STRATEGIC INTER-REGIONAL TRANSFERS

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Abstract

We derive the equilibrium level of redistribution from one mobile factor (say, the rich or capital) to another possibly mobile factor (say, the poor or labour) when regions choose both their inter-regional transfers and redistributive policies non-cooperatively. It is shown that inter-regional transfers are always desirable (to mitigate the fiscal competition), but cannot be sustained (as a Nash equilibrium) when chosen simultaneously with the redistributive policy. On the other hand, if regions can pre-commit to inter-regional transfers before setting their redistributive policy, their strategic effect makes efficient inter-regional transfers sustainable. However, there are also equilibria with inefficiently small inter-regional transfers or no transfers at all. The effects of regional asymmetries and additional regions on these results are also analyzed.

1. Introduction

Decentralization has some obvious advantages in terms of accountability and information. The idea of a government closer to the people is usually regarded as desirable. But decentralization also brings with it the fiscal externality problem. Fiscal externalities arise whenever regions choose independently some tax or regulation policy (to promote competition or to achieve some environmental, social, or quality standards). This results in severe losses for all if the taxed or regulated factor is very mobile. For example, if international

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capital mobility is high, each region competes to attract capital and this leads to a situation with little capital income taxation even if each region would like high capital taxation for public good provision and redistribution reasons.\(^1\) Similarly, the increasing mobility of individuals can limit the capacity of regions to redistribute from the rich to the poor as this may drive out the rich and attract the poor. This fiscal externality problem is serious in the current European Union context and in federal countries where the ongoing economic integration decreases mobility costs.

The existing literature on the subject provides several solutions to this problem. The most obvious solution (fiscal federalism) is the centralization of fiscal policy. However, diversity of local preferences undermines the case for centralization (see Oates 1972), and it can even be argued that centralization is not desirable at all when preferences are too heterogenous (Pauly 1973). Another solution (Pigovian corrective taxation) is to design corrective schemes at the federal level that aim to internalize the fiscal externalities that the local regions inflict on each other in setting their fiscal policies. Examples of such corrective schemes are federal matching grants to the payments to the poor made by regions and federal transfers to local regions according to the number of poor residents (see e.g., Boadway and Flatters 1982; Krelove 1992).

The implementation of these mechanisms is obviously problematic (mostly for informational reason) and has led some authors to propose a more decentralized solution.\(^2\) This solution, building on the seminal work of Myers (1990), challenges the need for central government intervention. The idea is that there exist Nash-equilibrium inter-regional transfers that can reach the same outcome as central government intervention. Myers shows the efficiency of inter-regional transfers in a representative agent economy with perfect labour mobility and local public goods. The point is that inter-regional transfers can discourage migration that depresses wages. Hence, voluntary inter-regional transfers would be made as part of equilibrium entry-deterrence behavior. An important caveat of this analysis is the assumption that individuals are identical which precludes the consideration of any redistributive issues. Another key assumption is perfect labour mobility. Indeed, Wellish (1994) shows that central intervention may again be needed if individuals are imperfectly mobile. (Mansoorian and Myers 1993, however, find that efficient Nash-equilibrium inter-regional transfers can be

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\(^1\)A specific but suggestive example of capital mobility is the use of transfer pricing by BMW to escape the high corporation tax in Germany: in 1988, BMW reported 88% of its profits in Germany, but by 1992, the proportion had fallen to only 5%.

\(^2\)See Piketty (1996) for a critical assessment of this Pigovian corrective tax solution. Consideration of asymmetric information between central and regional governments in the design of grants from central government can be found in Bucovestky et al. (1998) and Lockwood (1999).
recovered with imperfect mobility if there is enough asymmetry between the regions.\(^3\)

The purpose of this paper is to analyze the sustainability of inter-regional transfers and the effect they have on the equilibrium level of redistribution when the economy is populated by a large set of individuals who differ in their income level and their mobility. We concentrate on the strategic motive for inter-regional transfers and ignore the fact that they can also be used to prevent wage depressing inward-migration (although we consider the fact that migration of the poor can depress transfer payments). This paper starts from the assumption that each region abides \textit{de facto} to the free movement and equal treatment principles (i.e., unrestricted mobility).\(^4\) Building on this assumption, we argue that redistribution at the local level is possible without central government intervention and that there exists (subgame perfect) Nash-equilibrium inter-regional transfers that can reach the same efficient outcome as fiscal centralization. However, there also exist (subgame perfect) Nash equilibria with inefficiently small inter-regional transfers or no transfers at all.\(^5\)

We develop a simple model to establish these results. The purpose of this minimalist modelling approach is to make the logic behind the results sufficiently clear to convince the reader of their validity in more general environments. Throughout we shall adopt the policy-based approach to fiscal competition games: this takes the policies of other regions as fixed, in contrast to the membership-based equilibrium which takes the memberships of regions as fixed (see Caplin and Nalebuff 1997). So, in the policy-based approach (as in Epple and Romer 1991) individuals move after the policy choices are made, while in the membership-based approach residential choices precede policy choices.\(^6\) We suppose a fixed number of regions. Individuals differ both in their income and their preference for regional location. Each region abides by the free movement and equal treatment principles (i.e., unrestricted mobility) and chooses its policy taking the policy of the other as given. Intra-regional redistributive policies transfer resources (vertically) from the rich residents to the poor residents. Inter-regional transfers transfer resources (horizontally)

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\(^3\)To be complete, we should also mention the bargaining solution to the fiscal externality problem. According to this solution governments should realize that fiscal competition results in an inefficiency and should therefore directly cooperate. However, we believe that imperfections in the bargaining process (in the form of imperfect information) and the political opportunism of short-lived politicians will almost certainly prevent the emergence of an efficient solution.

\(^4\)This is consistent with, for example, the Treaty of Rome (Articles 48 and 51), the U.S. Constitution, and the Canadian Charter of Rights and Freedom (Constitution Act of 1982).

\(^5\)Besides internalizing inter-regional spillovers, inter-regional transfers can also be used for insurance motive (see Lockwood 1999).

between regions and take the form of a revenue sharing system. Both the rich and the poor are mobile, but we also assume that they have preferences for location which reduce their mobility. To keep the analysis tractable, we abstract from the production side and assume that individuals have fixed income (no incentive effect). In this context adopting the membership-based approach is not interesting because setting policies after the residential choices are made removes any fiscal competition from the analysis.

The results of the analysis show that inter-regional transfer cannot be sustained when transfer and redistribution policy are chosen simultaneously. But observation of federal countries (like Canada and the U.S.) and to a lesser degree the European Union, shows that transfers are prominent.7 The analysis we offer shows that transfers are supported through their strategic effects on the setting of redistributive taxes. This result holds true even with regional asymmetries and can be interpreted in two ways. First, it can be treated as an explanation of why transfers exist in federal countries. Second, the result can be taken as guidance on how a federal system should determine its fiscal affairs. That is, if transfers are to be set through negotiations, as they are in most federal countries, this is best done prior to the parties setting their tax rates. In this way, inter-regional transfers can be sustained without recourse to a central authority.

Our analysis must be related to the literature on equalization grants which is also a particular system of revenue sharing that aims to equalize differences in tax revenues. It has recently been shown that this mechanism can solve the efficiency problem of decentralized tax setting in a wide variety of circumstances with tax base mobility (see, e.g., Kothenburger 2002; Bucovestky and Smart 2002). The distinctive feature of our work is that we concentrate on the willingness of regional governments to resort to some revenue sharing mechanism without relying on any federal authority. That is, we study the circumstances under which inter-regional transfers are voluntarily made.8

The paper is organized as follows. Section 2 describes the fiscal competition game and the equilibrium concept used. Section 3 derives the symmetric equilibria of the game when inter-regional and intra-regional policies are chosen simultaneously. Section 4 derives the symmetric equilibria when inter-regional transfers are chosen before the intra-regional policies. Section 5

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7As for illustration, Hansen and Kessler (1998) report that the EU interstate transfer system, Regional Funds, represented about 1/4 of the total EU budget in 1993. In Germany, inter-regional transfers organized through the Landerfinanzausgleich system, represented a total of 50 billion DM in 1996.

8The literature on equalization grants also uses a model of fiscal competition for capital rather than mobile rich and poor workers. The focus is on efficient provision of public good rather than income redistribution. There is also some work on income redistribution with worker mobility recommending a Pigouvian solution as a corrective mechanism but again without checking if this mechanism could be voluntarily implemented by local governments (see Goodspeed 1995; Wellisch 2000).
investigates some extensions to the model such as the effects of regional asymmetries and additional regions on the results. Section 6 concludes the paper.

2. The Model

The model we use is adapted from Hindriks (1999). There are two exogenously given regions, called the West and East regions for sake of definiteness. We refer to the East region by the use of the superscript (*). The two regions are symmetric in a sense we shall make precise shortly. Regional asymmetries are introduced in Section 5. The population is divided into two income groups and income is taken to be fixed. The two income levels are normalized to 0 and 1. There is a continuum of poor individuals (whose income is equal to 0) with a mass of $n_1$, and there is a continuum of rich individuals (whose taxable income is equal to 1) with a mass of $n_2$. The relative mass of rich individuals in the economy is denoted by $\rho \equiv \frac{n_2}{n_1}$. Of course the terms “rich” and “poor” are metaphors which represent, respectively, the net contributors and the net beneficiaries from the redistributive policy. Within each income group, the preference for regional location can be described by a single taste parameter $x \in [0,1]$. Those with low $x$ prefer the West region, those with high $x$ prefer the East region and those in the middle are indifferent. We further make the simplifying (but innocuous) assumption that $x$ is uniformly distributed within each class (i.e., rich and poor).

The regions impose taxes $T$ and $T^*$ (with $0 \leq T, T^* \leq 1$) on their rich residents, and transfer fractions $\alpha$ and $\alpha^*$ of their tax revenue to the other region (with $0 \leq \alpha, \alpha^* \leq 1/2$); the rest is used to pay transfers $B$ and $B^*$ to their poor residents.\(^9\) Given the policy choices, each individual freely joins the region that maximizes his utility. Since there is a continuum of individuals, we can avoid the so-called integer problem (see Wooders 1978) due to the discontinuous jumps in the payoffs induced by individuals moving from one region to another. Each region is constrained to have a balanced budget, so the set of feasible tax-transfer policies that each region can afford to offer depends on who they attract. Furthermore, who they attract depends on their policy choices. Let $z \equiv (T, B, \alpha)$ and $z^* \equiv (T^*, B^*, \alpha^*)$, then each region selects a feasible policy

$$z \in Z(S(z, z^*)),$$

$$z^* \in Z(S^*(z, z^*)),$$

\(^9\)Note that if both regions choose $\alpha = \alpha^* = 1/2$ they will face the same tax base and the fiscal externality problem will disappear. Because of the symmetry between regions, we ignore situations where some regions share more than one half of their tax revenue while others share less than one half.
where \( \{S(z, z^*), S^*(z, z^*)\} \) is the partition of the population between the two regions that will result from the policy profile \( z, z^* \), and \( Z \) is the set of policies that break even given the composition of the region.

Individuals care only about their net income and their location. The payoff of a poor individual with preference \( x \in [0, 1] \) is

\[
U_1(z, z^*; x) = B - d_1 x \quad \text{in the West region},
\]

\[
U_1^*(z, z^*; x) = B^* - d_1 (1 - x) \quad \text{in the East region},
\]

where \( d_1 > 0 \) measures the degree of attachment to location of the poor. So, a higher degree of attachment is akin to lower mobility. Each poor individual with \( x \) such that \( U_1(z, z^*, x) \geq U_1^*(z, z^*, x) \) joins the West region.

The payoff of a rich individual with preference \( x \in [0, 1] \) is

\[
U_2(z, z^*; x) = (1 - T) - d_2 x \quad \text{in the West region},
\]

\[
U_2^*(z, z^*; x) = (1 - T^*) - d_2 (1 - x) \quad \text{in the East region},
\]

where the parameter \( d_2 > 0 \) measures the degree of attachment to location of the rich. Each rich individual with preference \( x \) such that \( U_2(z, z^*, x) \geq U_2^*(z, z^*, x) \) joins the West region. We shall assume that the degree of attachment is not too high \((d_2 < 1)\) so that regions are indeed competing to attract the rich. Hence, \( d_2 \in (0, 1) \). Note that their degree of attachment (and thus their degree of mobility) can be different from the poor. Let \( d = \frac{d_2}{d_1} \) denote the relative attachment of the rich or, equivalently, the relative mobility of the poor. So if \( d < 1 \) the rich are less attached to location and thus more mobile than the poor, and vice versa. Note that the model can accommodate arbitrarily low mobility of the poor (by setting \( d_1 \) sufficiently high).

Given these individual payoff functions, any policy configuration \( (z, z^*) \) induces the following partition of each group \( i = 1, 2 \) between the two regions

\[
S_i(z, z^*) = \{ x \in [0, 1] : U_i(z, z^*, x) \geq U_i^*(z, z^*, x) \},
\]

\[
S^*_i(z, z^*) = \{ x \in [0, 1] : U_i(z, z^*, x) < U_i^*(z, z^*, x) \}.
\]

Let \( S(z, z^*) \equiv S_1(z, z^*) \times S_2(z, z^*) \) and \( S^*(z, z^*) \equiv S^*_1(z, z^*) \times S^*_2(z, z^*) \).

The equilibrium concept is the non-cooperative Nash equilibrium. The strategic variables are tax rates, \((T, T^*) \in [0, 1] \times [0, 1] \) and revenue shares \((\alpha, \alpha^*) \in [0, 1/2] \times [0, 1/2] \). The benefit levels \((B, B^*) \) are adjusted automatically according to the resulting migration to maintain budget balance. Each region sets its policy to maximize the income of its poor residents, given the policy of the other region. Regions are fully aware of the migration effects of their policy choices. Equilibrium is a fixed-point in which no individual wishes to switch region, no region wishes to switch policy, and the budget is balanced. We denote by \( B(T, T^*, \alpha, \alpha^*) \) and \( B^*(T, T^*, \alpha, \alpha^*) \) the per capita transfer levels in both regions that result from the tax pair \((T, T^*) \) and revenue shares \((\alpha, \alpha^*) \).
Substituting these transfer functions into the individual utility functions, we obtain that for each strategy profile \((T, T^\ast, \alpha, \alpha^\ast)\) and for each class \(i\) (with \(i = 1, 2\)), there exists \(x_i(T, T^\ast, \alpha, \alpha^\ast) \in [0, 1]\) such that all individuals in class \(i\) with preference \(x \leq x_i(T, T^\ast, \alpha, \alpha^\ast)\) join the West region and all individuals in class \(i\) with preference \(x > x_i(T, T^\ast, \alpha, \alpha^\ast)\) join the East region. Hence, \(S(T, T^\ast, \alpha, \alpha^\ast) = \{x \in [0, 1] : x \leq x_1(T, T^\ast, \alpha, \alpha^\ast)\} \times \{x \in [0, 1] : x \geq x_2(T, T^\ast, \alpha, \alpha^\ast)\}\) and \(S^\ast(T, T^\ast, \alpha, \alpha^\ast) = \{x \in [0, 1] : x > x_1(T, T^\ast, \alpha, \alpha^\ast)\} \times \{x \in [0, 1] : x < x_2(T, T^\ast, \alpha, \alpha^\ast)\}\). Since \(x\) is uniformly distributed over \([0, 1]\) among each class \(i\) (\(i = 1, 2\)), \(x_i(T, T^\ast, \alpha, \alpha^\ast)\) is also the percentage of individuals in class \(i\) who join the West region and \(1 - x_i(T, T^\ast, \alpha, \alpha^\ast)\) is the percentage of individuals in class \(i\) who join the East region. Therefore, the budget balance requirement in each region reduces to

\[
B(T, T^\ast, \alpha, \alpha^\ast) = \rho \frac{(1 - \alpha)T x_2(T, T^\ast, \alpha, \alpha^\ast) + \alpha^\ast T^\ast (1 - x_2(T, T^\ast, \alpha, \alpha^\ast))}{x_1(T, T^\ast, \alpha, \alpha^\ast)}
\]

(1)

and,

\[
B^\ast(T, T^\ast, \alpha, \alpha^\ast) = \rho \frac{(1 - \alpha^\ast)T^\ast (1 - x_2(T, T^\ast, \alpha, \alpha^\ast)) + \alpha T x_2(T, T^\ast, \alpha, \alpha^\ast)}{1 - x_1(T, T^\ast, \alpha, \alpha^\ast)}
\]

(2)

This completes the description of the game. The game is symmetric, in the sense that if \(T = T^\ast\) and \(\alpha = \alpha^\ast\) then we have \(B = B^\ast\) and \(x_1(\cdot) = x_2(\cdot) = \frac{1}{2}\), that is, the rich and the poor are equally divided between the two regions. We now derive the equilibria of this game. First we consider the case where taxes and revenue shares are chosen simultaneously and derive the symmetric Nash equilibrium. Then we analyze the case where revenue shares are chosen before taxes and derive the symmetric Nash equilibrium. The equilibrium concept is the same in both cases: (perfect) Nash equilibrium. The games simply differ in their timing. In the sequential game, regions have a chance to choose their inter-regional transfers before taxes and, therefore, to influence the tax stage.

3. Simultaneous Taxes and Inter-Regional Transfers

In the simultaneous move game, each region sets its tax and revenue share taking as given the policy choice of the other, anticipating correctly the induced migration and the resulting transfer levels. Since the income of every poor resident is increasing in the transfer level of his own jurisdiction, a good candidate for equilibrium is the tax rate which maximizes the transfer to the
Therefore, given \( T^* \) and \( \alpha^* \), the West region solves

\[
\max_{(\alpha, T)} B(T, T^*, \alpha, \alpha^*),
\]

where \( B(T, T^*, \alpha, \alpha^*) \) is given by (1). To solve this optimization problem, we first derive the migration response of each class to a tax change. Since we look for a symmetric equilibrium, we can reasonably ignore the corner problems and focus on interior migration responses.

Given the policy choices \( (T, T^*, \alpha, \alpha^*) \), with \( T \) close to \( T^* \) and \( \alpha \) close to \( \alpha^* \), the equilibrium migration of the rich is characterized by the marginal individual with preference \( x = x_2(T, T^*, \alpha, \alpha^*) \) who is indifferent between the two regions, so \( x = x_2(T, T^*, \alpha, \alpha^*) \) solves

\[
(1 - T) - d_2 x = (1 - T^*) - d_2 (1 - x).
\]

This yields

\[
x_2(T, T^*, \alpha, \alpha^*) = \frac{1}{2} + \frac{T^* - T}{2d_2}.
\]

Since \( x_2(T, T^*, \alpha, \alpha^*) \) is independent of \( (\alpha, \alpha^*) \) we can write \( x_2(T, T^*) = x_2(T, T^*, \alpha, \alpha^*) \). Therefore all the rich with \( x \leq x_2(T, T^*) \) go to the West region and all the rich with \( x > x_2(T, T^*) \) go to the East region. Given the uniform distribution, \( x_2(T, T^*) \) is the fraction of the rich who choose to reside in the West region. We verify that \( x_2(T, T^*) = 1/2 \) for \( T = T^* \) (due to the symmetry of the model) and that \( x_2(T, T^*) \) is decreasing in \( T \) and increasing in \( T^* \). This reflects the fact that the rich prefer to join the region with a lower tax rate. The migration response of the rich to a small tax change in the West region is

\[
\frac{dx_2(T, T^*)}{dT} = -\frac{1}{2d_2}.
\]

Thus, the migration response of the rich to a marginal tax change is decreasing with their attachment to location.

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10 The reason for adopting this objective function is to concentrate on the redistribution issue arising from mobility without having the decision rule influenced by the variable number of rich and poor with a utilitarian criterion. The fact that we abstract away from the welfare of the rich could reflect that the poor are in a majority in each region. As we shall see this will simplify the analysis already made complex by the interaction of the mobility of the two groups and the budget externality arising from revenue sharing. Since confiscatory taxes are possible in equilibrium (say, because the rich are not mobile enough), we shall further assume that the rich have some untaxable income so that they cannot be made poorer than the poor. Note also that maximising per capita transfer to the poor is equivalent here to maximising the per capita utility of the poor, because a transfer increase in one region cannot harm its poor, even those who decide to move as a result. We also emphasise that in our model governments cannot have the perverse incentive to cut taxes not only to attract the rich but also to throw away poor people so as to increase per capita transfer. This is because in equilibrium the poor chase the rich.
Given the policy choices \((T, T^*, \alpha, \alpha^*)\) with \(T\) close to \(T^*\) and \(\alpha\) close to \(\alpha^*\) the utility of the poor individual with preference \(x\) is

\[
U_1(T, T^*, \alpha, \alpha^*; x) = B(T, T^*, \alpha, \alpha^*) - d_1 x \text{ in the West region,}
\]

and

\[
U_1^*(T, T^*, \alpha, \alpha^*; x) = B^*(T, T^*, \alpha, \alpha^*) - d_1 (1 - x) \text{ in the East region.}
\]

The equilibrium migration of the poor is characterized by the marginal individual with preference \(x = x_1(T, T^*, \alpha, \alpha^*)\) who is indifferent between the two regions. Using (1) and (2), \(x = x_1(T, T^*, \alpha, \alpha^*)\) solves

\[
\rho \frac{(1 - \alpha) T x_2(T, T^*, \alpha, \alpha^*) + \alpha^* T^*(1 - x_2(T, T^*, \alpha, \alpha^*))}{x} - d_1 x = \rho \left(1 - \alpha^*\right) T^*(1 - x_2(T, T^*, \alpha, \alpha^*)) + \alpha T x_2(T, T^*, \alpha, \alpha^*) - d_1 (1 - x).
\]

(6)

Given the uniform distribution, \(x = x_1(T, T^*, \alpha, \alpha^*)\) determines also the fraction of the poor who join the West region. Notice that the equilibrium migration of the poor, \(x_1(T, T^*, \alpha, \alpha^*)\) depends on the equilibrium migration of the rich, \(x_2(T, T^*)\).

Using the implicit function theorem together with (5) and the symmetry of the model, we obtain

\[
\left[d x_1 \right]_{z = z^*} = \frac{(1 - 2\alpha) \left(1 - \frac{2T}{d_2}\right)}{2d_1 + 4\rho T} \rho.
\]

(7)

It is worth noting that \(\left[d x_1(T, T^*)/dT\right]_{z = z^*} < 0\) for \(T > d_2/2\). The reason is that when the rich are highly mobile (low \(d_2\)), a tax increase induces so many rich to leave that the poor find it profitable to chase them.

We are now in a position to characterize the equilibrium policy choices. Given \((T^*, \alpha^*)\), the West region solves

\[
\max_{(T, \alpha)} B(T, T^*, \alpha, \alpha^*). \]

Differentiating \(B(T, T^*, \alpha, \alpha^*)\) with respect to \(T\) around \(z = z^*\) and using the symmetry of the model together with (5) and (7), we have

\[
\left.\frac{d B}{d T}\right|_{z = z^*} = \rho \frac{(1 - \alpha) x_2}{x_1} + \rho \left(\frac{(1 - \alpha) T - \alpha^* T^*}{x_1}\right) \frac{d x_2}{d T} + \frac{\partial B}{\partial x_1} \left(\frac{d x_1}{d T}\right)
\]

\[
= \rho (1 - \alpha) - \rho \frac{(1 - 2\alpha) T}{d_2} - \rho T \left(\frac{\rho (1 - 2\alpha) \left(1 - \frac{2T}{d_2}\right)}{d_1 + 2\rho T}\right).
\]

(8)
Simple calculation shows that

\[
\frac{dB}{dT} \bigg|_{z = z^*} > 0 : T < \left( \frac{1 - \alpha}{1 - 2\alpha} \right) \left( \frac{d_2}{1 - \rho d} \right),
\]

\[
= 0 : T = \left( \frac{1 - \alpha}{1 - 2\alpha} \right) \left( \frac{d_2}{1 - \rho d} \right),
\]

\[
< 0 : T > \left( \frac{1 - \alpha}{1 - 2\alpha} \right) \left( \frac{d_2}{1 - \rho d} \right).
\]

(9)

So a candidate tax equilibrium is

\[
(\bar{T}, T^*) = \left( \frac{1 - \alpha}{1 - 2\alpha} \right) \left( \frac{d_2}{1 - \rho d} \right), \quad \text{for } d_2 < \frac{(1 - \rho d)(1 - 2\alpha)}{1 - \alpha},
\]

\[
= 1 \quad \text{otherwise.}
\]

(10)

Following the definition of the candidate equilibrium, the tax pair \( \bar{T} = T^\ast \) is increasing with \( \alpha = \alpha^* \). This is because revenue sharing induces regions to internalize the fiscal externality. Indeed, from the above expression we obtain that there exists a critical revenue share \( a = \frac{1}{1 + \frac{1 - \alpha}{1 - \rho d - d_2}} < \frac{1}{2} \) such that for any \( \alpha = \alpha^* \geq a \), \( \bar{T} = T^* \) = 1, that is, the mobility problem is fully neutralized by revenue sharing. The equilibrium tax rates are also increasing with the relative mobility of the poor (i.e., higher \( d = d_2/d_1 \)). The reason is that, in equilibrium, the poor chase the rich.

Thus inter-regional transfers are desirable in symmetric tax competition as argued by most of the literature on fiscal federalism and a central planner would organize them.\(^{11}\) The question, now, is whether transfers can be made voluntarily by regions, that is, whether they are sustainable as a Nash equilibrium.

Given the triple \((T, T^*, \alpha^*)\), differentiating \( B(T, T^*, \alpha, \alpha^*) \) with respect to \( \alpha \) around \( z = z^* \), and using the symmetry of the model gives

\[
\left. \frac{dB}{d\alpha} \right|_{z = z^*} = -\rho T \frac{x_2}{x_1} + \left( \frac{\partial B}{\partial x_1} \right) \left( \frac{dx_1}{d\alpha} \right)
\]

\[
= -\rho T - 2\rho T \left( \frac{-\rho T}{2\rho T + d_1} \right)
\]

\[
= -\rho T \left( 1 - \frac{2\rho T}{2\rho T + d_1} \right) < 0.
\]

For any \( d_1 > 0 \) and any \( T = T^* \in [0, 1] \), each region has an incentive to reduce its revenue share. Hence we have

\(^{11}\)For a good review of the arguments, see Boadway and Flatters (1982) or more recently, Inman and Rubinfeld (1996).
PROPOSITION 1: Inter-regional transfers are not sustainable when set simultaneously with taxes. Any symmetric Nash equilibrium is characterized by $\alpha = \alpha^* = 0$ and $T = T^* = \frac{d_2}{1 - \rho d}$ (assuming an interior solution for taxes).

It is impossible for one region to benefit from making transfers to another region in order to forestall migration or to limit its extent (unless the poor are perfectly mobile as in Myers 1990). Regions can of course use inter-regional transfers to prevent some poor immigrating and depressing domestic benefit levels; but this effect is always dominated by the direct cost of making inter-regional transfers. Then beneficial migration deterring cannot occur and because there are no local risks to share, voluntary inter-regional transfers would never be made.\(^{12}\) We now show that even in this most unfavorable context voluntary inter-regional transfers can still be used as a strategic device to affect future tax competition. To see this we must consider a sequential game in which inter-regional transfers are set (and observable) before taxes. In this situation each region can pre-commit to share revenue so that the other region also chooses higher taxes. As we shall see, this strategic effect can make inter-regional transfers sustainable.

4. Strategic Inter-Regional Transfers

In this section we assume that regions can commit to inter-regional transfers if they anticipate benefiting from them. This commitment capacity can be due, for example, to some unmodeled repetition of the interaction between regions. This is also representative of the real world. In most federal countries, for instance, transfers are set through negotiations and members are to some extent committed to them prior to the setting of their tax rates.

We shall consider the following three-stage game:

- revenue shares choice: $\alpha, \alpha^*$;
- tax rates choice: $T, T^*$;
- residential choice: $x_i(T, T^*, \alpha, \alpha^*)$ with $i = 1, 2$.

4.1. The Poor Are Immobile

We first assume that $d_1 \to \infty$ so that the poor are effectively immobile and $x_1(\cdot) = 1/2$ for all policy choices.

We solve the game backwards. Given the policy choices $(z, z^*)$ the residential choice of the rich $x_2(\cdot)$ is as given in equation (4). Moving backwards to stage 2, given $T^*$ and the pair $(\alpha, \alpha^*)$, the tax choice of the West region solves

\(^{12}\)Note that the transfer paradox according to which it might be possible for one region to gain, in a welfare sense, from transferring resources to another region cannot arise because such transfers have no general equilibrium effects on the terms of trade within the context of the model used here.
Using (1) and (4) the necessary first-order condition is

\[
\frac{dB}{dT} = \frac{\rho (1 - \alpha) x_2}{x_1} + \rho \left( \frac{(1 - \alpha) T - \alpha^* T^*}{x_1} \right) \frac{dx_2}{dT} = \rho (1 - \alpha) \left( 1 + \frac{T^* - T}{d_2} \right) - \rho (1 - \alpha) \frac{T}{d_2} + \rho \alpha^* T^* \frac{dx_2}{dT} = 0. \tag{12}
\]

It is easily checked that the second-order condition is satisfied.\(^\text{13}\) Therefore the tax response function of the West region is

\[
T(T^*; \alpha, \alpha^*) = \frac{d_2}{2} + \left( 1 + \frac{\alpha^*}{1 - \alpha} \right) \frac{T^*}{2}, \tag{13}
\]

and by analogy

\[
T^*(T; \alpha, \alpha^*) = \frac{d_2}{2} + \left( 1 + \frac{\alpha}{1 - \alpha^*} \right) \frac{T}{2}. \tag{14}
\]

Combining (13) and (14) gives the unique Nash equilibrium of the stage 2 tax game

\[
T^*(\alpha, \alpha^*) = \frac{\left( 3 + \frac{\alpha^*}{1 - \alpha} \right) d_2}{4 - \left( 1 + \frac{\alpha^*}{1 - \alpha} \right) \left( 1 + \frac{\alpha}{1 - \alpha^*} \right)}, \tag{15}
\]

and by analogy

\[
T^*(\alpha, \alpha^*) = \frac{\left( 3 + \frac{\alpha}{1 - \alpha^*} \right) d_2}{4 - \left( 1 + \frac{\alpha}{1 - \alpha^*} \right) \left( 1 + \frac{\alpha^*}{1 - \alpha} \right)} \tag{16}
\]

It is easily checked that at \(\alpha = \alpha^*\),

\[
T = T^* = \left( \frac{1 - \alpha}{1 - 2\alpha} \right) d_2. \tag{17}
\]

Therefore for any \(\alpha < \frac{1 - d_2}{2 - d_2} = \bar{\alpha}\) we get an interior solution \(T = T^* < 1\).

Proceeding backwards to the first stage, each region chooses its revenue share given the revenue share of the other region, anticipating the resulting

\(^\text{13}\)Straightforward calculation gives \(d^2 B/d^2 T = -2\rho (1 - \alpha)/d_2 < 0\).
tax choices \((\overline{T}(\alpha, \alpha^*)\text{ and } \overline{T^*}(\alpha, \alpha^*))\), as well as the resulting migration of the rich \((x_2)\) and transfer levels \((B, B^*)\). So given \(\alpha^*\), the West region solves

\[
\max_{\alpha \in [0,\frac{1}{2}]} \rho(1-\alpha)\frac{\overline{T}(\alpha, \alpha^*)}{x_1} x_2(\cdot) + \rho\alpha^* \frac{\overline{T^*}(\alpha, \alpha^*)}{x_1} (1-x_2(\cdot)).
\]

In deciding on its revenue share \(\alpha\), the West region must therefore consider not only the direct effect (that is, the direct cost of sharing revenue, \(\partial B/\partial \alpha\)), but also the strategic effect that arises through the induced change in its rival’s tax behavior (that is, \(d\overline{T^*}/d\alpha\)). Formally, differentiating \(B(\alpha, \alpha^*)\) around \(\alpha = \alpha^*\), recalling that \(x_2\) is independent of \(\alpha\), and using the envelope theorem give

\[
\frac{dB}{d\alpha}\bigg|_{\alpha = \alpha^*} = -\rho \frac{\overline{T}(\alpha, \alpha^*)}{x_1} x_2(\cdot) + \frac{\partial B}{\partial \overline{T^*}} \frac{d\overline{T^*}}{d\alpha}.
\]  

(18)

The first term on the right-hand side of (18) is the direct effect from changing \(\alpha\); the second term is the strategic effect that arises from the other region’s equilibrium response to the change in \(\alpha\). Since

\[
\frac{\partial B}{\partial \overline{T^*}}\bigg|_{\alpha = \alpha^*} = \rho \alpha + \frac{\rho(1-2\alpha)\overline{T}}{d_2} = \rho > 0,
\]  

(19)

the strategic effect on the West region’s transfer is positive if \(d\overline{T^*}/d\alpha > 0\). By applying the implicit function theorem to (16) and using (17) we get

\[
\frac{d\overline{T^*}}{d\alpha}\bigg|_{\alpha = \alpha^*} = \frac{-(2-\alpha)d_2 + 4(1-\alpha)\overline{T^*}}{4(1-\alpha)^2 - 1} = \frac{(2(1-\alpha)^2 + \alpha)(1-\alpha)d_2}{(1-\alpha)(1-2\alpha)^2(3-2\alpha)} > 0.
\]  

(20)

Plugging (19) and (20) into (18), we get after straightforward manipulations,

\[
\frac{dB}{d\alpha}\bigg|_{\alpha = \alpha^*} = \left[\frac{2(1-\alpha)^2 + \alpha}{(1-\alpha)(1-2\alpha)(3-2\alpha)} - 1\right] \left(\frac{1-\alpha}{1-2\alpha}\right) \rho d_2
\]

\[
= \left[4\alpha^3 - 10\alpha^2 + 8\alpha - 1\right] \left(\frac{\rho d_2}{(1-2\alpha)^2(3-2\alpha)}\right).
\]  

(21)

Hence, there exists a threshold value \(\alpha^o = 0.15\) such that

\[
\frac{dB}{d\alpha}\bigg|_{\alpha = \alpha^*} < 0 : \alpha = \alpha^* < \alpha^o,
\]

\[
= 0 : \alpha = \alpha^* = \alpha^o,
\]

\[
> 0 : \alpha = \alpha^* > \alpha^o.
\]  

(22)
To guarantee that an equilibrium exists we also need to verify the shape of $B(\alpha, \alpha^*)$ for any $\alpha \neq \alpha^*$. First note that

$$B(\alpha, \alpha^*) = \left[ (1 - \alpha) T(\alpha, \alpha^*) x_2 + \alpha^* \bar{T}(\alpha, \alpha^*) (1 - x_2) \right] / x_1.$$ 

Substituting the equilibrium tax rates as given in (15) and (16), using (4) and recalling that $x_1 = 1/2$, we get

$$B(\alpha, \alpha^*) = \left[ (3(1 - \alpha) - 2\alpha^* - \alpha^* / (1 - \alpha^*)) \left( 1 + \frac{\alpha}{1 - \alpha^*} - \frac{\alpha^*}{1 - \alpha} \right) \right] \left( \begin{array}{c} \frac{d_2}{4 - (1 + \frac{\alpha}{1 - \alpha^*})(1 + \frac{\alpha^*}{1 - \alpha})} \\ \frac{d_2}{4 - (1 + \frac{\alpha}{1 - \alpha^*})(1 + \frac{\alpha^*}{1 - \alpha})} \end{array} \right).$$

This expression is proportional to $d_2$ and it can be shown that

$$\frac{dB(\alpha, \alpha^*)}{d\alpha} < 0 \quad \text{for all } \alpha \quad \text{if } \alpha^* < \alpha^o,$$

$$\geq 0 \quad \text{for all } \alpha \quad \text{if } \alpha^* = \alpha^o,$$

$$> 0 \quad \text{for all } \alpha \quad \text{if } \alpha^* > \alpha^o.$$ (24)

The shape of $B^*(\alpha, \alpha^*)$ has the same features. Hence the best reply function of the West region is

$$r(\alpha^*) = 0 \quad \text{for } \alpha^* < \alpha^o,$$

$$= \alpha^o \quad \text{for } \alpha^* = \alpha^o,$$

$$= \bar{\alpha} \quad \text{for } \alpha^* > \alpha^o,$$ (25)

and similarly for the East region. Therefore we have the following result.

PROPOSITION 2: Suppose that the poor are immobile and regions set their inter-regional transfers before setting taxes, then there is no asymmetric equilibrium and there exist three (perfect) symmetric Nash equilibria with the following features:

(a) Efficient inter-regional transfers: $\bar{\alpha} = \alpha^o = 1 - \frac{d_2}{2 - d_2}$ and $T = \bar{T} = 1$.

(b) Partial inter-regional transfers: $\bar{\alpha} = \alpha^* = 0.15$ and $T = \bar{T} = 1.2d_2$.

(c) No inter-regional transfers: $\bar{\alpha} = \alpha^* = 0$ and $T = \bar{T} = d_2$.

Inter-regional transfers bring both a direct cost (the cost of sharing your tax revenue) and a strategic benefit in altering the tax competition in the next stage. This strategic effect is however increasing with the level of inter-regional transfers, and there exists a critical level of inter-regional transfers such that
below this level the strategic effect is too small for inter-regional transfers to be made voluntarily. But if inter-regional transfers are high enough, their strategic effect is high and they are self-sustaining. Note that it cannot be profitable for regions to set their revenue share above $\frac{1-d_2}{2-d_1}$, as taxes are already at a corner solution for this level of revenue sharing, and more revenue sharing would bring about no strategic benefit but only the direct cost. Note also that the interior solution for $\alpha$ is independent of the mobility of the rich $d_2$. It is sometimes argued that in the face of multiple equilibria the Pareto-dominant equilibrium should be chosen whenever it exists. However this suggestion has raised two criticisms. The first is that the Pareto-dominant equilibrium may be too risky for the players without preplay communication (Harsanyi and Selten 1988). The second is that even with preplay communication a player may have the incentive to say that he will play according to the dominant equilibrium even if he intends not to do so (Aumann 1990).

4.2. Mobility of the Poor

The introduction of mobility of the poor brings with it a new channel through which inter-regional transfers can affect regions. The allocation of a larger revenue share for the inter-regional transfer will cause the marginal poor in a region to migrate. How this possibility affects the set of potential equilibria will now be investigated. We continue to focus on symmetric equilibria. From Section 3 (in which the mobility of the poor is allowed) we know from (10) that for any arbitrary $\alpha = \alpha^* \in [0, 1/2]$, the interior symmetric tax equilibrium is

$$(\overline{T}, \overline{T}^*) = \left( \frac{1 - \alpha}{1 - 2\alpha}, \frac{d_2}{1 - \rho d} \right).$$

Therefore, the mobility of the poor (lower $d_1$ which is akin to a higher $d = d_2/d_1$) mitigates tax competition between regions and leads to higher taxes. This is because the poor chase the rich in equilibrium. If the poor are mobile enough, then by chasing the rich they can fully neutralize the effect of the mobility of the rich and thereby solve the fiscal externality problem. Hence, there is no need to use inter-regional transfers to alter tax competition (no strategic benefit). On the other hand, if the poor are not mobile enough, then inter-regional transfers can be used as a strategic move to mitigate future tax competition. Voluntary inter-regional transfers can thus be made only if the poor are not too mobile relative to the rich.

Formally, in setting its revenue share $\alpha$, the West region must consider not only the direct effect of its revenue share (that is, the direct cost of sharing revenue and the strategic effect that arises in altering its rival’s tax behavior, but also the migration effect (that is, $dx_1/d\alpha$). Therefore, differentiating $B(\alpha, \alpha^*)$
Table 1: Equilibria for Various Degrees of Mobility of the Poor and \(d_2 = 0.5, \rho = 1\)

<table>
<thead>
<tr>
<th>(d_1)</th>
<th>(\alpha)</th>
<th>(T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0.571</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0.526</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>0.502</td>
</tr>
</tbody>
</table>

around \(\alpha = \alpha^*\) and using the envelope theorem \((\partial B/\partial T = 0)\) gives

\[
\left[ \frac{dB}{d\alpha} \right]_{\alpha=\alpha^*} = -\frac{\rho T}{x_1} + \left( \frac{\partial B}{\partial x_1} \right) \left( \frac{dx_1}{d\alpha} \right) + \left[ \frac{\partial B}{\partial T^*} \right] \left[ \frac{dT^*}{d\alpha} \right]
\]

\[= -\rho T \left( 1 - \frac{2\rho T}{2\rho T + d_1} \right) + \left[ \frac{\partial B}{\partial T^*} \right] \left[ \frac{dT^*}{d\alpha} \right]. \tag{27}\]

It follows that the migration of the poor reduces the direct cost of sharing revenue. The mobility of the poor of course also affects the strategic effect which can no longer be derived explicitly. To investigate the possible equilibria we now turn to numerical simulations. The results of the simulation are given in Table 1. These describe the generic pattern of findings as \(d_1\) is increased holding \(\rho = 1\) and \(d_2 = 0.5\) constant.

As can be seen from the table, multiple equilibria arise for high values of \(d_1\) (i.e., poor are not very mobile) and voluntary inter-regional transfers can be made (i.e., \(\alpha > 0\) is a Nash equilibrium). However, when the poor are very mobile (i.e., for low values of \(d_1\)) there is a unique equilibrium. This involves no inter-regional transfers. This is because the poor are mobile enough to counteract the mobility of the rich and there is no gain from using inter-regional transfers at all. Note that for all values of \(d_1\), the equilibrium with no inter-regional transfers \((\alpha = 0)\) is sustained.

These results illustrate that the introduction of mobility of the poor extends the previous analysis in a natural way. Proposition 2 has shown that when the poor are completely immobile there are three (symmetric) perfect Nash equilibria. This is also the case here when \(d_1\) is sufficiently large. Hence multiple equilibria arise due to insufficient mobility of the poor. In contrast, when the poor are highly mobile there is a unique equilibrium which involves no inter-regional transfers.

5. Extensions

In this section we briefly consider a number of extensions of the basic model. A more detailed discussion of these points can be found in the Hindriks and Myles (2001) working paper.

The introduction of regional asymmetries is important for both theoretical and empirical reasons. Theoretically they are important because they are the main obstacle to the implementation of the fiscal federalism solution.
It is indeed difficult to believe that regional authorities with different preferences for taxation would agree to transfer all their fiscal power to a central authority. Regional asymmetries are also a reality and therefore must be introduced in the analysis if we want to compare the predictions of the model with empirical evidence. It is also important that the model is able to handle the introduction of more regions.

5.1. Regional Attractiveness

The first asymmetry we consider is regions that differ in their attractiveness with, for example, location in one region providing a higher income or some non-pecuniary benefit such as climate. Such a difference in attractiveness causes parallel shifts in opposite directions of the tax responses (i.e., an upward shift for the more attractive region and a downward shift for the less attractive). Consequently, if the two regions shared their revenue equally, the tax rate would be higher in the more attractive region.

For the game as a whole, the two corner solutions of complete sharing and no sharing are still equilibria. Numerical methods show that, for the interior equilibrium, as one region becomes more attractive its revenue sharing falls but its tax rises. The converse happens in the less attractive region. The more attractive region also transfers more to the less attractive region than it receives from it and this net transfer is increasing with the difference in attractiveness. Interestingly enough, the more attractive region is also paying higher benefits to its poor residents. The greater the difference in attractiveness, the larger the difference in benefits levels.

5.2. Redistribution Motives

As a second source of asymmetry, consider regional differences in the redistribution motive. We interpret this as meaning that in both regions welfare is a weighted sum of benefits to the poor and after-tax income for the rich, but with weights that differ across regions. In this case, the region with a stronger preference for redistribution will tax more in equilibrium, other things equal. The division of the rich between the two regions is only indirectly affected by this asymmetry through its effect on tax choices. A lower redistribution motive in one region induces a parallel shift downwards of its tax response and, because of the strategic complementarity in taxes, the tax rate in the other region is reduced. This illustrates how a Left-wing government competing with a Right-wing government may have to cut its tax rate. It is also easily seen from these tax responses, that if the two regions share their revenue equally the tax rate would be higher in the region with the higher redistribution motive.

The results for optimal revenue sharing show that the region that cares less about redistribution shares less revenue but surprisingly taxes almost the same. Revenue sharing acts as a buffer that absorbs almost completely
the differences in the preference for redistribution. As both regions care less about redistribution, they share more revenue again with few effects on their tax rates. This may explain why in federal countries, Left-wing and Right-wing local governments can impose similar taxes but choose very different revenue shares. Tax harmonization can thus be reconciled with political disintegration if member states can negotiate different inter-regional transfers.

5.3. Additional Regions

The results that we have derived can be extended to incorporate additional regions. To understand how this can be done, note that implicit in the model we have described is a linear location model with two regions at either end of a line. As in the industrial organization literature, we can incorporate further regions by employing a model of location around a circle (see Hindriks 1999). Naturally, provided the regions are equally distributed around the circle, the symmetry of the basic model is maintained regardless of the number of regions. The determination of equilibrium can then be undertaken using arguments familiar from industrial organization. The advantage of this approach is that it can be seen immediately that the results we have derived will remain valid in this framework. In addition, an increase in the number of regions acts in the same way as an increase in mobility (so a reduction in $d_i$, $i = 1, 2$). We have already discussed the consequence of this at a number of points above.

6. Conclusion

In this paper we have shown that inter-regional transfers are desirable and can be sustained as a Nash equilibrium. Remarkably this is true irrespective of regional asymmetries. In contrast to the existing literature, inter-regional transfers are not used to purchase the optimal population (like in Myers 1990) or for risk sharing (like in Lockwood 1999) but rather because of their strategic effects. In deciding on their inter-regional transfers, regions can limit future tax competition. This idea was already discussed in Brennan and Buchanan (1980).

These strategic inter-regional transfers of course are effective only if regions can credibly commit to them before setting their taxes on the mobile factors. But since this strategic move brings a better outcome to all regions (compared to the simultaneous game without such strategic move), it is also well known that their credibility is questionable. Therefore, an important issue to consider is how regions can acquire this credibility.

This brings into question the institutional structures that can support the efficient outcome. In the European context, the working paper shows that the tax rates and contributions to the European Union of member states are consistent with the predictions of the asymmetric model. This provides support
for our analysis which could bear further investigation. What is not clear is that the distribution of revenues between member states can be interpreted as the transfers we have described. For our analysis to apply directly it would have to be the case that transfers between states were explicit and that the contributions to the centre were determined after each member state had independently set their tax rates.

**References**


