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Decentralizing Taxation and Public Expenditure within a Federation

Jonathan H. HAMILTON, Steven M. SLUTSKY*

ABSTRACT. – A model of a central government and two local governments is used to study the role of fiscal federation in reducing the effect of revenue externalities between local jurisdictions. Immobile consumers buy goods in both their own and the other local community and pay sales taxes in each community. Depending on demand parameters, the fiscal externality may be positive or negative. In the former case, the local governments set tax rates below those a central government would choose. With a positive revenue externality, the central government can use the same tax bases as local governments to finance revenue sharing grants, stimulating local public expenditure, and thus raising welfare. If communities are heterogeneous, this revenue sharing system will not be fully optimal, but it can dominate a system of exclusive central revenue collection.

Décentralisation de la fiscalité et des dépenses publiques dans une fédération

RÉSUMÉ. – Dans cet article, nous considérons une économie comptant deux communautés, deux gouvernements locaux et un gouvernement central. Les consommateurs achètent leurs biens soit dans leur communauté de résidence, soit dans l'autre s'acquittant de taxes indirectes dans chacune d'entre elles. Dans certaines conditions, l'externalité fiscale est positive et le gouvernement local adopte un taux de taxation inférieur à celui que choisirait le gouvernement central. Dans le cas auquel s'attache cet article, le gouvernement central peut utiliser la même assiette fiscale que le gouvernement local pour financer des subventions ayant pour effet d'accroître les dépenses publiques locales et partout le bien être.

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* J. H. HAMILTON; S. M. SLUTSKY: University of Florida.

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1 Introduction

In many developed countries, the economic role of local and regional governments has been expanding over time. In the United States, Federal government civilian employment has hardly changed in twenty-five years, while state and local government employment has grown dramatically. The development of the European Union has brought some economic decisions to a supernational entity while, at the same time in several member states, local and regional authorities have become important.

Provision of public education is a good illustration of the complicated interaction of different levels of government. In the United States, primary and secondary education are under the control of local school boards. In many states, these school districts are small; several states have more than 1000 such districts [1]. Thus, school districts can tailor school policy and expenditure to local demand for education. Within-state variations in expenditure are large, reflecting variations in preferences or resources. Cost differences are also an issue-often poor districts offer low quality at high cost per student [2]. These expenditure differences have stimulated interest in attempts to equalize school expenditures across districts within states [3]. The focus of centralization has been almost purely on the revenue side in re-distribuing tax revenue. Centralization of management, including control of personnel and curriculum, appears to be minimal with local boards retaining a great deal of control. The taxes levied by local school boards constitute only a part of their budgets. Federal and state governments contribute 5.8% and 45.4% of school expenditures, on average [4]. These funds come to local school boards through a variety of programs-matching grants, capitation grants, conditional grants for special functions, and so forth.

In general, national governments transfer revenue to local governments who retain responsibility for certain functions, but the national government often exercises indirect control using such instruments as minimum and maximum tax rates, minimum levels of public expenditure, conditional and unconditional revenue transfers, and procedural constraints. Two justifications for this activity are to redistribute tax revenue across jurisdictions and to increase local spending. The second justification requires elaboration – why do local governments prefer to spend less than the central government would like them to? Beyond poor districts lacking sufficient

1. See KENNY and SCHMIDT [1994]. They also document and discuss factors which have led to a decline in the number of districts over time.
2. See HAMILTON [1983] for a discussion of some effects of a negative correlation between resident income and cost of providing a public good.
3. Legal challenges to current systems of funding schools have been successful in a number of states, including California and Texas.
4. These are 1988 data from the 1992 *Statistical Abstract of the United States*, Table 214. For all local governments, Federal and state aid account for 3.6% and 33.6% of general revenue (1990 data). For state general revenue, Federal and local transfers are 22.9% and 1.5% of spending.

resources, is their some reason for inefficency at the local level? Is there some reason why a federal system with multiple levels of government is desirable instead of complete central control or, as is a current trend in the U. S., extensive devolution of central functions to local levels? The value of a local government role in purchasing local public goods is largely based on the argument that a smaller government unit is likely to possess better information about its citizens' preferences than a higher-level, larger government with many other concerns. If residents' tastes or the production functions for public goods differ across local jurisdictions, a unitary government would likely make inappropriate decisions about public good provision or settle for offering a standard bundle in all communities.

On the other hand, revenue externalities among competing local jurisdictions go a considerable way to justifying a central government role within a federal system. The initial seminal study of competition among local jurisdictions, TIEBOUT [1956], actually came to an opposite conclusion that competition among jurisdictions in a metropolitan area has the same beneficial effects as competition among firms and, hence, no higher level government action is necessary. Jurisdictions must offer attractive tax-benefit packages to induce residents to move there. The threat of migration prevents local governments from being unresponsive to citizens, in contrast to unitary governments. Later research extends this model in many ways, including examining properties of voting equilibria and effects of scale economies [5]. Despite its potential flaws, the Tiebout model has led many economists to support competition among governments as a way to limit public sector inefficiencies.

A crucial assumption of Tiebout is that all local government expenditure is financed by head taxes or other non-distortionary taxes (such as property taxes on site values alone). Since local governments in the United States rely heavily on property taxes (on structures as well as land) and on sales taxes, this assumption is unwarranted in practice [6]. Perhaps more importantly, the Tiebout framework assumes that only local residents pay the taxes and receive the public good benefits. If local governments levy taxes which fall on nonresidents or nonresidents benefit from local communities' expenditure, then the competitive product market analogy fails to support predictions of efficient outcomes.

In this paper, we devote our attention to a model in which both residents and nonresidents pay taxes to local governments, but only residents benefit from local public expenditure [7]. We focus on competition between

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5. See ZODROW [1983] for an overview of work following TIEBOUT and STIGLITZ [1983] for a discussion of potential efficiency failures in the Tiebout model.

6. Other researchers have studied effects of property tax competition in models with mobile factors, either business capital or residents themselves. ZODROW and MIESZKOWSKI [1983, 1986] examine effects of local taxation of business capital on local government fiscal equilibria. EPPLE, FILIMON, and ROMER [1993] study the effect of competition in property tax rates among local governments when structures are taxed. In contrast to our work, they focus on the effects on location choice by consumers.

7. See WILDASIN and WILSON [1991] for a discussion of recent research on tax competition. GORDON [1983] presents a model of fiscal federalism that is more general than ours. He informally discusses some of the policies we consider in our propositions below.

communities for sales tax revenue. The competition is over consumer spending which is mobile across communities, even though residents and resources are fixed within communities. This contrasts with previous models of property tax competition whose focus was on actions to attract businesses or residents. In addition, a major focus of our paper is the interaction of a central government with the competing localities, something not yet fully explored in the literature. These issues are examined in a simple model.

Residents of two jurisdictions purchase two goods, one at home and one in the other jurisdiction. There is also an untaxed numeraire, leisure. Each local government taxes both its own residents' and outsiders' purchases of the good produced there. This may occur either because individuals travel to other jurisdictions and purchase goods subject to local sales taxes or because consumers import goods from other jurisdictions subject to production taxes. We make assumptions about the production technology such that all taxes fall on consumers in either case. Each jurisdiction uses its tax revenue and grants from the central government to furnish a single local public good, whose benefits flow only to residents. This is a representative consumer model, so the local governments could provide either a true public good or a publicly provided private good.

Because consumers pay taxes to both jurisdictions, this model includes elements of tax exporting and tax competition. Low tax rates attract spending into a jurisdiction, so governments compete with each other for revenue. But at the same time, taxes fall both on residents and nonresidents. If local governments do not value the welfare of nonresidents, they would levy higher tax rates than when no tax exporting occurs. Whether or not the tax competition effect dominates the tax exporting effect depends on structural parameters of the model. In addition to considering the effects of revenue externalities between competing local governments, we consider what, if anything, the central government can do to mediate these externalities. We focus on the tax competition case because spending and tax instruments are more useful in this case to increase efficiency than in the tax exporting case.

Section 2 contains the model and some preliminary results on the efficiency of the equilibrium of the game between jurisdictions. Section 3 considers how the central government can use tax policy to alter this equilibrium. Section 4 contains our conclusions. An appendix contains all proofs.

2 The Model

There are two communities with equal numbers of consumers. Consumers are identical within a jurisdiction, but may differ across jurisdictions. Each individual consumes two goods, purchasing one in jurisdiction 1 and the other in jurisdiction 2. For consumers in jurisdiction 1, these are denoted X_1 and X_2, and for consumers in jurisdiction 2, they are denoted Y_1 and Y_2. The

goods in the two communities have equal constant pre-tax producer prices, p. Therefore, any local production or consumption taxes leave producer prices unchanged, making consumers bear the full burden. Each consumer sells labor (the numeraire) to purchase goods and may also have additional money income from nonlabor sources. Consumers benefit from public provision of another good, G, which may be public or private in nature. The preferences of a representative individual in jurisdition i are described by a mixed direct-indirect utility function $V^i(p + t_1,\ p + t_2,\ I_i) + B^i(G_i)$, where t_i is jurisdiction i's specific tax and I_i is nonlabor income [8]. Additively separable utility between public and private goods greatly simplifies the analysis by making private demands and tax revenues independent of the level of government expenditure. We assume that B^i is strictly concave in G_i and that $\partial B^i/\partial G_i$ tends to ∞ as G_i goes to 0.

This model captures in simple form the essential aspects of competition among localities. The assumption that there are only two local jurisdictions might seem questionable since in actuality numerous independent local governments exist. However, little would be gained by assuming the presence of many localities at a cost of greatly increased complexity of analysis. Having more than two communities would only strengthen the realism of the Nash assumptions made below that each jurisdiction disregards the effect of its actions on the tax rates of others or on the budget constraint and actions of the central government. Possibilities (such as negotiations among the communities to overcome fiscal externalities) that might be plausible if there were literally only two communities become unreasonable if many localities exist [9]. In addition, for some purposes, especially the nature of demand, the assumption of two localities is reasonable. Having consumers demand a "home" product and a "foreign" product can be justified by a differentiated products model along the lines of Dixit and STIGLITZ [1977] [10]. The taxed commodities in our model are not produced outputs, such as from manufacturing or farming, but sales of goods produced elsewhere in department stores, automobile dealerships, gas stations, or restaurants. The geographical distribution of jurisdictions means that costs are incurred for travel by consumers or for shipping of goods from one locality to another [11]. Clearly, the

8. That the prices are equal is essentially a normalization, since any producer price differences could be built into the V^i functions.

9. Even with two communities, political aspects enherent in governments seem to prevent bargaining solutions. For example, the city of Gainesville, Florida, is entirely contained in Alachua County, and, in fact, makes up the majority of the county. Yet these overlapping governments have been unable to negotiate agreements on many areas of service provision.

10. See ANDERSON, DE PALMA, and THISSE [1992] for a discussion of the relationship between the Dixit-Stiglitz model and location models with heterogeneous consumers.

11. In the presence of such transport costs, the indirect utility functions could then be written as $V^1(p + t_1, p + s + t_2, I_1)$ and $V^2(p + s + t_1, p + t_2, I_2)$, where s is the per unit transport cost. If s is constant, then we can suppress it in the notation.

products of nearby localities would be more relevant to consumers than those sold in further away communities. Thus, complicating the model by adding more communities and, hence, more commodities would not necessarily affect demands (such as by making the level of home demand small) [12].

Each jurisdiction maximizes the utility of its residents subject to the budget constraint:

$$t_i\,[X_i\,(p+t+t_1,\ p+t+t_2,\ I_1) + Y_i\,(p+t+t_1,\ p+t+t_2,\ I_2)] + R_i - G_i \geq 0, \qquad i=1,\ 2,$$

where R_i is a transfer from the central government and t is a tax on X and Y levied by the central government to finance such transfers. The properties of $B^i\,(G_i)$ ensure that a solution to this maximization is always an interior one with respect to G_i.

The tax rates for the local jurisdictions are the Nash equilibrium outcome of a game. The maximization problem for each jurisdiction has two choice variables (t_i and G_i) and one constraint, so we can specify a game with a single choice variable for each jurisdiction. Whether the tax rate or the expenditure level is the strategic variable (analogous to Bertrand and Cournot games in oligopoly) is significant. We consider only the game where each jurisdiction chooses a tax rate and spends all revenue on the public good. We study this game for several reasons. First, since the other jurisdiction's tax rate and not its expenditure level enters each jurisdiction's maximization problem, this is more tractable. Second, without migration or expenditure spillovers, the competition between the jurisdictions is simply for tax revenue, which is more directly affected by the tax rates. Third, and most importantly, this specification seems closest to local government behavior. Local governments often operate under constitutional restrictions requiring public hearings or votes to change (or at least, to increase) tax rates. Further, constitutional provisions impose balanced budgets on localities who must thus set tax rates in advance and adjust spending to the subsequent revenue raised. Formally, the Nash equilibrium of the tax rate game is a pair of tax rates $(t_1^*,\ t_2^*)$ that solve simultaneously:

$$\underset{t_i}{\text{Max}}\ V^i\,(p+t+t_1,\ p+t+t_2,\ I_i) + B^i\,(t_i\,(X_i+Y_i)+R_i), \qquad i=1,\ 2.$$

For convenience, let $W^i\,(t_1,\ t_2) \equiv V^i\,(p+t+t_1,\ p+t+t_2,\ I_i) + B^i\,(t_i\,(X_i+Y_i)+R_i)$ be the payoff to community i, as a function of the strategic variables, t_1 and t_2.

A number of factors affect the efficiency of the equilibrium of the game between local jurisdictions. First, local taxes are commodity taxes and not

12. This would depend on whether more juridictions were added by arbitrarily dividing a given community into separate governments or by adding geographically distinct new communities.

lump-sum taxes and, hence, distort consumption-labor decisions. Second, even if labor supply were fixed, commodity taxes distort purchases between the jurisdictions. These two effects tend to cause jurisdictions to raise less revenue and finance less expenditure than if they could use lump-sum taxes. A countervailing third effect is that some tax revenue comes from nonresidents' purchases. Since jurisdictions care only about their own citizens, this factor tends to make the equilibrium taxes greater than the socially optimal ones.

To analyze this more formally, we focus on the second and third effects which involve the jurisdictional structure and the efficiency of decentralized systems. The consumption-labor distortions would still arise in a centralized system. Thus, we compare the outcome to that in a centralized system in which the central government sets a common tax and expenditure policy for both jurisdictions. The maximization for the central government is [13]:

$$\max_{t,G} V^1(p+t,\, p+t,\, I_1) + V^2(p+t,\, p+t,\, I_2) + B^1(G) + B^2(G)$$
$$\text{s.t.} \quad t(X_1 + Y_1 + X_2 + Y_2) - 2G \geq 0$$

Denote the solution to this problem as t^*.

PROPOSITION 1: With symmetric communities, $t^* > t_i^*$ $(t^* < t_i^*)$ if and only if $\frac{\partial W^i(t_1^*, t_2^*)}{\partial t_j} > 0 \left(\frac{\partial W^i(t_1^*, t_2^*)}{\partial t_j} < 0\right)$.

If the communities differ but the heterogeneity is not too extreme, then the result in Proposition 1 remains valid. To interpret this, note that $\partial W^2(t_1^*, t_2^*)/\partial t_1$ is the marginal fiscal externality caused by community 1's taxes on the welfare of community 2, evaluated at the Nash equilibrium. When this is positive, the social optimum entails higher taxes and, when negative, lower ones. To understand when the fiscal externality is positive or negative, note that:

$$\frac{\partial W^1}{\partial t_2} = -\alpha_1 X_2 + \frac{\partial B^1}{\partial G_1} t_1 \left(\frac{\partial X_1}{\partial t_2} + \frac{\partial Y_1}{\partial t_2}\right)$$

and

$$\frac{\partial W^2}{\partial t_1} = -\alpha_2 Y_1 + \frac{\partial B^2}{\partial G_2} t_2 \left(\frac{\partial X_2}{\partial t_1} + \frac{\partial Y_2}{\partial t_1}\right),$$

where α_i is the marginal utility of money income for the consumer in jurisdiction i. The first term in these expressions is the loss in welfare in a community because its citizens' consumption declines when the other community raises its tax rate. The second term concerns the revenue effects on a community when the other community raises its tax rate. Revenues change because of cross-price effects on demands by the residents

13. For simplicity, we assume the central government is utilitarian, maximizing the sum of utilities across communities. Allowing the communities to be of different size or using a more general Bergson-Samuelson social welfare functions would not alter any results.

of both communities. If the products of the two communities are gross complements ($\partial X_i/\partial t_j < 0$, $\partial Y_i/\partial t_j < 0$, $i \neq j$), then this effect is also negative. In this case, both effects work together to create a negative fiscal externality. A local community exports the harmful effects of its taxes to both the citizens and the public budget of the other community. If, on the other hand, the two communities' products are gross substitutes, then increases in one community's taxes increase demands and revenue in the other community. The overall external effect could be positive or negative, depending on whether the revenue effect outweighs the consumption effect. Only when the revenue effect is large enough is the externality positive. Then, communities compete with each other for tax base by lowering rates below their optimal levels.

3 Central Government Intervention

The equilibrium tax rates may be higher or lower than in the socially efficient outcome, but they will almost never be the rates the central government would choose. The central government could abolish the local units and make unified decisions on taxes to resolve the externality problem. This, however, could create several costs. First, the central government is likely to have poorer information about local tastes for the mix of various public goods. While still causing some difficulties, this lack of information on the part of the central government about local resident preferences creates fewer problems in a mixed central-local federal system. The local governments could report summary information on the value of public expenditure in the form of the $B^i(G_i)$ functions to the central government. While this information would be sufficient for the central government to select appropriate levels for total public expenditure, it would not be sufficient to allow it to allocate these funds appropriately among the different public goods. HAMILTON and SLUTSKY [1996] describe more fully the nature of information flows in a decentralized system [14].

Second, the central government is likely to operate under a number of political constraints. A central government may be compelled to offer the same quantities of public goods in all jurisdictions. While most central governments explicitly redistribute among different regions, this redistribution primarily serves to equalize income differences across regions, rather than to meet differing tastes and needs for public goods. Political constraints are also likely to prevent a central government from levying differential tax rates across local jurisdictions, even when different regions prefer different levels of public expenditure.

Since the localities cannot be abolished efficiently, the question then is whether the central government can alleviate the revenue externality problem

14. We do not consider here important questions of how to induce the localities to report these summary functions truthfully to the central government.

of the local jurisdictions. We concentrate on decentralized mechanisms in which local governments set independent policies which are affected by central government policies. The central government does not mandate local actions directly, but only indirectly, leaving the local governments with some latitude. In other words, we allow the central government to choose policies which change the Nash equilibrium of the tax rate game, rather than eliminating all local government discretion [15].

We study the consequences of the central government choosing a uniform tax rate in all communities and transferring the revenue to local governments. The central government chooses its tax and transfer policies first and local governments choose their policies knowing the central government's decisions. We analyze such policies for the tax competition case where local governments would choose too little spending without central government action. We do not study the tax exporting case here because alleviating that revenue externality requires a different set of institutions.

Revenue sharing policies in some form can increase the efficiency of local tax and expenditure policies, but in other forms are ineffective. First, consider a policy which fails to affect the equilibrium. Suppose that transfers to local governments are directly tied to the central government tax collections in each region. The grant to each locality exactly equals central tax collections on the tax base in that jurisdiction, and the localities recognize this. The central government is no more than a collection agency for the regions. Formally, $R_i = t(X_i + Y_i)$ and each local government knows this relation. Some U. S. states use a portion of their retail sales tax collections for revenue sharing in precisely this form. Let the total tax charged in each locality be $\hat{t}_i = t_i + t$ where t is the central tax and t_i the local tax.

PROPOSITION 2: Assume the central government levies a tax at rate t on X and Y in both jurisdictions and rebates the proceeds to local governments according to the formula $R_i = t(X_i + Y_i)$.
(i) If local governments can tax or subsidize sales in their jurisdiction (t_i positive or negative), then the Nash equilibrium total tax rates $\hat{t}_i$ do not vary with t.
(ii) If local governments cannot subsidize sales ($t_i \geq 0$), then the central government can alter the equilibrium total taxes only when t is sufficiently high that the equilibrium t_i equal zero.

This is essentially a neutrality result, akin to those for the private provision of public goods [16]. Each local government can effectively undo what the central government is doing on its behalf. When the central government sets t, the feasible set and payoffs of the local governments do not change from

15. We do not consider policies which effectively force local jurisdictions to change their tax policies. One such possibility would be for the central government to levy "Pigovian taxes" on local tax collections. WILDASIN [1991], for example, considers such subsidies to reduce inefficient migration in a common labor market. Such taxes on local revenue might be difficult to implement in a federal system where local governments retain certain tax powers.
16. See, for example, BERGSTROM, BLUME, and VARIAN [1986].

when there is no central tax collection. There is an important qualification – if local governments cannot subsidize purchases of X and Y, then a tax and transfer scheme can increase local government expenditure but only by setting $t > t_i^*$ in which case local taxes t_i equal zero. This latter outcome is not truly decentralization. The central government takes over the task of revenue collection entirely and local governments choose only the distribution of expenditure across different public goods.

A different transfer scheme does result in a more complete decentralization. Suppose the central government institutes a tax and grant system where it sets a tax rate and gives each local jurisdiction a fixed grant not tied to the revenues collected in the locality. If central government grants depend on local socioeconomic characteristics, then no direct connection would exist between the local tax base and the amount of the grants. Each local government, taking the grant as given, can levy its own tax and spend more than it receives from the central government. A central government policy $(t,\ R_1,\ R_2)$ is consistent if, in equilibrium, the sum of the grants equals total revenue, although out of equilibrium, budget balance is not required. This is complicated since the levels of the grants affect equilibrium total taxes, which in turn affects the demands and central government revenue. Denote the equilibrium local taxes as $t_i\,(t,\ R_1,\ R_2)$ with demands $X_i\,(t + t_1\,(t,\ R_1,\ R_2),\ t + t_2\,(t,\ R_1,\ R_2),\ I_1)$ and $Y_i\,(t + t_1\,(t,\ R_1,\ R_2),\ t + t_2\,(t,\ R_1,\ R_2),\ I_2)$. Consistent policies must satisfy:

$$t\,[X_1 + X_2 + Y_1 + Y_2] = R_1 + R_2.$$

For a given t, there can exist multiple values of R_1 and R_2 satisfying this. The central government could choose among these to maximize social welfare or it might be constained by political considerations as to how R_1 and R_2 are divided. For example, the equilibrium grants to a locality might be constrained to equal the revenues raised in the locality, $R_i = t\,(X_i + Y_i)$ [17].

When goods are substitutes for leisure, under any central government policy $(t,\ R_1,\ R_2)$, whether or not it is consistent, local governments levy positive supplementary taxes.

PROPOSITION 3: Suppose that both goods are gross substitutes with leisure. Then, there exists some $\bar{t}$ which is less than the central government's optimal tax rate t^* such that, for any central government tax t in both communities with $\bar{t} < t \leq t^*$ and any distribution of fixed grants R_1 and R_2, local governments set positive tax rates and local expenditures exceed the levels of their grants.

17. Sufficient technical assumptions can be imposed to guarantee that, for any t, there exists an $(R_1,\ R_2)$ for which this holds. These conditions can be viewed as a mapping from $(R_1,\ R_2)$ space into itself, $R_i^* = t\,[X_i\,(t,\ R_1,\ R_2) + Y_i\,(t,\ R_i,\ R_2)]$. If there exists a unique local Nash equilibrium for each t and if demands are well-behaved, then this mapping has a fixed point which yields the required budget balancing grants.

The condition of gross substitutability is sufficient but not necessary. The same result would hold with complementarity which is not too extreme. Further, the result is independent of whether there is tax competition or tax exporting.

The difference between Propositions 2 and 3 lies in the perceptions of local governments. In Proposition 2, the local government takes into account that a tax increase reduces its revenue-sharing grant. In Proposition 3, R_i is thought to be fixed and the local government perceives no effect on its grant from an increase in t_i. Most actual revenue sharing systems probably correspond more closely to the fixed grants system. Even if a central government designates a revenue source to fund grants to local communities, the distribution of grants often depends on more than local tax bases. For such formulas, the link between local tax rates and the size of grants will be weak for individual communities. Thus such revenue sharing programs increase local public spending, alleviating the tax competition externality.

With revenue sharing in the form of fixed grants, when the localities are identical, not only can the central government affect the local equilibrium, but it can sustain the overall efficient outcome without completely taking over revenue collection. Efficient real decentralization is possible.

PROPOSITION 4: Assume the central government selects a consistent t, R_1 and R_2, and then local governments, taking these as given, choose their own tax rates. If the localities are identical and there is a positive fiscal externality, there exists a consistent policy $(\hat{t},\ R,\ R)$ with $t < t^*$ such that $t^* = \hat{t} + t_i(\hat{t},\ R,\ R)$, $i = 1,\ 2$. Hence, the central government can use a partial revenue sharing system to support the central government's optimal tax rate and expenditure levels.

When communities are identical, having real decentralization with both the central and local governments imposing taxes does not seem significantly different from having only the central government doing this, since the same level of public expenditure occurs. The benefit of positive activity at both levels of government is much stronger when local communities differ (the V^i and B^i functions differ across communities). The efficient outcome would have different taxes and spending in the communities. A central government might be unable to do this due to informational and political constraints discussed above. On the other hand, if the central government does nothing, the equilibrium of the game between localities will have heterogeneous outcomes, but it will still be inefficient. A common central government tax and grant system with supplemental local activity could be more efficient, while maintaining heterogeneous outcomes geared to local preferences.

To model heterogeneous localities in a decentralized system, we must specify how the central government divides its revenues. We assume that, in equilibrium, any central government revenues are divided among localities in proportion to how they were raised, $R_i = \hat{t}(X_i + Y_i)$. As discussed above, this division might be imposed by political constraints which prevent redistribution of revenue, since this division will not

generally be optimal if the central government could arbitrarily choose the transfers [18].

Given this assumption, the preferences of the central government depend solely on the total taxes, $\hat{t}_i = \hat{t} + t_i^*$ and not on how this total is divided between the central government and the localities. We can write the central government's preferences as:

$$W(\hat{t}_1, \hat{t}_2) = W^1(\hat{t}_1, \hat{t}_2) + W^2(\hat{t}_1, \hat{t}_2).$$

In this circumstance, unlike the result in Proposition 4 for identical communities, a decentralized outcome will generally not be efficient. When the central government can charge different taxes in the two communities, its optimum is the solution to:

$$\underset{\hat{t}_1, \hat{t}_2}{\text{Max}}\ W^1(\hat{t}_1, \hat{t}_2) + W^2(\hat{t}_1, \hat{t}_2)$$

where the first order conditions are:

$$\frac{\partial V^i}{\partial t_i} + \frac{\partial B^i}{\partial G_i} X_i + Y_i + \hat{t}_i \left(\frac{\partial X_i}{\partial t_i} + \frac{\partial Y_i}{\partial t_i} \right) + \frac{\partial V^j}{\partial t_i} + \frac{\partial B^j}{\partial G_j} \left(\hat{t}_j \left(\frac{\partial X_j}{\partial t_i} + \frac{\partial Y_j}{\partial t_i} \right) \right) = 0, \quad i = 1, 2, \quad \text{and } j \neq i.$$

In the Nash equilibrium, each community solves:

$$\underset{t_i}{\text{Max}}\ V^i(t_1 + \hat{t}, t_2 + \hat{t}, I_i) + B^i(t_i(X_i + Y_i) + R_i)$$

which has the first order condition:

$$\frac{\partial V^i}{\partial t_i} + \frac{\partial B^i}{\partial G_i} \left(X_i + Y_i + t_i \left(\frac{\partial X_i}{\partial t_i} + \frac{\partial Y_i}{\partial t_i} \right) \right) = 0.$$

Any $\hat{t}$ inducing a Nash equilibrium satisfying the central government first order condition must satisfy:

$$\hat{t} = \frac{-\left(\frac{\partial V^j}{\partial t_i} + \frac{\partial B^j}{\partial G_j} \hat{t}_j \left(\frac{\partial X_j}{\partial t_i} + \frac{\partial Y_j}{\partial t_i} \right) \right)}{\frac{\partial B^i}{\partial G_i} \left(\frac{\partial X_i}{\partial t_i} + \frac{\partial Y_i}{\partial t_i} \right)}, \qquad i = 1, 2$$

For heterogeneous communities, no single value of $\hat{t}$ satisfies this for both communities. There are two equations but only one central government variable. The decentralized outcome is inferior to that which a central government which could charge different taxes in the two localities could

18. We use this particular rule to illustrate how the central government can improve on the uncontrolled equilibrium with a fixed revenue sharing system. Other rules have the potential to do even better.

attain. Even allowing the R_i to be chosen optimally does not alter this result. Of course, with identical communities, the common value of $\hat{t}$ in these equations is that needed to achieve the efficient outcome of Proposition 4.

Although not fully efficient, the decentralized outcome can be better than the outcome with only a central government constrained to charge identical taxes in the two communities. To show this, we make several simplifying assumptions. First, we assume uniform heterogeneity. This means that, in all relevant circumstances, the same locality, arbitrarily designated as locality 1, prefers higher expenditures and taxes. At the central government optimum and, at the Nash equilibrium for every central tax rate $\hat{t}$, total tax $\hat{t}_1$, exceeds $\hat{t}_2$. Second, we assume that social preferences are convex in the space of total taxes, $(\hat{t}_1, \hat{t}_2)$. Third, consider the locus of the Nash equilibrium total taxes as $\hat{t}$ varies. We assume this is monotonically increasing in $\hat{t}$ and that everywhere along this locus, $\partial W/\partial t_1 > 0$. The latter part of this assumption implies that, at the Nash equilibrium locus for every t_1, there is a positive fiscal externality with tax competition always holding.

PROPOSITION 5: Assume that the central government must charge identical taxes in each locality and that any revenue raised must be spent in the locality where it is raised, although the localities view the expenditure as a fixed grant. If the three assumptions listed above are satisfied, then the equilibrium under a mixed central-local system in which the localities augment central government actions is preferable either to the outcome of the central government acting alone with localities forbidden to augment or to that when only localities tax and spend with no central government activity.

This proposition presents sufficient conditions for the desirability of allowing local supplements to central government taxation and spending. For the most part, such assumptions as uniform heterogeneity, upward sloping Nash equilibrium locus, and convexity of social preferences seem relatively innocuous or not crucial. The assumption that $\partial W/\partial t_1 > 0$ everywhere along the Nash equilibrium locus is more problematical. It is certainly possible that, at sufficiently high total taxes, this term reverses in sign. However, as is clear from the proof, this condition can be weakened significantly. What is important is that the Nash equilibrium locus lies between the central government bliss point and the 45° line. In effect, this means that the variability between the localities in their taxes at a Nash equilibrium is less than at the socially efficient point. If this holds, then the variability created by having local supplements moves toward a more efficient outcome. If, on the other hand, the Nash equilibrium is more variable, then allowing supplements would move the outcome past the efficient level and might reduce social welfare. While this latter possibility cannot be ruled out, in many games, the Nash equilibrium does exhibit less variability than in the efficient outcome. For example, in a Cournot game with different marginal costs between firms, the joint profit maximizing outputs differ by more than the Nash equilibrium outputs do.

4 Concluding Remarks

We examined a model of taxation and public expenditure with a central government and competing local governments. We established a role for central government revenue sharing to reduce the effects of the fiscal externalities of tax competition. A system of grants to local communities can increase local spending, thus moving toward a social optimum. When communities are heterogeneous, a revenue-sharing system can dominate complete centralization of revenue collection. Thus, decentralization with the central government sharing the revenue-collection function with local governments may raise welfare. It is noteworthy that revenue-sharing reduces the fiscal externality problem without requiring a system of Pigovian taxes or subsidies on local revenue but only requires letting community grants be independent of their tax collections.

Propositions 4 and 5 show that central government revenue sharing is beneficial when there are positive fiscal externalities. In this case, the localities tax and spend less than is socially desirable since they are engaged in tax competition with each other. The central government increases total public spending and hence raises social welfare. When the fiscal externality is negative due to tax exporting, then the Nash equilibrium taxes are too large relative to their efficient levels. Revenue sharing will not be effective in improving the outcome since it will tend to move the outcome in the wrong direction. To increase efficiency, the central government must reduce local activities. This could be done in several ways. One would be to have a completely local system of spending and taxes but with centrally imposed ceilings placed on local activities. Another would be to eliminate all local activity and only allow central government actions, in effect internalising the externality. For reasons similar to those discussed above, the existence of heterogeneous localities can cause problems for either approach. The ceilings on the tax rates would have to vary across localities which could be difficult politically or informationally.

Beyond the normative analysis of this paper, our model has applications in positive predictions. The "flypaper effect" is the empirical finding that grants to local jurisdictions stimulate local public expenditure more than increases in local income do. That is, "money sticks where it hits" in public or private budgets (OATES [1994]). HAMILTON [1986] shows that the efficiency cost of local taxation can generate flypaper effects, in contrast to other models which rely on factors such as agenda manipulation. MIESZKOWSKI [1994] questions whether the efficiency cost alone can explain the magnitude of the effect. But all previous work has ignored competition among local jurisdictions. In a separate paper, we find cases where the equilibrium effects exceed those in models with a single local jurisdiction.

Another potential prediction of the model is that the need for revenue sharing depends on what tax bases local jurisdictions have. Central governments often determine what tax bases local governments can use. If there are large positive revenue externalities, then central governments need to use revenue sharing to a greater degree than if the revenue externalities

are small or negative. Hence, we would expect that, if local governments depend heavily on property taxes, there is less revenue sharing than if local governments rely heavily on sales taxes.

Proof of Propositions

Proof of Proposition 1: If the central government maximizes $W^1 + W^2$, it chooses equal tax rates in the set of tax rates Pareto superior to the Nash equilibrium. When $\frac{\partial W^i}{\partial t_j} > 0$, this Pareto superior set lies to the northeast of (t_1^*, t_2^*). See Figure 1. When $\frac{\partial W^i}{\partial t_j} < 0$ then the set of such Pareto superior tax rates lies southwest of (t_1^*, t_2^*). See Figure 2. □

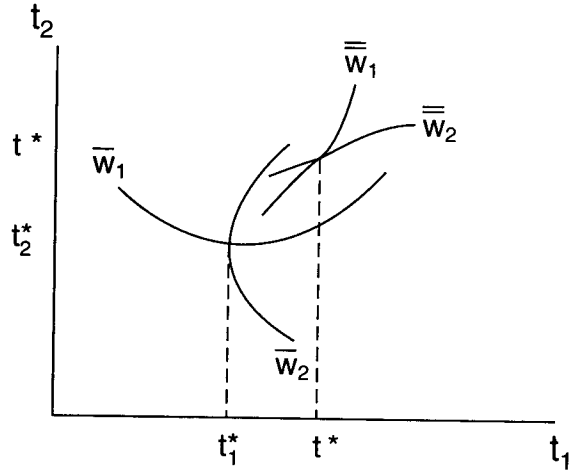

FIGURE 1

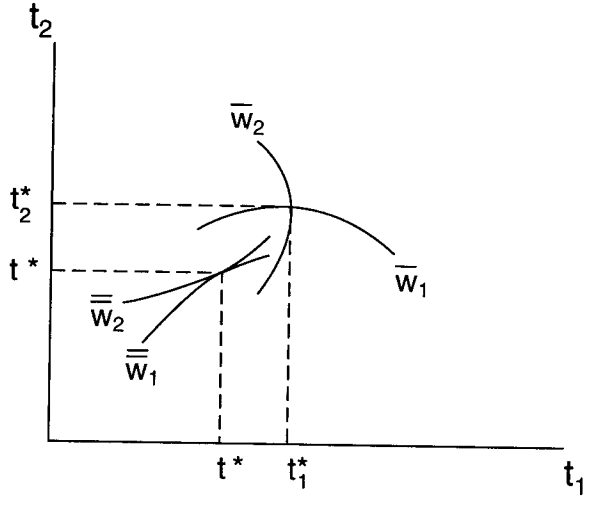

FIGURE 2

Proof of Proposition 2: For any central tax t, a pair of local taxes (t_1, t_2) is a Nash equilibrium if and only if they simultaneously solve:

$$\text{(A1)} \quad \frac{\partial W^i}{\partial t_i} = -\alpha_i X_i + \frac{\partial B^i}{\partial G_i} \times \left(X_i + Y_i + (t + t_i) \left(\frac{\partial X_i}{\partial t_i} + \frac{\partial Y_i}{\partial t_i} \right) \right) = 0, \quad i = 1, 2$$

For some value $\hat{t}$, let $(\hat{t}_1, \hat{t}_2)$ be the Nash equilibrium local taxes. Consider some other value $\tilde{t}$ of t. Consider $\tilde{t}_1 = \hat{t} + \hat{t}_i - \tilde{t}$, $i = 1, 2$. Then $(\tilde{t}_1, \tilde{t}_2)$ simultaneously solve (A1) given $\tilde{t}$, since all terms $(X_i, Y_i, \alpha_i, \frac{\partial B^i}{\partial G_i}, t + t_i, \partial X_i/\partial t_i$, and $\partial Y_i \partial t_i)$, and are the same under $(\tilde{t}, \tilde{t}_1, \tilde{t}_2)$ as under $(\hat{t}, \hat{t}_1, \hat{t}_2)$. Hence, $(\tilde{t}_1, \tilde{t}_2)$ is a Nash equilibrium given $\tilde{t}$. Total taxes and spending are constant, so neutrality holds. For $\tilde{t} > \hat{t} + \hat{t}_i$, this implies a negative value for $\tilde{t}_i$ with the local government providing a subsidy instead of a tax. If this is not allowed, neutrality fails. □

Proof of Proposition 3: Let R be the grant received by jurisdiction 1. The problem facing this jurisdiction is:

$$\underset{t_i}{\text{Max}}\ W^1 = V^1 (\tilde{t} + t_1, \tilde{t} + t_2, I_1) + B^1 (t_1 (X_1 + Y_1) + R)$$

To determine the sign of t_1, consider:

$$\left. \frac{\partial W^1}{\partial t_1} \right|_{t_1 = 0} = -\alpha_1 X_1 + \frac{\partial B^1}{\partial G_1} (X_1 + Y_1)$$

At (t^*, R, R). the first order condition for the central government's problem is:

$$\left(\frac{\partial B^1}{\partial G_1} - \alpha_1 \right) (X_1 + Y_1) + \frac{\partial B^1}{\partial G_1} t \left(\frac{\partial X_1}{\partial t_1} + \frac{\partial Y_1}{\partial t_1} + \frac{\partial X_2}{\partial t_1} + \frac{\partial Y_2}{\partial t_1} \right) = 0.$$

The demand assumption is sufficient to guarantee that the second term is negative. Therefore, $\frac{\partial B^1}{\partial G_1} > \alpha_1$ must hold.

Thus, $\frac{\partial W^1}{\partial t_1} \Big|_{t_1 = 0} > 0$ at $t = t^*$. Since this is strictly positive, it remains positive for a range of tax rates below t^*, giving the $\bar{t}$ asserted in the proposition.

Proof of Proposition 4: Let $t_i (t, R_1, R_2)$ be the Nash equilibrium local tax given a consistent central government policy (t, R_1, R_2). From the assumption of a positive fiscal externality, $t_i (0, 0, 0) < t^*$, and from Proposition 3, $t_i (t^*, R, R) > 0$. If $t_i (t, R, R)$ is continuous in t, then there exists a $\hat{t}$ such that $\hat{t} + t_i(\hat{t}, R, R) = t^*$. See Figure 3. □

Proof of Proposition 5: Consider the various outcomes in the space of total taxes $(\hat{t}_1, \hat{t}_2)$ as shown in Figure 4. Let $(\bar{t}, \bar{t})$ be the point on the 45° line, which is the best the central government can do when constrained to charge the same tax in both communities. Let (t_1^0, t_2^0) be the central government optimum when the restriction of equal tax rates is

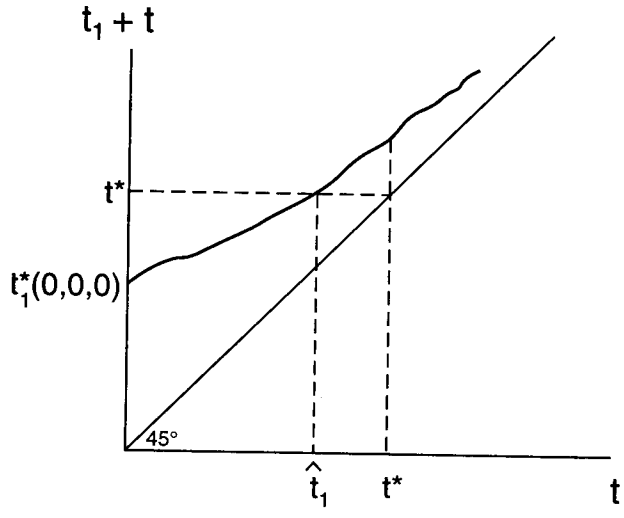

FIGURE 3

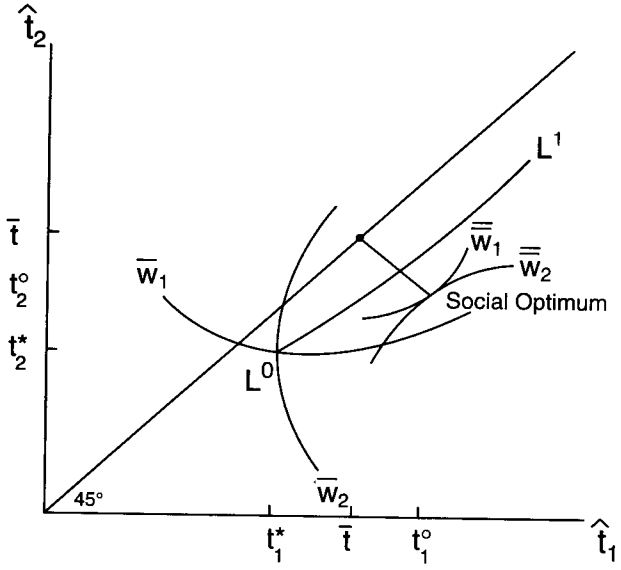

FIGURE 4

not imposed. Finally, let the curve L^0L^1 be the locus of total taxes arising under local Nash equilibirum as the central government tax rate varies. From uniform heterogeneity, $t_1^0 > t_2^0$ and the locus L^0L^1 lies below the 45° line. Furthermore, the locus L^0L^1 slopes up with the point L^0 corresponding to the central government tax equaling 0 from the assumption that the total tax in each community is increasing in t. From the assumption that $\partial W/\partial t_1 > 0$ everywhere along L^0L^1, the efficient point $(t_1^0,\ t_2^0)$ lies below L^0L^1 , given convexity of social preferences.

The optimal outcome with mixed central and local government actions must lie somewhere on the L^0L^1 locus. We first show that it is not at L^0 making the mixed optimum preferable to the local equilibrium with $t = 0$. To see this, note that:

$$\frac{\partial W}{\partial t} = \left(1 + \frac{\partial t_1^*}{\partial t}\right)\left(\frac{\partial V^1}{\partial p_1} + \frac{\partial V^2}{\partial p_1} + \frac{\partial B^1}{\partial G_1} \times \left(X_1 + Y_1 + (t + t_1^*)\left(\frac{\partial X_1}{\partial p_1} + \frac{\partial Y_1}{\partial p_1}\right)\right)\right) + \frac{\partial B^2}{\partial G_2}\left((t + t_2^*)\left(\frac{\partial X_2}{\partial p_1} + \frac{\partial Y_2}{\partial p_1}\right)\right) + \left(1 + \frac{\partial t_2^*}{\partial t}\right)\left(\frac{\partial V^1}{\partial p_2} + \frac{\partial V^2}{\partial p_2} + \frac{\partial B^1}{\partial G_1}(t + t_1^*)\left(\frac{\partial X_1}{\partial p_2} + \frac{\partial X_1}{\partial p_2}\right) + \frac{\partial B^2}{\partial G_2}\left(X_2 + Y_2 + (t + t_2^*)\left(\frac{\partial X_2}{\partial p_2} + \frac{\partial Y_2}{\partial p_2}\right)\right)\right)$$

At L^0, given the first order conditions for a Nash equilibrium and that $t = 0$, this reduces to:

$$\frac{\partial W}{\partial t} = \left(1 + \frac{\partial t_1^*}{\partial t}\right)\frac{\partial W^2}{\partial t_1} + \left(1 + \frac{\partial t_2^*}{\partial t}\right)\frac{\partial W^1}{\partial t_2}.$$

This must be positive since $1 + (\partial t_i^*/\partial t) > 0$ and $\partial W^j/\partial t_i > 0$ by assumption. Thus, increasing t from $t = 0$ along L^0L^1 raises W, so the mixed optimum is preferable to that with $t = 0$.

Second, we show that the mixed outcome is preferable to $(\bar{t}, \bar{t})$, the optimum with central government activity only. Consider the line connecting $(\bar{t}, \bar{t})$ and (t_1^0, t_2^0). By convexity of $W(\bar{t}_1, \bar{t}_2)$, every point on this line, including its intersection with L^0L^1, is preferred to $(\bar{t}, \bar{t})$ and the mixed optimum is at least as good as the intersection point. □

• References

ANDERSON, S., DE PALMA, A., THISSE, J.-F. (1992). – "*Discrete Choice Theory of Product Differentiation*", Cambridge: *MIT Press.*

BULOW, J., GEANAKOPLOS, J., KLEMPERER, P. (1985). – "Multimarket Oligopoly: Strategic Substitutes and Complements", *Journal of Political Economy,* 93, pp. 488-511.

BERGSTROM, T., BLUME, L., VARIAN, H. (1986). – "On the Private Provision of Public Goods", *Journal of Public Economics*, 29, pp. 25-49.

DIXIT, A., STIGLITZ, J. (1977). – "Monopolistic Competition and Optimum Product Diversity", *American Economic Review,* 67, pp. 297-308.

EPPLE, D., FILIMON, R., ROMER, T. (1993). – "Existence of Voting and Housing Equilibrium in a System of Communities with Property Taxes", *Regional Science and Urban Economics*, 23, pp. 585-610.

GORDON, R. (1983). – "An Optimal Taxation Approach to Fiscal Federalism", *Quarterly Journal of Economics*, 97, pp. 567-586.

HAMILTON, B. (1983). – "The Flypaper Effect and Other Anomalies," *Journal of Public Economics,* 22, pp. 347-361.

HAMILTON, J. (1986). – "The Flypaper Effect and the Deadweight Loss of Taxation", *Journal of Urban Economics,* 19, pp. 148-155.

HAMILTON, J., SLUTSKY, S. (1995). – "Decentralizating Allocation and Distribution by Separation with Information Transfers", University of Florida, *working paper.*

KENNY, L., SCHMIDT, A. (1994). – "The Decline in the Number of School Districts in the U. S.: 1950-1980", *Public Choice*, 79, pp. 1-18.

MIESZKOWSKI, P. (1994). – "Comments on Chapter 5, in J. Quigley and E. Smolensky, ed., *Modern Public Finance,* Cambridge: Harvard University Press.

OATES, W. (1994). – "Federalism and Government Finance", in J. Quigley and E. Smolensky, ed., *Modern Public Finance*, Cambridge: Harvard University Press.

STIGLITZ, J. (1983). – "The Theory of Local Public Goods Twenty-Five Years after Tiebout: A Perspective", in ZODROW [1983].

WILDASIN, D. (1991). – "Income Redistribution in a Common Labor Market", *American Economic Review*, 81, pp. 757-774.

WILDASIN, D., WILSON, J. (1991). – "Theoretical Issues in Local Public Economics", *Regional Science and Urban Economics*, 21, pp. 317-331.

ZODROW, G., ed. (1983). – *Local Provision of Public Services: The Tiebout Model after Twenty-Five Years,* New York: Academic Press.

ZODROW, G., MIESZKOWSKI, P. (1983). – "The Incidence of the Property Tax: The Benefit View versus the New View", in ZODROW [1983].

ZODROW, G., MIESZKOWSKI, P. (1986). – "Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods", *Journal of Urban Economics*, 19, pp. 296-315.