OPTIMAL FISCAL FEDERALISM IN THE PRESENCE OF TAX COMPETITION

by

Eckhard Janeba
University of Mannheim

and

John Douglas Wilson*
Michigan State University

Revised, November, 2010

Abstract. This paper models the optimal division of public good provision between central and regional governments in an economy with interregional tax competition. Regional provision is inefficient because governments compete for scarce capital by lowering their capital taxes and public good levels to inefficiently low levels. On the other hand, central provision is inefficient because it is determined by the minimum winning coalition (MWC) within a legislature. The optimal degree to which public good provision should be decentralized depends on a tradeoff between these inefficiencies. In our main model, complete centralization is never optimal: regional governments should supply some public goods.

* Corresponding Author: Professor John D. Wilson, Department of Economics, Marshall-Adams Hall, Michigan State University, East Lansing, MI 48824, USA. Emails: wilsonjd@msu.edu and janeba@uni-mannheim.de . We would like to thank Steeve Mongrain and Marcel Gerard and other participants at the conference in honor of Robin Boadway, Queens University, 2009, for their helpful comments and suggestions on an earlier version of this paper. Thomas Bräuninger and seminar participants at the University and Waterloo and Michigan State University also provided useful comments and suggestions. Finally two reviewers for this journal provided valuable advice.

1. Introduction

A fundamental question in public economics is how to allocate spending responsibilities and taxing powers between the central and lower-level governments. While multi-tier government structures are the norm in many countries today, the benefit of hierarchical government structures is not obvious. One of the more prominent approaches, originally put forward by Oates (1972), views federal structures as balancing the various inefficiencies of central and local provision of public goods. Under central provision, there is an inefficient uniformity of public good benefits across localities, whereas cross-border spillovers of public good benefits create inefficiencies under decentralized provision. Oates's decentralization theorem states that decentralization is preferable in the absence of spillovers.

In a related approach, Besley and Coate (2003) also view public goods as being inefficiently allocated across localities under centralization. But by giving careful attention to the exact form of legislative bargaining and strategic delegation under centralization, their approach yields inefficiencies involving the unequal distribution of public good expenditures across jurisdictions. In a complementary paper, Lockwood (2001) also compares the benefits from centralization relative to decentralization. He shows that legislative outcomes under centralization are not sufficiently sensitive to the within-region benefits of the public projects that are being allocated across regions.

All three of these models suggest that spillovers must be sufficiently small for decentralization to be more efficient than centralization. It is tempting to generalize this finding to other sources of interjurisdictional externalities.

In this paper, we replace spillover effects with the fiscal externalities associated with tax competition. This focus is particularly interesting, because standard tax competition models provide no justification for decentralizing public good provision. Only the inefficiencies associated with local government behavior are modeled, not inefficiencies at the central level. In particular, a major theme of the tax competition literature has been that competition for mobile capital by local governments leads to inefficiently low tax rates and public good levels.[1] By modeling inefficiencies in the legislative process at the central level, the literature reviewed above suggests that decentralization is the preferable outcome if the price elasticity of capital demand is sufficiently small at the regional level, since this elasticity influences the size of fiscal externalities.

[1] See Wilson (1986) and Zodrow and Mieszkowski (1986) for the initial contributions. Wilson (1999) and Wilson and Wildasin (2004) review the literature on tax competition, and Wilson (2006) reviews models of tax competition in a federal setting.

We borrow from Besley and Coate's specification of a minimum winning coalition (MWC) as the decision-maker for public good provision at the central level. But we replace their assumption of a single public good with many public goods, thereby enabling us to analyze equilibria in which some goods are centrally provided, while others are provided by regional governments. We then obtain a stronger result: *some* decentralization of public good provision is always preferable to complete centralization. In particular, this result holds regardless of the price elasticity of capital at the regional level. The paper also describes circumstances under which at least some centralization of public goods provision is desirable, and it considers an alternative specification of the model where complete centralization may be optimal when the resulting inefficiencies are sufficiently low. But the case for some decentralization as part of an optimal federal system appears to be stronger when there is tax competition than when there are spillover effects.

For our model of tax competition, we extend the Zodrow-Mieskowski (1986) model to include a continuum of public goods, all of which are imperfect substitutes from the consumers' perspective.[2] Regional (or "local") governments act in the best interest of their representative citizens but must use a distortionary tax on interregionally mobile capital to finance public good expenditures. A Nash game in public goods is used to model competition for mobile capital. Thus, the tax increase required to raise a region's public expenditures one unit causes an outflow of capital, and the regional government treats as a cost the resulting loss in tax revenue. But this outflow represents an inflow for other regions, and the resulting increase in their tax revenue is the fiscal externality. The size of this externality clearly depends on the level of capital taxation. If most of the public goods supplied to a region's residents are centrally provided, then the region will need only a small tax rate to finance its provision of the remaining public goods, and so it will care little about the capital outflow that occurs when it raises its tax rate to supply an additional unit of one of its public goods. In this sense, the tax competition problem is relatively unimportant when only a small amount of public good provision is decentralized.

This last insight is the basis for our finding that some decentralization is optimal. We first use the Besley-Coate reduced-form specification of a minimum winning coalition, which

[2] The continuum approach has been successfully used before by Lorz and Willmann (2005), as well as Wilson and Janeba (2005), both in the context of fiscal decentralization. The use of a continuum of public goods avoids the all-or-nothing decision between centralization and decentralization, and allows us to focus on the optimal degree of decentralization and the co-existence of multiple tiers of government.

treats all regions within it identically.[3] Membership in the MWC is random, with equal probabilities of belonging, in which case an optimal federal system may be defined as one that maximizes the common expected welfare for each region, calculated prior to knowing this membership. To focus on efficiency issues, utility functions are assumed to be quasi-linear, leaving the discussion of distributional issues to our concluding section.

The literature contains other approaches to fiscal federalism. In our own work (Janeba and Wilson, 2005), we have examined how countries might use a federal structure to gain a strategic advantage over foreign rivals in their competition for internationally mobile capital. Another approach is based on the idea that lower-level governments possess informational advantages over the central government. In this case, the central government should act as a principal in an agency problem, confronting the lower-level governments (the "agents") with incentives to behave in ways that are optimal for the entire system of regions (see, e.g., Raff and Wilson, 1997). The microfoundations behind these informational asymmetries are not well-understood, however. Finally, it is widely understood that the distributional functions of the government should be allocated to the central government.[4] See Tresch (2002) for a careful and critical discussion of the argument concerning redistribution. In contrast, our approach focuses on the efficiency issues associated with tax competition, rather than income distribution problems.

The work by Lockwood (2001) and Besley and Coate (2003) are early contributions in a sizable political economy literature on fiscal decentralization, which is surveyed by Lockwood (2006). A number of other papers consider the benefits of centralization relative to decentralization in the presence of public good spillovers. These spillovers are important components of the models developed by Besley and Coate. Dur and Roelfsema (2005) show that underprovision of centrally-provided goods occurs when the cost of provision cannot be fully shared across districts, and regions therefore strategically delegate 'conservatives' under centralized decision making. Lorz and Willmann (2005) endogenize the range of public goods that are to be centrally provided, where local public goods differ in terms of their regional spillover degree. They show that in a political economy equilibrium, too few goods are centralized relative to the social optimum. Cheikbossian (2008) demonstrates that even in the presence of symmetric regions, centralization can lead to inefficient outcomes because of rent-seeking activities by jurisdictions to influence the policy choice under centralized

[3] For simplicity, Besley and Coate work with a 2-region model, whereas we find it useful to assume many ex ante identical regions. In standard tax competition models, the inefficiencies from tax competition increase with the number of competing regions, making decentralization less desirable (see Hoyt, 1999).
[4] Oates (1972) includes this insight as part of his decentralization theorem.

decision making. Koethenburger (2008) revisits Oates' Theorem and examines the difference in welfare levels under centralization (with uniform provision of public goods across districts) and decentralization. This difference is found to be non-monotonic in the spillover parameter for some preference parameters. In a recent contribution, Hatfield and Padro i Miquel (2009) derive the optimality of partial decentralization. While decentralization suffers from tax competition, as in our model, centralization leads to excessive capital taxation due to lack of commitment power. As a result the median voter wishes to delegate some provision of public goods to the regional level. All of the above papers share our interest in the merits of fiscal decentralization, but none emphasizes the difference between tax competition and public good spillovers.

The next section presents the model, and Sections 3 and 4 describe the main results concerning optimal federalism. Our formal model divides public goods into those provided by the central government and those provided by the regional governments. This division is decided at the "constitutional stage," before taxes and public good are chosen. Section 5 amends the model by allowing regional governments to also top off the public good supplies obtained from the central government if they are deemed to be too low. This extra policy freedom is enough to eliminate the desirability of decentralization in some cases, primarily because regions outside the MWC must now impose significant taxes even when all public goods are centrally provided, to fund the top offs. But the optimality of complete centralization holds only in cases where the MWC possesses little power to unequally distribute public good levels across regions. Section 6 investigates an example with specific function forms, and Section 7 concludes.

2. The Model

We consider an economy consisting of many identical regions, each of which treats the after-tax return on interregionally-mobile capital as fixed. Thus, individuals regions cannot use capital taxes to manipulate this return, but our working paper [Janeba and Wilson (2009)] obtains similar insights from a two-region model with this motivation for tax policy.[5] Following the Wilson (1986) and Zodrow and Mieszkowski (1986) model of tax competition, each region contains a representative resident, who supplies labor to competitive firms within the region. These firms use a constant-returns technology to produce output from this labor and mobile capital. Labor is fixed in supply within each region, whereas capital is mobile

[5] In the current model, regions would not wish to manipulate the terms of trade even if they were large, because they neither import nor export capital. Section 5 analyzes a model in which regions choose different tax rates, generating trade in capital and output, but regions are again small. Our working paper considers a similar model with large regions, in which case terms-of-trade effects become important

across regions but fixed in supply for the economy as a whole. Thus, capital exhibits diminishing marginal productivity in a region, given the fixed labor supply. The assumption of a fixed total supply of capital works in favor of centralized provision of public goods, since it implies that capital taxation among regional governments creates positive fiscal externalities: when one region taxes capital at a higher rate, some of the capital relocates to other regions, increasing their tax bases. As a result, regions choose inefficiently low tax rates. If, instead, capital owners were free to earn a fixed foreign return by investing their capital outside of the system of regions, then there would be no fiscal externalities among the regions, and therefore, decentralized decision-making would be efficient. Intermediate cases where capital is imperfectly mobile between the system of regions and the rest of the world imply smaller fiscal externalities than the case of a fixed capital stock, and therefore a greater likelihood that decentralization is desirable.

The representative resident within each region possesses labor and capital endowments, $\overline{L}$ and $\overline{K}$, which are used to finance private consumption, z. Thus, the resident's budget constraint is $z = w\overline{L} + r\overline{K}$, where r is the after-tax return on capital and w is the wage rate. The mobility of capital eliminates any differences in r across regions, but w will depend on the region's tax policy.

The output produced from labor and capital is sold to individuals as the consumption good z, and also to governments for use as the sole input in the production of publicly-provided goods. There is a continuum of such goods, and we refer to them as "public goods" for short, although they possess the attributes of private goods because there are no scale economies in their production or consumption. An individual's utility function takes the form

$$U = z + G; \qquad G = \int_0^1 u\big(g(n)\big)dn; \tag{1}$$

where G is "aggregate" utility from public good consumption, and $g(n)$ is the consumption of public good n in the given region, where n ranges from zero to one. The function u is increasing and strictly concave. The representative consumer's only economic decision is to allocate capital across regions.

The rule for efficient public good provision for the economy as a whole can be derived by maximizing (1), subject to an aggregate feasibility constraint, which leads to

$$u'(g(n)) = 1, \tag{2}$$

where we normalize the unit resource cost of the public good to equal one. Thus, the efficient *g(n)* is identical across *n.* Condition (2) is the Samuelson rule.

To model a federal system, we assume two levels of government, central and regional (also called "local"). The central government will be allowed to provide a particular set of public goods, *C*, leaving the set of remaining goods, *D*, to be provided solely by regional governments. We later extend the model to allow regional governments to "top off" the centralized provision of public goods if these levels are deemed to be too low, but for now, goods in *C* can only be provided by the central government. Without loss of generality, we let *D* denote the interval *[0, n*],* leaving *C* to denote *[n*, 1].* Note that the physical location of public good production is unimportant in this model. What matters is which regions receive the benefits of the public goods, and which level of government chooses and finances their supplies. Thus, central provision could consist of providing regions with grants that are earmarked for particular public goods.

Each level of government finances its expenditures with a tax on capital. Let t_i denote the unit tax at source that region i imposes on the capital employed within its borders, and let *T* denote the unit tax that the central government imposes on all capital. Then the before-tax return on capital within region i is $R = r + T + t_i$. The after-tax return, *r*, is determined by the requirement that the total demand for capital equal the total supply. With regions treated as small, we may approximate the number of regions as a continuous variable, with each region identified as a number i on the interval *[0, I]*, where $I = 2$ for notational convenience. Then

$$\int_0^2 K\ (r+T+t_i)di = 2\overline{K}\,, \tag{3}$$

The function *K(R)* gives the demand for capital in a region as a function of the gross return *R.* Equation (3) determines *r* as a function of *T* and the vector of regional tax rates. Since *T* applies to the economy's entire fixed stock of capital, a rise in *T* lowers *r* by the same amount, i.e., there is full capitalization. The central government's capital tax is lump sum because total capital supply, $2\overline{K}$, is fixed.

A major difference between governments is their objectives. Regional governments care only about the well-being of their own residents. Following Besley and Coate (2003), we assume that central government policies are determined by a legislative process, whereby a subset of regions is designated as the "minimum winning coalition" (MWC) and given control

of tax and expenditure policies. We refer to members of the MWC as the "insider regions," and to the other region as the "outsider regions." Since the number of regions is large, the size of the minimum winning coalition is approximately half the regions, which is how we will treat it. In the current paper, we do not consider how the MWC is formed, but our working paper extends the model by singling out a region to serve as the agenda setter, which provides transfers to recruit members into the minimum winning coalition.

The insider regions are able to use the revenue obtained from the capital tax T to distribute public good expenditures to their residents. However, we assume that outsider regions must receive a fixed fraction of the public goods supplied to insider regions. This fraction, denoted x, is less than one, reflecting the ability of the insider regions to disproportionately benefit from the central government's expenditure functions. We interpret x as describing the amount of "power" possessed by the MWC in its attempts to tilt public good provision in favour of its members. Given x, the centrally-provided public goods are chosen to maximize the well-being of insider residents. In the concluding section, we will argue that cooperative approaches to the policy decision process typically do not eliminate the inefficiency under centralization due to strategic delegation. Hence our use of a noncooperative approach such as the minimum winning coalition captures in a nutshell an interesting disadvantage of centralized decision making.

The central government and regional governments choose public good levels simultaneously in a Nash game.[6] With this setup, both levels of government pursue inefficient policies from the viewpoint of the economy as a whole. At the regional level, there is the usual tax competition problem, consisting of inefficiently low taxes and expenditures. In contrast, two forms of inefficiency arise at the central level: expenditures are inefficiently varied across regions, and they are overprovided to the insider regions, since part of the funding comes from taxing the capital used by the outsider regions.

Our main task is to investigate how the federal system should be designed – i.e., what goods the central government should be allowed to supply – to achieve the most efficient allocation of goods and resources. The assignment of public good provision to different levels of government can be seen as the constitutional stage, whereas the game between central and regional governments described above is the post-constitutional stage. Given our assumption of quasi-linear utility, the level of efficiency is easily measured by the aggregate

[6] For the current model, the order of moves is unimportant. But when we later allow outsider governments to top off centrally-provided public good supplies, letting the central government move first would allow it to recognize that increasing its tax rate and public good supplies would reduce the revenue needs of outsider regions, causing them to lower their tax rates.

"surplus" from public goods provision, summed across regions and public goods, where a single region's surplus is defined as the total utility it obtains from public good provision net of the resource cost (where the unit cost of each public good has been normalized to equal one). If we follow Besley and Coate by assuming that each region has an equal probability of becoming a member of the MWC, maximizing this aggregate surplus is equivalent to maximizing the expected utility obtained by each region's representative resident. The federal system that provides the highest surplus and, therefore, highest expected utility, is referred to as "optimal" from a constitutional standpoint Equivalently, we may minimize the total "deadweight loss" from public good provision, defined as the shortfall of expected utility from its first-best level, under which the Samuelson rule holds for all public goods. With no income effects in public good demands, these deadweight losses may be approximated using the usual Harberger triangle approximations, which become exact if the demand curves for public goods are linear. We will work with linear demand curves throughout the paper, since they clearly illustrate the importance of the various demand and supply elasticities.[7]

For the Nash game played by the central government and regional governments, we first analyze the central government's decision. In particular, the central government chooses the tax T and public good supplies for each n between n* and 1 to maximize welfare for the insider region, as shown in (1), subject to the budget constraint

$$\int_{n^*}^{1} g(n)(1+x)dn = 2T\overline{K} \tag{4}$$

The central government equates the marginal benefit and marginal cost of each of its public goods, holding fixed the $g(n)$'s supplied by regional governments. Using the government budget constraint and the budget constraint for a representative resident of an insider region, the optimality condition becomes

$$u'(g(n)) = \frac{1+x}{2}. \tag{5}$$

Let g^c denote the common value of the optimal $g(n)$.

Comparing (5) with the efficiency rule given by (2), we see that public goods are clearly overprovided to the insider regions by the central government. The intuition for the overprovision result is straightforward. The cost for centrally-provided public goods are split

[7] Proposition 1 does not require linear demand curves.

between all regions, whereas outsider regions get a lower fraction of public good benefits, implying a cost of $p^c = (1 + x)/2 < 1$ for the insider regions. The solution to (5) gives the demand for each centrally-provided public good as a function of the price, $g^c = g(p^c)$. The decline in total welfare from this inefficient pricing, or "deadweight loss," summed over all centrally-provided public goods provided to all insider regions (normalized to equal one) can be approximated by the Harberger expression:

$$-\frac{1}{2}\frac{dg}{dp}\left(\frac{1-x}{2}\right)^2(1-n^*), \tag{6}$$

Unless otherwise indicated, we assume throughout the analysis that the public-good demand curve is neither completely inelastic nor completely elastic at the equilibrium public good levels. Then (6) shows a positive deadweight loss whenever $x < 1$. Outsider regions are essentially subsidizing the public goods provided by the central government to insider regions, since they receive smaller amounts of these goods.

In contrast, the outsider regions receive the level xg^c for each n between n^* and 1. Perhaps surprising, xg^c may also be above the efficient level. The basic idea is that the total effective subsidy that outsider regions provide to insider regions for public good provision grows with the level of this provision, and the insider regions may wish to take full advantage of this subsidy by actually oversupplying public goods to outsider regions. If insider regions have a sufficiently large price elasticity of demand for the public good, then they will increase g^c so much as x drops that xg^c will also grow. Of course, this cannot be the case if x is set at zero, since then outsider regions receive no centrally-provided public goods, regardless of how much insider regions receive.

To compute the deadweight loss associated with either over- or underprovision of centrally-provided public goods to outsider regions, we calculate the implicit tax (positive or negative) on this provision, denoted t^m under which public good levels satisfy the optimality condition $u'(xg^c) = 1 + t^m$. Letting g^e denote the level of g that satisfies the Samuelson rule, this tax satisfies $g^e - xg^c = -t^m(dg/dp)$, which may be written,

$$g^e - x\left[g^e - \left(\frac{1-x}{2}\right)\frac{dg}{dp}\right] = -t^m\frac{dg}{dp}, \tag{7}$$

using the demand derivative to determine the excess of g^c over g^e. Let ε^e denote the price elasticity of demand for the public good, evaluated at the Samuelson level, where $p = 1$: $\varepsilon^e = -(dg/dp)/g^e$. Substituting this elasticity into (7) allows us to solve for the implicit tax:

$$t^m = \left(\frac{1-x}{2}\right)\left(\frac{2}{\varepsilon^e} - x\right). \tag{8}$$

Thus, for elasticities less than $2/x$, the implicit tax is positive, implying $xg^c < g^e$, whereas $xg^c > g^e$ for elasticities above $2/x$. Since $2/$x exceeds two, underprovision appears to be the more empirically-reasonable case, but our analysis allows for either case. By squaring this implicit tax and multiplying by one-half the demand derivative, we obtain the deadweight loss for each centralized public good level received by outsider regions. Multiplying this loss by the total number of centralized public goods and adding the result to (6) gives the total deadweight loss from centralized public good provision:

$$L^c = -\frac{1}{2}\frac{dg^c}{dp^c}\left(\frac{1-x}{2}\right)^2\left[1+\left(\frac{2}{\varepsilon^e} - x\right)^2\right](1-n^*) \tag{9}$$

Observe that this loss goes to zero as x goes to 1, reflecting efficient central provision at $x = 1$.

The goal of a regional government is to maximize utility subject to its government budget constraint**.** We may write the government budget constraint for both insider and outsider regions as follows:

$$\int_0^{n^*} g(n)dn = tK(r + T + t). \tag{10}$$

The optimality condition for each regionally-supplied public good is[8]

$$u'(g(n)) = \frac{1}{1+\frac{t}{K}K'}, \tag{11a}$$

or

$$u'(g(n)) = \frac{1}{1-\frac{t}{R}\eta}. \tag{11b}$$

[8] To derive (11), choose t and the common value of $g(n)$ to maximize (1), subject to (10) and the representative resident's budget constraint, $z = w\overline{L} + r\overline{K}$, where r is treated as fixed and w is a decreasing function of $R = r + T + t$, defined by the requirement the profits equal zero for private firms.

where η is the (positively measured) demand elasticity for capital, - *K'R/K* The denominator is less than one, reflecting the cost of the tax-induced outflow of capital.

Under decentralized provision, regions face an effective price of the public good equal to the right sides of (11), which is the same for both types of regions because they choose the same tax rate. This price exceeds the unit resource cost, representing a distortionary tax. Let $g^D = g^D(p^D)$ denote the resulting demand for a regionally-provided public good as a function of the price, $p^D = 1/(1 + t(K'/K))$. Then the total deadweight loss from this distortionary tax, $p^D - 1$, summed over all regions (normalized to equal 2), is

$$L^D = -\frac{dg}{dp}\left(\frac{-t\frac{K'}{K}}{1+t\frac{K'}{K}}\right)^2 n^*. \qquad (12)$$

Summing (9) and (12) gives us the total deadweight loss from the distorted public good supplies and capital allocation. The goal of an optimal federal system is to choose the level of decentralization, measured by n^*, to minimize this deadweight loss. We now investigate the solution.

3. The Case for Some Decentralization

We now show that for any positive amount of inefficiency in the public sector, no matter how small, *some* decentralization of public good provision is *always* optimal in the sense that it increases each resident's expected utility.

Proposition 1. *For any $x < 1$, expected utility is strictly increasing in n^* at $n^* = 0$. Thus, for any positive amount of inefficiency in the public sector, there exists an $n^* > 0$ such that decentralizing the provision of public goods between 0 and n^* raises expected utility,*

Proof. With $n^* = 0$ initially (no decentralization), differentiate the two deadweight loss expressions with respect to n^*. From (9), the deadweight loss from central provision declines as n^* rises, assuming $x < 1$. From (12), the derivative is zero, because the regional capital tax equals zero at $n^* = 0$, implying no deadweight loss, and a marginal increase in this tax from zero has a zero first-order impact on the deadweight loss (because the deadweight loss

depends on the square of the tax). Thus, the total deadweight loss from both central provision and regional provision is strictly decreasing in n^* at $n^* = 0$. Q.E.D.

This result points to a difference between tax competition and the cross-border spillovers of public good benefits modelled by Besley and Coate (2004). These spillover effects lead to inefficiently low public good levels under decentralized provision, but they also result in centrally-provided public goods becoming more evenly distributed across regions. Thus, centralized provision is preferable to decentralized provision if the spillover effects are sufficiently strong, whereas decentralized provision is preferred if the spillover effects are sufficiently weak. Besley and Coate consider only a single public good and therefore do not consider partial decentralization. But similar results concerning the welfare comparison between complete centralization and complete decentralization would hold in our model, if we replaced tax competition with spillover effects in public good provision

In the current analysis, however, tax competition creates fiscal externalities, which also lead to inefficiently low decentralized supplies of public goods. The importance of these fiscal externalities can be exogenously varied by altering the capital demand elasticity, with low elasticities implying small fiscal externalities for a given tax rate (more on this in the next section). But unlike the spillover effects in Besley-Coate, it will always be the case that some decentralization is desirable if there is some inefficiency in central government provision ($x < 0$). The reason is that there is also an endogenous element to the fiscal externalities. When the level of decentralization is low, regions tax capital lightly at the local level, so competition for capital does not distort their decisions much. In particularly, the fiscal externalities can be treated as second-order in importance, as indicated by the squared tax terms in our deadweight loss expressions. For this reason, some decentralization being desirable, regardless of the capital demand elasticity. In contrast, the spillover effects in Besley-Coate are always first-order in importance.

Note finally that the efficiency analysis in this section ignores distributional concerns. Even when some decentralization creates efficiency improvements for the federal system as a whole, it may leave the insider regions worse off ex post, since some of their public goods are no longer being partially financed by the outsider regions.

4. The Optimal Level of Decentralization

It is tempting to search for a general result concerning the desirability of centralizing public good provision for at least a small share of public goods. But there may be no positive

share that improves welfare. The reason is that central provision creates first-order inefficiencies. To investigate this issue, we differentiate the total deadweight loss with respect to n^*.

This derivative has two components. First, differentiate the total deadweight loss with respect to n^*, holding the regional tax rate fixed. Subtracting (9) from (12) gives the resulting deadweight loss change, holding tax rates fixed:

$$-\frac{1}{2}\frac{dg}{dp}\left[2\left(\frac{\tau\eta}{1-\tau\eta}\right)^2-\left(\frac{1-x}{2}\right)^2\left(1+\left(\frac{2}{\varepsilon^e}-x\right)^2\right)\right], \tag{13}$$

where $\tau = t/R$. Thus, the additional deadweight loss from more centralization depends on a comparison of effective tax rates and subsidies between centralized provision and decentralized provision.

For the second component, we recognize that an increase in n^* will cause a rise in regional tax rates to fund the additional public good provision at the regional level, and this tax increase will further raise the deadweight loss from regional provision. By differentiating the regional government budget constraint, given by (10), we obtain an equation relating the increase in each region's level of public good provision, dg^D/dn^*, to the increase in its tax rate, dt/dn^*. Differentiating the optimality condition (11) then allows us to substitute the tax derivative for the public good derivative, yielding[9]

$$\frac{dt}{dn^*}=\frac{t^*}{1+n^*\left(\frac{\tau\eta}{1-\tau\eta}\right)\varepsilon^D}. \tag{14}$$

where ε^D is the price elasticity of demand for the public good, evaluated at the equilibrium public good level under decentralized provision. Thus, higher price elasticities for both public goods and capital lower the tax elasticity. But the deadweight loss given by (12) is increasing in the public good elasticity, all else equal, since $dg/dp = -\varepsilon(g/p)$. Differentiating this loss with respect to the tax rate and using (14) then gives the additional loss resulting from the tax change dt/dn^*:

[9] An unpublished appendix with omitted derivations is available upon request.

$$\frac{dL^D}{dt}\frac{dt}{dn*} = 2\varepsilon^D g^D\left(\frac{\tau\eta}{1+\tau\eta}\right)^2 \frac{n*}{1+n*\dfrac{\tau\eta\varepsilon^D}{1-\tau\eta}}, \tag{15}$$

which is increasing in both the public good elasticity and the capital elasticity, reflecting the common observation that high elasticities create high marginal deadweight losses.

For the total change in deadweight loss from a marginal increase in decentralization, measured by $n*$, we rewrite the demand derivative in (13) in terms of the demand elasticity, evaluated at the equilibrium for regional pubic good levels: $dg/dp = -\varepsilon^D g^D(1-\tau\eta)$, noting that $1/(1-\tau\eta)$ is the public good price facing regions. Making this substitution and summing (13) and (15) while canceling common terms then gives

Proposition 2. *The first-order change in total deadweight loss from a marginal increase in the level of decentralization, measured by n*, has the same sign as*

$$2\left(\frac{\tau\eta}{1-\tau\eta}\right)^2\left(1+2\frac{n*}{1-\tau\eta+n*\tau\eta\varepsilon^D}\right)-\left(\frac{1-x}{2}\right)^2\left(1+\left(\frac{2}{\varepsilon^e}-x\right)^2\right). \tag{16}$$

Proposition 2 confirms the previous result that some decentralization is always optimal: (16) is necessarily negative when evaluate at $n* = 0$, since the regional tax rate equals zero in this case. But what does (16) tell us about whether some centralization is optimal? The regional tax rate rises as the amount of decentralization increases, causing (16) to rise. If we treat the public good and capital elasticities as fixed, we also see from (16) that the total deadweight loss will keep dropping as $n*$ rises from 0 to 1, or there will be a unique $n*$ between 0 and 1 at which deadweight loss is minimized. For a sufficiently low capital demand elasticity, it is clear that complete decentralization will be optimal, whereas a high capital demand elasticity implies that some centralization is desirable, but never complete centralization as long as $x < 1$. These results reflect the dependence of tax competition on this elasticity.

Let us investigate the sign of (16) at $n* = 1$, since this tells us whether some centralization is desirable. Assume also that the public good demand elasticity equals one, evaluated at the decentralized public good level At $n* = 1$, (16) then has the same sign as:

$$6\left(\frac{\tau\eta}{1-\tau\eta}\right)^2 - \left(\frac{1-x}{2}\right)^2\left(1+\left(\frac{2}{\varepsilon^e}-x\right)^2\right). \qquad (17)$$

Suppose first that outsider regions get no centrally-provided public goods. Since ε^e is evaluated at a lower price than $\varepsilon^D = 1$, we know that $\varepsilon^e < 1$, given the assumption of a linear demand curve. So a necessary condition for a little centralization (fall in n^* from 1) to lower deadweight loss is

$$6\left(\frac{\tau\eta}{1-\tau\eta}\right)^2 > \left(\frac{1-x}{2}\right)^2\left(1+(2-x)^2\right) \qquad (18)$$

The literature on the marginal cost of public funds suggests a benchmark value for the effective tax rate on regionally-supplied public goods, $\tau\eta/(1-\tau\eta)$, of about .25 [10] In this case, the left side of (18) becomes .375, and a necessary condition for some centralization to be optimal is that x exceeds about .36. Thus, while the model can easily generate an optimal federal system with centralized and decentralized public good provision existing together, it can also easily generate cases where complete decentralization is optimal, including cases where the MWC must provide outsider regions with significant supplies of the centrally-provided public goods.

5. Top Offs

In cases where outsider regions receive inefficiently low public good supplies from the central government, one way in which they might mitigate this inefficiency would be to top off these supplies with their own production of the same public goods. But in this case, the tax rates chosen by outsider regions can be substantial, even in the case of complete centralization, where the central government provides the full range of public goods. As a result, the increase in taxes brought on by decentralizing the provision of a small number of public goods can cause first-order efficiency losses. Whether or not welfare falls will depend

[10] There is a wide range of empirical estimates of the marginal cost of public funds, represented here by $1/(1-\tau\eta)$. But a reasonable mid-point of the estimates is 1.25 (see Ballard, 1997), which implies $\tau\eta = .2$.

on the size of these tax increases. The next proposition shows that at least a small amount of decentralized provision remains optimal if the MWC is sufficiently powerful (i.e., x is low).

Proposition 3. *Assume that top offs are possible.*
(a) If x is sufficiently close to zero, there always exists an n > 0 such that decentralizing the provision of public goods between 0 and n* raises expected utility.*
(b) If x is sufficiently close to one, then increasing n from zero has a negative first-order impact on expected utility.*

Thus, small amounts of decentralization will not be desirable if the level of inefficiency in central provision is sufficiently small, but not if it is large. There is a simple explanation for this change in results. For low x, outsider regions are already devoting substantial expenditures to topping off centrally-provided public goods, so introducing a little decentralization does not require them to raise their taxes much. Hence, some decentralization is again desirable. But for high x, these taxes do have to be raised by significant amounts. We show below that the resulting first-order welare loss dominates the other effects of centralization, causing total deadweight loss to rise.

As a prelude to the more formal proof, let us now briefly describe how top offs enter the model. First, an extra expenditure term must be added to the outsider budget constraint to account for these top offs:

$$\int_0^{n^*} g(n)dn + \int_{n^*}^{1} \left(g(n) - xg^c\right)dn = tK(r + T + t). \tag{19}$$

Since outsider governments are now controlling the total public good supplies for all public goods, these total supplies are now all determined by condition (11), implying a total deadweight loss equal to

$$L^o = -\frac{1}{2}\frac{dg}{dp}\left(\frac{-t^o \dfrac{K^{o\prime}}{K^o}}{1+t^o \dfrac{K^{o\prime}}{K^o}}\right)^2, \tag{20}$$

where superscripts distinguish between insider and outsider regions. Adding the corresponding deadweight loss for insider governments then gives $L^D=L^o+L^I$:

$$L^D = L^o + L^I = -\frac{1}{2}\frac{dg}{dp}\left(\frac{\frac{-t^o K^{o\prime}}{K^o}}{1+t^o\frac{K^{o\prime}}{K^o}}\right)^2 - \frac{1}{2}\frac{dg}{dp}\left(\frac{\frac{-t^I K^{I\prime}}{K^I}}{1+t^I\frac{K^{I\prime}}{K^I}}\right)^2 n^*, \tag{21}$$

which differs from (12) because, for the outsider regions, we are summing deadweight losses over all goods ranging from 0 to 1, rather than 0 to n^*. This additional deadweight loss is offset to some extent by less deadweight loss from central provision, since the central government just controls total supplies of the public goods it delivers to insider regions:

$$L^c = -\frac{1}{2}\frac{dg^c}{dp^c}\left(\frac{1-x}{2}\right)^2(1-n^*). \tag{22}$$

It is easily seen that $t^I < t^o$ whenever the central government supplies some public goods, since the insider regions do not need to top off the supplies of public goods that are centrally-provided. For this reason, the allocation of capital between insider and outsider regions is also distorted, and we can again use the Harberger formula to measure the excess burden from this distortion:

$$L^K = -\frac{1}{4}K'(t^o - t^I)^2. \tag{23}$$

This expression reflects the fact that, for linear capital demand curves,[11] equilibrium in the capital market is achieved after the imposition of regional taxes by a reduction in the after-tax return on capital equal to the average of t^o and t^I. Thus the gross return on capital in outsider regions rises by half the tax difference, $t^o - t^I$, whereas this gross return in outsider regions falls by half this difference. In this way, we maintain a common after-tax return, $r = R^o - t^o - T = R^I - t^I - T$. These changes in gross returns cause $-K'(t^o - t^I)/2$ units of capital to leave each outsider region, and the same $-K'(t^o - t^I)/2$ units to enter each insider region.

[11] This linearity assumption is not needed to prove Proposition 3, but we do introduce a more general assumption below.

Multiplying this capital flow by one-half the tax wedge, $t^o - t^I$, gives the area of the Harberger triangle. The number of such pairs of insider and outsider regions has been normalized to equal one.

The introduction of some decentralization will now alter insider and outsider capital taxes by different amounts, causing a reallocation of capital. For this reason, our proof of Proposition 3 requires an additional assumption on the capital demand derivative:

Assumption A: *$-K'(R)/K(R)$ is increasing or constant in R.*

This assumption encompasses both linear demand curves and demand curves that are not too convex.

Armed with the new deadweight loss expressions and assumption A, we now prove Proposition 3.

Proof of Proposition 3.

(a) Consider a marginal rise in n^* from zero. For any $x < 1$, there is a first-order drop in L^c, simply because fewer public goods are being inefficiently provided by the central government. Since insider regions are initially receiving all of their public good supplies from the central government, their local taxes equal zero, and so $L^I = 0$ initially. Although the insider tax rises with n^*, the derivative of L^I with respect to the insider tax rate is zero when evaluated at $t^I = 0$. Thus, there is a zero first-order change in L^I as n* rises from zero. For outsider regions, initial capital taxes at $n^* = 0$ are positive if $x < 1$. Suppose first that $x = 0$. Then raising n^* causes no change in the budget constraints for outsider governments, holding fixed their capital supplies. But since the insider tax rises with n^* to fund the provision of decentralized public goods, capital flows from the insider regions to the outsider regions. This capital flow has two effects. First, it reduces the distortion to the capital supply; that is, L^K falls as the tax difference declines (see (23)). Second, it raises the tax base for outsider regions, lowering the tax rate required to fund their initial expenditures, while also reducing or not changing $-K'(R)/K(R)$ (by assumption). We therefore find that the effective tax rate on public good provision in the outsider regions, given by the squared term in (20), falls, causing a first-order decline in L^o. Combining these effects, we conclude that the total deadweight loss from inefficient public good provision in the economy declines. By the continuity properties of the model, this result extends to positive values of x that are sufficiently small.

(b) Starting from $x = 1$ and $n^* = 0$, calculate all of the marginal deadweight losses with respect to a drop in x, to find that they are all zero except for $-dL^c/dx$, which is positive because reducing x below 1 represents the imposition of a distortionary subsidy on centrally-provided public goods. Moreover, $-dL^c/dx$ and $-dL^1/dx$ are independent of n^* when evaluated at $x = 1$. The remaining loss derivate is

$$-\frac{dL^o}{dx} = -\left(\frac{dg}{dp}\right)\left(\frac{t^o\left(\frac{K^{o\prime}}{K^o}\right)^2\left(-\frac{dt^o}{dx}\right)}{\left(1+t^o\frac{K^{o\prime}}{K^o}\right)^3}\right) \tag{24}$$

At $x = 1$ and $n^* = 0$, we then have $-d^2DL^0/dxdn^* > 0$, since increasing n^* above zero when $x = 1$ causes t^o to rise above zero, to fund decentralized public goods In words, a marginal rise in n^* from zero has a positive first-order effect on the first-order deadweight loss from a small reduction in x below one. This proves part (b). Q.E.D.

Proposition 3 is robust to a generalization of government instruments. In our analysis, the central government can make the insider regions better off only through public good provision. This is relatively inefficient in the sense that the marginal benefit of the last unit of public good has a lower value than one more unit of the private good. Assume instead that the central government controls non-negative, direct transfer payments to citizens, differentiated by region. Transfers to the insider regions are beneficial because costs are shared with the outsider regions, and their availability will eliminate one of the inefficiencies from centralization, namely the overprovision of public goods to the insider regions. But other inefficiencies remain, including the inefficient distribution of public goods between regions, and the misallocation of capital. For this reason, Proposition 3 continues to hold.[12]

6. An Example

While Proposition 3 concerns the introduction of a small amount of decentralization, further intuition about the globally-optimal level of decentralization can be obtained by developing a specific example. In particular, we consider the following piecewise linear relation between utility and the public good:

[12] See our working paper for details. Proposition 1 also holds with similar modifications.

$$u(g) = \begin{cases} b_1 g & if\ g \le g_1 \\ b_2 g + (b_1 - b_2) g_1 & if\ g_1 < g \le g_2 \\ b_2 g_2 + (b_1 - b_2) g_1 & if\ g > g_2. \end{cases} \quad (25)$$

This function departs from our assumption of strict concavity, but its use helps make more transparent the tradeoffs involved in choosing the optimal level of decentralization, while keeping the analysis mathematically tractable. The marginal benefit of a public good is b_1 in the first segment and b_2 in the second. We assume $g_1<g_2$ and $b_1>1>b_2>0.5$. With lump-sum taxation, a single region always provides public goods up to the threshold g_1 because the marginal benefit exceeds marginal costs. Provision beyond g_1 is only beneficial when the cost can be shared with others, as is the case with a minimum winning coalition which comprises half of the regions. Provision beyond the second threshold, g_2, is never optimal, as $u(g)$ is constant.

As for the production side, we assume a constant returns to scale, quadratic production function, $f(K,L) = a_1 K + a_2 L - \frac{a_3 K^2}{L}$. A key parameter in the following analysis is a_3, which drives the capital elasticity η and hence allows us to examine the intensity of tax competition. Lower values of a_3 lead to higher elasticity. Note that the production function is in line with Assumption A.

We assume furthermore that there is perfect discrimination against outsider regions, that is, $x=0$, which tends to bias the model in favor of decentralization. As a result, the outsider regions must tax capital enough to fund all public good levels, regardless of whether there is centralization. To create a second-best problem, we assume that the optimality condition for the outsider regions' provision of public goods, given by (11), is satisfied at a level of g below g_1, where the marginal benefit of the public good is b_1.

The piecewise linearity of the subutility function $u(g)$, together with $x=0$, makes the central government's optimization problem straightforward. In particular, insider regions obtain the level g_2, whereas outsider regions get nothing. From the central government's budget constraint, the tax T is set at $T=(1-n^*)g_2/2$. An attractive feature is that the tax is linear in n^*.

The Nash equilibrium features two regimes, one for small n^* and the other for large n^*. For n^* above some critical value n', tax revenues are not large enough for the insider regions to provide the threshold g_1 for all n^* decentralized goods. In this case, the marginal benefit of the public good is b_1 for both outsider and insider regions and, therefore, they satisfy the equilibrium condition (11) by choosing the same tax rate:

$$t^I = t^o = \frac{2a_3(b_1 - 1)}{b_1\left(\frac{L}{K}\right)} \equiv t^*, \quad (26)$$

[13]

where *L/K* equals the economy's labor-capital endowment ratio. In this case, there are no capital flows between regions. But for $n^* < n'$, the revenue collected with the tax t^* is larger than the amount necessary for the insider regions to provide g_1. Then the insider tax rate is determined by budget constraints (10), with $g(n)$ set at g_1 and the capital demands set at $K(r + T + t^I)$ for insider regions and $K(r + T + t^o)$ for outsider regions, where $r + T$ clears the capital market, given the two regional tax rates. The critical level is given by

$$n' = \frac{2a_3(b_1 - 1)}{b_1 g_1}. \quad (27)$$

Note that n' depends positively on the parameter a_3, which is negatively related to the capital demand elasticity. In fact, we next show that n' and one are the only candidates for the optimal n^*.

Proposition 4. *For the example with a quadratic production function and piecewise linear utility, the optimal n* equals one if*

$$\frac{g_2}{g_1} > \frac{b_1 - b_2}{1 - b_2}. \quad (28)$$

If this inequality is reversed, the optimal n equals n'.*

Proof. We first show that for $n^* \geq n'$, the candidate for optimal decentralization is either $n^*=1$ (full decentralization) or $n^* = n' > 0$, which is interior. The welfare analysis for changes in the level of decentralization over this range of n^* is particularly simple and intuitive because regional tax rates are determined by (26), independently of n^*, and the central government's tax is linear in n*. A marginal increase in decentralization, $dn^* = -1$, leads to a reduction in the central tax T for insiders and outsiders, amounting to a gain of g_2. On the

[13] Formally, an insider region's utility is $U^I = z_I + \int_0^{n^*} b_1 g(i)di + (1 - n^*)g_2 = z_I + b_1 t^I K^I + (1 - n^*)g_2$. An outsider's utility looks similar ($U^o = z_o + b_1 t^o K^o$) but without the last term, as the region must provide all public goods by itself. The last term in the insider's utility is constant and hence utility maximization with respect to the regional tax rate leads to the same first order condition for insiders and outsiders.

other hand, the rise in n^* reduces the utility of insiders. The marginal rise in n^* results in a reduction in public good levels from g_2 to a level g' < g_1 for those public goods that are moved from centralized provision to decentralized provision, resulting in a welfare loss of $b_2(g_2 - g_1) + b_1(g_1 - g')$; and the insiders' public good level must be reduced by $dg = - g'/n^*$ to keep the government budget satisfied following the marginal rise in n^*, resulting in a further welfare loss of $b_1 g'$ when summed over all n^* public goods. Hence, welfare is increasing in n^* for $n^* > n'$ if and only if (28) holds.

As n^* falls below n', the insider regions obtain enough revenue to fund the efficient public good level, g_1, with a tax t^I below t^*, whereas the outsider regions continue to set each $g(n)$ at a level less than g_1. Inserting the fixed marginal benefit b_1 into (11) shows us that t^o/K^o must remain constant as n^* falls (since the derivative K' is constant). With t^I below t^*, this can only happen if t^o also falls below t^* but remains above t^I at a level that causes a sufficient capital outflow from outsider regions to keep t^o/K^o constant. With both K^o and t^o falling, the common $g(n)$ provided by outsider regions at all n also falls, representing an increased deadweight loss from public good underprovision. In addition, the increase in the tax difference $t^I - t^o$ worsens the deadweight loss from the capital misallocation. Finally, with insider governments providing the efficient level of g for all n less than n^*, the fall in n^* results in more public goods being provided at the inefficiently-high level g_2 rather than the efficient level g_1. We conclude that total deadweight loss rises as n^* falls below n', and continues to increase until n^* equals zero. Consequently, deadweight loss minimization occurs at n^* either equal to n' or one. Q.E.D.

Thus, either complete decentralization is optimal, or there is a unique interior optimum, given by (27). Condition (28) for complete decentralization is more likely to be fulfilled the smaller is the marginal benefit of the public good at public good levels above the efficient level g_1, which makes sense because the deadweight losses from overprovision rise as b_2 falls, making it less likely that any centralization will be optimal. By similar reasoning, complete decentralization is more likely to be optimal the higher is the excessive public good level, g_2, relative to g_1.

One interesting aspect of this example is that complete decentralization can be optimal even for high levels of the capital demand elasticity. The basic reason is that although high elasticities imply low taxes, these taxes do not change in the example as decentralization increases beyond the critical value n'. But n' does decrease as the capital demand elasticity rises, as represented by a fall in the parameter a_3. Thus, for high capital demand elasticities,

either there will be no centralization or there will be a lot of centralization at the optimum. In contrast, Proposition 2 suggests that high capital demand elasticities always lead to low levels of decentralization. Besides not allowing top offs, Proposition 2 also relies on the assumption of a linear demand curve for the public good, which is violated here.

Note finally that in the case of an interior solution, the optimal level of decentralization will be low if b_1 is close to one, since then the net benefits from regionally-provided public goods are small. But relatively low values of b_1 also increase the likelihood that complete decentralization is optimal, since in this case there is little welfare loss from the decline in the public good levels provided by insider regions as decentralization rises.

7. Concluding Remarks

This paper has investigated conditions under which a multi-tier government structure is desirable when lower-level governments are characterized by tax competition. Our approach is to exploit the tradeoff between the cost of decentralization (underprovision of public goods due to fiscal externalities) and the cost of centralization (undersupply of public goods to regions not in the MWC and oversupply of public goods to regions in the MWC). Our main model shows that some decentralization of public good provision is always desirable, whereas it is possible that no positive amount of centralization is optimal. But if we replace tax competition with public good spillovers as the source of inefficiencies at the local level, then it is possible for no decentralized provision to be optimal. Thus, tax competition and spillovers have different implications for optimal fiscal federalism. For an extension of the model, we later also find that no decentralization may be optimal, but only if regions not in the MWC can top off supplies of centrally-provided public goods and these supplies are already not too far below their efficient levels.

One of our key assumptions is that decisions under centralization are taken in a non-cooperative way by assuming that the minimum coalition acts in its own interest at the expense of outsiders to the coalition. The latter may nevertheless obtain a fraction x of a coalition member's public good level. The fraction x is a critical value in our analysis, since it determines the level of inefficiency in centralized provision. Examples from the U.S. suggest that x is significantly greater than zero, but not so high that Proposition 2 allows us to dismiss the possible optimality of complete decentralization as empirically irrelevant.[14] For example, looking at the federal highway aid program in the US, Table 2 in Knight (2002) shows that Louisiana received 55 dollars in highway grant receipts per capita during the period 1982-

[14] It is important to remember that the model abstracts from considerations that favor centralization, such as economics of scale in public good provision.

2007, while paying associated gasoline taxes of 77 dollars, whereas West Virginia received 146 dollars and also paid 77 dollars. It is possible that this difference reflects differences in needs or adjustments to exogenous changes. Quite likely, however, the difference is explained by the role of Robert Byrd who was a senator of West Virginia from 1959 to 2010. His seniority and leadership of the Appropriations Committee enabled him to obtain considerable funds for projects in West Virginia. At the same time it is clear that all states obtain some highway spending (ignoring tax payments for a moment). Knight (2002) reports that New York is the state with the lowest per capita highway grant receipts in the amount of 46 dollars, which is less than 20% of what Wyoming (the largest recipient outside Alaska and Hawaii) gets: 241 dollars.

Evidence of unequal net distributions of federal expenditures can also be found outside the U.S. For example, Mattila (2006) examines redistributive expenditures in the EU. Controlling for GDP per capita, he shows that voting power (measured by the inverse of the number of citizens needed per vote in the EU Council) is a significant explanatory variable for expenditures from and net contributions to the EU budget. His explanation is that smaller countries are cheaper to buy and hence vote trading occurs at the expense of larger countries. This suggests that strategic coalition formation plays a role in the European Union, resulting in unequal distributions of expenditures.[15]

To examine the robustness of our results, our model could be extended in a number of ways. For example, we work with a utility function that is quasi-linear and separable, so that the demand for a public good does not depend on income or the price of other public goods. In this case, central provision of some public goods does not affect the regional demands for other public goods, except in cases where it results in changes in the effective marginal costs of these other public goods. More general demand structures would provide other avenues through which central provision alters the behaviour of lower-level governments.

Four other assumptions seem noteworthy. First, our modelling of centralization assumes that the legislative majority needed to pass a fiscal package is the smallest number consistent with a majority in the legislature. Yet political systems in modern economies often require more than a simple majority to pass particular types of legislation. We suspect that such a higher threshold level or supermajority requirement would make centralization relatively more attractive. Our reasoning follows from the observation that when the supermajority includes every region, centralization is first-best efficient. However, this extension would not upset the reasoning behind our main propositions. Fiscal policy decisions

[15] For related work, see Mattila (2004) and Kaeding and Selck (2005).

are usually not made unanimously and thus the basic inefficiency identified under centralization remains even under larger coalitions than the MWC.

Second, we assume that regional governments act in the interest of their representative citizen. On the other hand, it could be argued that special-interest politics might operate at the local or regional level in ways that lead to increased public good provision. In addition, real or imagined opportunities to export capital tax burdens might also result in increased public good provision, although such tax exporting cannot occur under this paper's assumption of many price-taking regions. To the extent that these increases in public good provision simply counteract the underprovision associated with tax competition, the case for decentralization is strengthened. But it would be useful to extend the analysis to include an explicit political economy model at the regional level. If it turns out that the interaction of political economy and tax competition concerns produce more efficient public decision-making at the regional level, then one might also ask whether further decentralization of regional decisions to even lower levels of government would be beneficial.[16] It would be interesting to examine under what conditions the typical three-tier government structure, consisting of federal, regional and local governments, emerges as an optimal response to the trade-off between the benefits and costs of decentralization.

A third critical assumption is the lack of Tiebout mobility. Such mobility might alleviate the inefficient political processes discussed in the previous paragraph, thereby affecting the desirability of decentralization. On the other hand, we would expect the asymmetric provision of centrally-provided public goods to induce migration of households from outsider regions to insider regions, thereby lessoning the inefficiencies from this asymmetry and increasing the attractiveness of centralized public good provision. There exists models that combine labor mobility with competition for capital; see, in particular, Wilson (1995), Bruckner (2000), and Kessler, Lulfesmann, and Myers (2002). But all of these papers consider a single tier of competing governments. It would be useful to extend the current analysis of optimal federalism to include both labor and capital mobility.

[16] In related work, Wilson (2005) amends the standard tax competition model to allow self-interested public officials to provide a public input, with the goal of increasing surplus tax revenue. Competition for mobile capital is found to be welfare-improving. Gordon and Wilson (2003) obtain similar welfare results for a model where public officials compete for mobile households through their provision of a public good. These results suggest that decentralization is preferable, but only if the only difference between the central government and lower-level governments is whether the economy is open or closed to factor mobility. By carefully modeling political institutions in a model with self-interested politicians, Janeba and Schjelderup (2009) find that the welfare effects of tax competition are no longer as clearcut; they depend on the type of political institutions, and on the discount factor of politicians. None of these papers consider partial decentralization.

The final critical assumption is the use of minimum winning coalition concept. The MWC concept can been criticised because it assumes that decision making under centralization is noncooperative, and this may be unrealistic in a context with few decision makers where bargaining costs are assumed to be small. It is not clear to us whether bargaining costs are sufficiently small in national legislatures with several hundred legislators (such as in the House of Representatives in the U.S. or the Bundestag in Germany) to make a cooperative approach the only reasonable assumption. Even if it were we think that, the basic trade off between centralization and decentralization remains. Besley and Coate (2003) and others such as Lorz and Willmann (2005) and Dur and Roelfsma (2005) show that even under cooperative legislative behaviour, centralization is typically not efficient in the presence of spillovers, as regions use strategic delegation to manipulate the outcome of the bargaining process. Finally, future research should more thoroughly examine the implications of different federal structures for the distribution of income. The welfare criteria used throughout our analysis has been the sum of utilities across regions. Given our assumption of a quasi-linear utility function, along with our assumption that regions are identical ex ante, the analysis effectively ignores income distribution issues. We have observed, however, that centralization helps regions inside the minimum winning coalition at the expense of outsiders. Thus, the analysis suggests that centralization has the potential to worsen the distribution of income. In contrast, a theme of the local public economics literature is that distributional policies should be centralized, given the limitations that factor mobility places on the ability of lower-level governments to redistribute income. While these limitations are certainly important, the type of model considered here highlights the potential for bad politics at the central level to lead to capricious changes in the distribution of income.

References

Ballard, Charles. 1997. "Marginal Efficiency Cost Calculations for Different Types of Government Expenditure: A Review." In John G. Head and Richard Krever (eds.), *Taxation Towards 2000*, Melbourne: Australian Tax Research Foundation: 537-563.

Baron, D. and J. Ferejohn: Bargaining in Legislatures*, American Political Science Review* 83, 1989, 1181-1206.

Besley, T. and S. Coate: Centralized versus Decentralized Provision of Local Public Goods: A Political Economy Analysis, *Journal of Public Economics*, Volume 87, Issue 12, December 2003, Pages 2611-2637.

Bjorvatn, K. and G. Schjelderup: Tax Competition and International Public Goods, *International Tax and Public Finance* 8, 2002, 111-120.

Brueckner, J.K.: A Tiebout/Tax-Competition Model, *Journal of Public Economics* 77, 2000, 285-306.

Buchanan, J. and G. Tullock: The Calculus of Consent, University of Michigan Press: Ann Arbor, 1962.

Cheikbossian, G.: Rent-seeking, spillovers and the benefits of decentralization, *Journal of Urban Economics* 63, 2008, 217-228.

Dur, R. and H. Roelfsma: Why does centralisation fail to internalise policy externalities?, *Public Choice* 122, 395-416.

Hatfield, J.W. and G. Padro i Miquel: A political economy theory of partial decentralization, NBER Working Paper No. 14628, January 2009.

Hoyt, William H.: Property Taxation, Nash Equilibrium, and Market Power, *Journal of Urban Economics* 34, 1991, 123-131.

Janeba, E. and G. Schjelderup: The Welfare Effects of Tax Competition Reconsidered: Politicians and Political Institutions, *Economic Journal* 119, 2009, 1143-1161.

Keading, M. and T.J. Selck (2005): Mapping out Political Europe: Coalition Patterns in EU Decision Making, *International Political Science Review* 26(3), 271-290.

Kessler, A.S., C. Lulfesmann, and G. M. Myers: Redistribution, Fiscal Competition and the Politics of Economic Integration, *Review of Economic Studies* 69, 2002, 899-923.

Knight, B.G.: Endogenous Federal Grants and Crowd-Out of State Government Spending: Theory and Evidence from the Federal Highway Aid Program, *American Economic Review* 92, 2002, 71-92.

Koethenburger, M.: Revisiting the "Decentralization Theorem" – On the role of externalities, *Journal of Urban Economics* 64, 2008, 116-122.

Lockwood, B.: Distributive Politics and the Costs of Centralisation, *Review of Economic Studies* 69, 2002, 313-338.

Lockwood, B.: The political economy of decentralization, in: Ahmad, E. and G. Brosio (eds.), Handbook of Fiscal Federalism, Edward Elgar, Cheltenham, 2006, 33-60.

Lorz, O. and G. Willmann: On the endogenous allocation of decision powers in federal structures, *Journal of Urban Economics* 57, 2005, 242-257.

Mattila, M. (2004): Contested decisions: Empirical analysis of voting in the European Union Council of Ministers, *European Journal of Political Research* 43, 29-50.

Mattila, M. (2006): Fiscal transfers and redistribution in the European Union: do smaller member states get more than their share? *Journal of European Public Policy* 13(1), 34-51.

Oates, W.: Fiscal Federalism, Harcourt Brace Jovanovich, New York, 1972.

Raff, H. and J.D. Wilson: Income Redistribution with Well-Informed Local Governments, *International Tax and Public Finance* 4, 1997, 407-428.

Riker, W.: The Theory of Political Coalitions, Yale University Press: New Haven, 1962.

Tresh, R.W.: Public Finance – A Normative Theory, Academic Press, 2002.

Wilson, J. D.: A Theory of Interregional Tax Competition, *Journal of Urban Economics* 19, 1986, 296-315.

Wilson, J.D.: Mobile Labor, Multiple Tax Instruments, and Tax Competition, *Journal of Urban Economics* 38, 1995, 333-356.

Wilson, J.D.: Theories of Tax Competition, *National Tax Journal* 52, 1999, 269-304.

Wilson, J.D.: Welfare-Improving Competition for Mobile Capital, *Journal of Urban Economics* 57, 2005, 1-18.

Wilson, J.D., Tax Competition in a Federal Setting, in**:** Ahmad, E. and G. Brosio (eds.), Handbook of Fiscal Federalism, Edward Elgar, Cheltenham, 2006.

Wilson, J.D. and R. Gordon: Expenditure Competition, *Journal of Public Economic Theory* 5, 2003, 399-417.

Wilson, J.D. and E. Janeba: Decentralization and International Tax Competition, *Journal of Public Economics* 89, 2005, 1211-1229.

Wilson, J.D. and E. Janeba: Optimal Fiscal Federalism in the Presence of Tax Competition, unpublished mimeo., Michigan State University, 2009.

Wilson, J.D., and D. Wildasin: Capital Tax Competition: Bane or Boon?, *Journal of Public Economics* 88, 2004, 1065-1091.

Zodrow, G. R., and P. Mieszkowski: Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods, *Journal of Urban Economics* 19, 1986, 356-370.