left( \bar{g} \right) \right) + \int_{\hat{a}}^1 ada \\
+ \Phi \left( v(t+T,x) + b\left( g \right) - v\left( \bar{T}, \bar{x} \right) - b\left( \bar{g} \right) - 2\hat{a} + 1 \right) \\
+ \lambda \left( \hat{a}t \cdot \left( y(\cdot) + x \right) + S - g \right) + \bar{\lambda} \left( \left( 1 - \hat{a} \right) T \cdot \left( \bar{y}(\cdot) + \bar{x} \right) + \bar{S} - \bar{g} \right) \\
+ \Lambda \left( \hat{a}T \cdot \left( y(\cdot) + x \right) + \left( 1 - \hat{a} \right) T \cdot \left( \bar{y}(\cdot) + \bar{x} \right) - \bar{S} - \bar{S} \right)
\]

The first-order conditions for \( S, \bar{S} \) immediately yield \( \lambda = \bar{\lambda} = \Lambda \). After decisions over the provision of regional public goods have been made, the optimal policy for the federal government is to equalize the shadow price of government revenue from all budgets. Although the regions’ anticipation of this federal policy will distort their behavior in the previous stage, the federal government cannot commit to do otherwise. Using these, the first-order conditions on \( \hat{a}, t \) and \( \bar{t} \) may be simplified, using the migration equilibrium condition, to:

\begin{align*}
(23) & \quad \Lambda \left( t + T \right) \left( y + x \right) - \Lambda \left( \bar{t} + T \right) \left( \bar{y} + \bar{x} \right) = 2\Phi \\
(24) & \quad \frac{\hat{a} + \Phi}{\hat{a}} \frac{y + x}{y + x - \left( t + T \right) y'} - \lambda = \frac{1 - \hat{a} - \Phi}{1 - \hat{a}} \frac{\bar{y} + \bar{x}}{\bar{y} + \bar{x} - \left( \bar{t} + T \right) \bar{y}'}.
\end{align*}

Equation (23) has the same form as (9) in the planning solution, and as in that case we presume \( \Phi < 0 \). The migration constraint is binding in the problem of the federal
government, given that per capita tax revenues are not equal between the two regions. By (24), the MCPFs are adjusted to take account of migration, as in the planning solution. As in the second-best optimum, the solution to the federal problem determines the relative size of transfers but not their absolute level. Again, we assume that $S$ is set to zero so transfers are at the minimal level required to satisfy (24).

B. The Problem of Region $P$

Region $P$ chooses $g$ to maximize utility, anticipating the federal choice of tax rate and transfer in the next stage as well as the region’s own tax rate. We take that into account by treating $S$, $T$, $t$ and $a$ as artificial control variables and adding as constraints the regional and federal budget constraints, the migration constraint and (23), which characterizes the federal government’s policy in the next stage. The Lagrangian expression is the same as (13) but with two constraints added: the federal budget constraint (11) (with multiplier $\gamma$) and (24) (with multiplier $\eta$). The first-order condition for $S$ gives $\delta = \gamma$, as expected. Then, the conditions on $g$ and $t$ may be written:

\begin{align}
(25) \quad (a + \mu) b'(g) &= \delta \\
(26) \quad \delta &= \frac{y + x}{y + x - (t + T)} y' \left[ \frac{\eta}{\tilde{a}} \left( \frac{\partial \lambda}{\partial t} - \frac{\partial \lambda}{\partial t} \right) + \frac{\tilde{a} + \mu}{\tilde{a}} \right].
\end{align}

By (26), the MCPF perceived by region $P$ is distorted by two effects. The first term in the square brackets on the right-hand side of (26) reflects the incentive of the regional government to over-tax in order to attract a larger transfer from the federal government, thereby exploiting the inability of the federal government to commit. From (24), and using (23), we can verify that $\frac{\partial \lambda}{\partial t} > 0$ and $\frac{\partial \lambda}{\partial t} < 0$. Therefore, the first term is negative, which tends to lower the MCPF perceived by region $P$. The second term represents the effect of mobility. The MCPF is multiplied by $(\tilde{a} + \mu)/\tilde{a}$ (as in the full commitment case), which reflects the horizontal externality associated with migration. This effect tends to increase the MCPF perceived by region $P$ since $\mu > 0$. Thus, mobility mitigates the tendency of the region to underestimate the true MCPF, and on balance may even result in overestimation.

Combining (26) with (25), region $P$’s spending rule is given by:

\begin{align}
\tilde{a} b'(g) &= \frac{y + x}{y + x - (t + T)} y' \left[ 1 + \frac{\eta}{(\tilde{a} + \mu)(y + x)} \left( \frac{\partial \lambda}{\partial t} - \frac{\partial \lambda}{\partial t} \right) \right].
\end{align}

Since the last term in square brackets is negative, this shows that the inability of the federal government to commit to its transfer scheme implies that region $P$ will overspend. Note, though, that the tendency to overspend is mitigated by mobility, as reflected by
the term $\mu$ in the denominator, which as we have seen tends to increase the region’s perceived MCPF.

The problem of region $R$ differs from that of region $P$ since it receives no transfer ($S = 0$). Therefore, in solving the problem of region $R$, we need not impose the federal budget constraint, but still require that $\lambda = \tilde{\lambda}$. The perceived MCPF of region $R$ will be distorted by the same effects as for region $P$, in addition to the distortion associated with the vertical fiscal externality that was characterized in the analysis of the previous section. Even if region $R$ receives no transfer from the federal government, increasing $\bar{g}$ will tend to reduce the transfer provided to region $P$, some of which is financed by federal taxes in region $R$. Therefore, the same incentive for overspending will apply in region $R$, and its magnitude will be tempered by mobility.

In the case of symmetric regions, both regions will face the same incentives to overspend, including that arising from the vertical fiscal externality. The equilibrium will be symmetric, so the federal tax rate and transfers will turn out to be zero. Nonetheless, both regions will choose a level of public good higher than in the second-best optimum.

C. Summary of Results

Under limited federal commitment, the main results are the following.

1. Once the levels of provision of regional public goods are determined, the federal government’s optimal policy consists of equalizing the MCPF between regions.

2. The poor region has an incentive to set a relatively high tax rate and overspend in order to attract a larger transfer from the federal government. Mobility increases the MCPF perceived by the poor region and therefore mitigates the tendency to overspend.

3. The federal government’s inability to commit also induces the rich region to overspend, in addition to the vertical fiscal externality. As for the poor region, the incentive to overspend is tempered by mobility.

VII. THE SOFT BUDGET CONSTRAINT

In this case, we assume that the regions can choose both their spending and their taxes before the federal government chooses its taxes and transfers. The presumption is that the federal government is unable to commit to not bailing out the regions, so it makes whatever transfers are required to allow regional budgets to be balanced. In terms of the timing of the previous section, stage 3 now precedes stage 2. This corresponds with the timing assumed in Goodspeed (2002). We begin with these two stages, which can be treated at the same time.
A. Tax and Transfer Policies

Given that regional governments are able to commit to specific tax rates before the federal government chooses its transfers, the federal government will be forced to make transfers that satisfy the regional budget constraints. Anticipating this, regional governments will simply set their tax rates to zero (assuming that tax rates are restricted to be non-negative). Therefore, regional expenditures will be entirely financed by transfers, so \( S = g \) and \( S^- = g^- \), where regional public goods have already been chosen at this point. The federal tax rate is simply determined by the federal budget constraint.

B. Regional Expenditure Policies

Both regions will face a similar problem, so consider only the problem of region \( P \). Anticipating that transfers will be equal to regional expenditures in both regions, region \( P \) will choose \( g \) to maximize utility, taking \( g^- \) as given. We can solve the regional problem by treating \( T \) and \( \tilde{\alpha} \) as artificial control variables and adding the federal budget and the migration equilibrium condition as constraints. The Lagrangian for region \( P \) is the following, where we have used \( S = g \) and \( S^- = g^- \):

\[
\Gamma = \tilde{\alpha}\left(v(T,x) + b(g)\right) + \tilde{\alpha} - \int_0^1 \tilde{\alpha}da + \gamma \left( \tilde{\alpha}T' \cdot (y(\cdot) + x) + (1 - \tilde{\alpha})T' \cdot (\tilde{y}(\cdot) + \tilde{x}) - g - \tilde{g} \right) + \mu \left( v(T,x) + b(g) - v(T,\tilde{x}) - b(\tilde{g}) + 1 - 2 \tilde{\alpha} \right).
\]

The first-order conditions for \( g \), \( T \) and \( \tilde{\alpha} \) can be written, respectively, as:

\[
(27) \quad (\tilde{\alpha} + \mu) b'(g) = \gamma \\
(28) \quad \gamma = \frac{\tilde{\alpha}(y + x) + \mu(y + x - \tilde{y} - \tilde{x})}{\tilde{\alpha}(y + x - Ty') + (1 - \tilde{\alpha})(\tilde{y} + \tilde{x} - (T)(\tilde{y}')}) \\
(29) \quad v(T,x) + b(g) + 1 - \tilde{\alpha} + \gamma T \cdot (y + x - \tilde{y} - \tilde{x}) = 2\mu.
\]

The left side of (29) characterizing \( \tilde{\alpha} \) is the net benefit of an additional migrant to region \( P \). It corresponds to the utility of the migrant plus the federal marginal cost of public funds multiplied by the reduction in federal revenues that results from the migration of one individual from the high-productivity region to the low-productivity region. This term will again be positive, unless the reduction of federal revenues is sufficiently large.

Condition (28) is the marginal cost of public funds perceived by region \( P \). In the absence of mobility, the last term in the numerator would disappear, and the regional government would underestimate the MCPF relative to the social MCPF as reflected by the last term in the denominator. This term is positive and results from the fact that...
part of the efficiency cost of increasing the federal tax rate is supported by the residents of the other region. The term involving \( \mu \) in the numerator is negative, implying that mobility reduces further the MCPF perceived by the regional government. The intuition is the following. Recall from the household problem that \( v_T = -(y + x) \) and \( \bar{v}_T = -(\bar{y} + \bar{x}) \), so that \( (y + x - \bar{y} - \bar{x}) = \bar{v}_T - v_T < 0 \). An increase in the federal tax rate reduces the difference in after-tax incomes between the high- and low-productivity regions, which tends to reduce the relative benefit of residing in region \( R \). Therefore, it induces migration towards region \( P \). In turn, this lowers the MCPF perceived by region \( P \). For region \( R \), the effect of migration on the perceived MCPF will be the opposite. That is, the fact that increasing the federal tax rate induces migration away from region \( R \) will tend to increase the MCPF perceived by the rich region.

Combining (27) and (28), we obtain:

\[
\tilde{a}b'(g) = \frac{y + x - \frac{\mu}{\bar{a} + \mu}(\bar{y} + \bar{x})}{(y + x - Ty') + \frac{(1 - \bar{a})}{\bar{a}}(\bar{y} + \bar{x} - (T)(\bar{y}''))}.
\]

This differs from the modified Samuelson condition in the second-best optimum by two effects. First, in the denominator, the second term reflects the implicit marginal transfer from region \( R \) to region \( P \) associated with a marginal increase in \( g \), given that it is entirely financed from federal tax revenues. Since this term is positive, it tends to reduce the marginal cost of public funds perceived by region \( P \) and induces overspending. The same effect will also induce region \( R \) to overspend.

Second, the decision rule for \( g \) is also affected by migration, as reflected by the last term in the numerator. If the net benefit of an additional migrant to region \( P \) is positive, then \( \mu > 0 \). In this case, there is an incentive to increase spending in order to attract additional migrants. In the case of region \( R \), the desire to attract migrants will tend to lower spending given that a lower federal tax rate induces more migration towards region \( R \). Note that, in contrast to the case in which the federal government can commit to its tax rate, regions can affect migration through their spending decisions because changing the provision of regional public goods has no effect on regional tax rates.

Note the difference between this soft budget constraint case and the previous one where the federal government chooses its transfers before the regions choose their tax rates. In that case, mobility tended to mitigate the overspending of both regions that would otherwise occur as they exploited the inability of the federal government to commit to transfers before regional spending occurs. Here, mobility mitigates the overspending of the rich region but it exacerbates the problem in the poor region. Thus, timing is important in determining the effect that migration has on the fiscal imbalance.

In the special case where \( x = \bar{x} \), both regions would set their tax rate to zero and overspend, anticipating a federal transfer to cover their expenditures. In contrast to the limited commitment case, both regions will end up receiving a transfer.
C. Summary of Results

The main results in the soft-budget constraint case are summarized below.

1. Anticipating that federal transfers will be set to balance regional budgets, regions set their tax rates to zero and regional public goods are entirely financed by transfers.
2. Both regions tend to underestimate the MCPF and overspend since part of the efficiency cost of the federal tax is supported by the other region.
3. Given that an increase in the federal tax rate will reduce the difference in after-tax incomes across regions and lower the level of migration to the rich region, mobility tends to exacerbate the overspending problem in the poor region, but mitigate it in the rich region.

VIII. CONCLUSIONS AND EXTENSIONS

In this paper, we characterized the optimal fiscal gap and the fiscal imbalances that can arise in a federation in which different governments are making decisions sequentially and non-cooperatively, and examined how labor mobility affects the size of both the fiscal gap and the fiscal imbalance. In considering the effect on fiscal imbalance, our analysis distinguished between the cases in which the federal government can and cannot commit to a structure of taxes and transfers to regions before regional policies are set. The main results of the analysis are the following:

1. Under reasonable circumstances, mobility increases the size of the optimal fiscal gap in the second-best optimum, entailing a higher share of revenues assigned to the federal government.
2. In non-cooperative decentralized outcomes, the optimal fiscal gap is not achieved. The size of the fiscal imbalance depends on the order in which federal and regional decisions are made.
3. In the case in which the federal government can commit to taxes and transfers:
   a) The presence of a vertical fiscal externality lowers the MCPF perceived by regional governments, especially for the rich region, which expects to receive limited federal transfers. In the absence of mobility, this distortion induces regional overspending.
   b) To reduce the size of the vertical fiscal externality, the federal government commits to relatively low tax rates and transfers, which results in a negative fiscal imbalance in the sense that transfers to poorer regions are lower than in the second-best optimum.
   c) The presence of labor mobility, generating horizontal fiscal externalities, works against vertical fiscal externalities. It increases the MCPF perceived by regional governments and reduces the size of the fiscal imbalance. If the horizontal fiscal externality dominates the vertical one, the fiscal imbalance may disappear altogether, though not the externalities themselves.
4. In the case with limited federal commitment where the federal government chooses its taxes and transfers after regions choose their expenditures but before they choose their taxes:
   a) Regions overspend to attract larger transfers (or to reduce transfers to poor regions, in the case of rich ones). In effect, their budget constraints are not completely hard. Without mobility, regions underestimate the MCPF and over-provide public goods.
   b) The incentive of the federal government to equalize the MCPF across regions ex post results in a positive fiscal imbalance, i.e., transfers are larger than in the second-best optimum.
   c) Mobility reduces the size of the imbalance since the desire of regions to attract migrants increases their perceived MCPF.

5. In the case of soft budget constraints where regions choose both their spending and taxes before the federal government chooses its taxes and transfers:
   a) Regional public goods are entirely financed from federal transfers, leading regional governments to underestimate the marginal cost of public funds and over-provide public goods.
   b) In contrast to the previous cases in which the federal government could commit to its transfers before regional rates were set, mobility increases the overspending problem under soft budget constraints.

Throughout the analysis, we considered a setting in which the productivity of labor in each region was fully known by governments when making their expenditure and taxation decisions. However, productivity shocks could also occur after government policies are set. If regional governments have to choose their levels of spending before finding out the levels of labor productivity, they would provide the local public goods such that marginal benefits equal the expected marginal costs of public funds, given the probabilities of facing different types of shocks and the impact of these shocks on the levels of taxation and migration. In our two-region setting, if the potential shocks are such that both regions can end up with lower labor productivity, both could be the recipient of federal transfers, implying that the expected MCPF perceived by both regions would be distorted by a vertical fiscalexternality. Nonetheless, the essence of our results would hold under this different timing assumption.

Our analysis also relied on the assumption that migration decisions were made after government policy decisions. It might also be worth characterizing tax and transfer policies in a setting in which migration decisions are made before government policies are determined. As shown in Mitsui and Sato (2001) for the case of costless migration, when migration occurs first and governments are unable to commit to transfer policies, individuals’ anticipation of ex-post transfers can lead to greater population concentration than in the absence of any interregional transfers. In our model, if migration decisions occurred first, the government’s choice of tax and expenditure policies would no longer be subject to the migration equilibrium condition. Therefore, the mitigating effect of
mobility on fiscal imbalances would disappear. Potential migrants would anticipate the impact of migration on government policies and would agglomerate, to some extent, into the rich region. Greater population concentration in the rich region would tend to increase the optimal fiscal gap, and the incentives to agglomerate would be somewhat mitigated by the desire of the federal government to equalize the marginal cost of public funds across regions.

The broad message of this paper from a tax policy or tax assignment perspective is that mobility enhances the case for more centralized revenue-raising in a federation, while it tends to mitigate the fiscal imbalances that arise in federations that may face asymmetric shocks or that have asymmetric regions to begin with. In the Canadian case, which motivated our interest in fiscal imbalance, the federation has in recent years been subject to both substantial aggregate shocks and substantial asymmetric shocks, both of which have led to fiscal imbalances, arguably of the negative sort. At least in the case of the latter, mobility has played an important role in mediating the consequences of the shocks for fiscal balance. Nonetheless, the sheer size of the asymmetric shock, which took the form of a resource boom in selected provinces, has resulted in significant fiscal imbalance. Given the highly decentralized nature of the Canadian fiscal system, the federal government has had limited ability to respond. Perhaps encouraging federal-provincial cooperation by some form of institutional change could be helpful.

On the other hand, horizontal imbalances also entail some equity concerns, and incorporating them into our analysis would be a useful next step.

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