How Large Are the Welfare Costs of Tax Competition?

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Abstract

Previous literature has shown that competition among regional governments may lead to inefficiently low levels of capital taxation, because governments do not take account of the external benefits of capital flight to other regions. However, the fiscal distortion is smaller the more elastic the supply of capital (for the region bloc), if governments are not perfectly competitive, or they behave in part as a revenue-maximizing Leviathan.

There has been very little empirical work on the magnitude of the welfare effects of fiscal competition. This paper presents extensive calculations of the welfare effects using a model that incorporates the possibility of Leviathan behavior, strategic behavior by governments, monopsony power in factor markets, and a wide range of capital supply elasticities. The welfare costs of tax competition are generally fairly small, and even these costs can disappear fairly quickly when some weight is attached to the possibility of Leviathan behavior.

Key Words: fiscal competition, tax harmonization, welfare costs, Leviathan, strategic behavior

JEL Classification Numbers: H73, H21, H23

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1. Introduction

There is a large theoretical literature on the welfare implications of fiscal competition between governments of different regions, such as states within the United States, provinces within Canada, or countries within the European Union (EU).[1] A key theme of this literature is that taxes on mobile factors such as capital, and hence overall public spending, may be inefficiently low due to a fiscal externality. When an individual government chooses its capital tax, it does not take account of the efficiency gains to other regions within a bloc from the resulting flight of capital out of its region, and thus the local cost to individual regions of higher taxes exceeds the social cost for the region bloc (Wildasin 1989; Wilson 1984; Zodrow and Mieszkowski 1986). Put another way, to the extent that reducing capital taxes in one region attracts capital from neighboring regions, the local incentives for lower taxes are socially excessive.

In principle, this externality may provide a justification for a system of subsidies from some central authority to the regional governments, although when regions are heterogeneous, the corrective measure is a fairly complicated one that requires a different subsidy rate for each region (e.g., DePater and Myers 1994; Wildasin 1984).[2] This approach may not be feasible in the EU because the budget of the European Commission is only around 2% of GDP (Commission of the European Communities 1993). Instead, the European Commission is considering imposing minimum rates of corporation income tax and other capital taxes across the EU.[3]

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[1] See, for example, Wilson 1999 for a comprehensive review.

[2] In the United States, Canada, and Australia the central government does provide extensive subsidies for regional governments. See Rounds 1992 for a detailed comparison of these countries.

[3] Currently, the EU imposes a minimum rate of value-added tax (17.5%) and a minimum rate of gasoline tax (although the latter is currently too low to be binding). Tax harmonization is a second-best response to the fiscal externality because it imposes the same rate of taxation across regions—the optimum amount of government spending and taxation differs across regions when they are heterogeneous.

However, in theory several factors may dampen the severity of the fiscal externality problem. First, at the region bloc level, the supply elasticity of capital may be non-zero. Thus, as higher taxes across regions within the bloc depress the net of tax return on capital, there might be a reduction in savings or capital flight outside the bloc. These effects limit the socially optimal size of the public sector for regions in the bloc.[4] Second, individual regions may be large enough to have some monopsony power in the capital market. To the extent that an individual region faces an upward sloping, rather than flat, supply curve for capital, this will limit capital flight out of that region and work against the fiscal externality (e.g., Hoyt 1991). Third, regional governments may act strategically by anticipating some reaction from neighboring regions in response to their own tax changes. For example, the local incentives to reduce taxes are modified somewhat if a regional government anticipates that other governments may also cut taxes in response.

Moreover, it is also possible that tax competition is desirable, because it curbs excessive government spending and taxation, rather than undesirable because it results in an inefficiently small public sector. This can be the case if government behavior is in part driven by the revenue-maximizing behavior of bureaucrats, or by the interplay of interest groups, rather than by a desire to maximize social welfare or satisfy the median voter (Brennan and Buchanen 1980; Edwards and Keen 1996; McGuire 1999; Rauscher 1998; and Sinn 1992). Thus, the theoretical literature is ambiguous as to whether the public sector is actually too small or too large, and whether there is a case for policies to increase the size of government (e.g., subsidies from a central authority, minimum tax laws), or for policies to reduce the size of government (e.g., California's Proposition 13, which limits the rate and base of property taxes).

Very little work has been done on the empirical magnitude of the welfare effects of fiscal competition. For example, Oates writes: "We are badly in need of empirical studies that can shed some light on the likely *magnitude* of the welfare losses resulting from fiscal competition" (1999, p. 10). Clearly, we need to be confident that, under reasonable assumptions about underlying parameter values, taxes are too low *and* that the resulting welfare losses are empirically "significant" in magnitude, in order to make an economic case for measures to expand the size of the public sector. If the welfare costs are empirically small, there is not much

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[4] See, e.g., Boadway and Wildasin 1984 and Kotlikoff 1984 for some discussion of these issues.

to gain on efficiency grounds from minimum tax rates, and if there are significant welfare costs because the public sector is initially too large, there is an economic case for imposing maximum rather than minimum tax rates.

To our knowledge, the only previous study that provides empirical calculations of the welfare effects of fiscal competition is Wildasin 1989. He estimates that the welfare losses from property tax competition in the United States could be sizeable under some parameter scenarios. This paper presents extensive calculations of the welfare effects of tax competition using a model that generalizes Wildasin 1989 in several important respects. In particular, we allow for a non-zero aggregate supply elasticity for capital, we consider the effects of Leviathan behavior, we allow for monopsony power in capital markets, and we examine strategic behavior by governments.

Our purpose is to quantify the welfare effects of fiscal competition over wide ranges of plausible values for the key parameters, using a fairly standard model of tax competition from the literature. The key parameters are the tax elasticity of demand for capital, the supply elasticity of capital, the demand elasticity for public goods, the respective weights attached to Leviathan and welfare-maximizing behavior by governments, and parameters summarizing the effects of monopsony power and strategic behavior. We illustrate under what combinations of parameter values there are significant welfare costs from taxes being too low, when there are significant welfare costs from taxes being too high, and when taxes could be too high or too low but the welfare effects are empirically small.

The next section develops our basic, welfare-maximizing model, incorporating the fiscal externality and allowing for a non-zero supply elasticity for capital. Here we show that the welfare costs from the fiscal externality can be significant—we call the welfare costs significant when they exceed 3% of capital tax revenues—but only under fairly special conditions, when the tax elasticity of demand for capital has a relatively high value and the supply curve for capital is inelastic. The welfare losses are modest or quite small in magnitude (3% of capital tax revenues) when the tax elasticity has a low value or the capital supply elasticity is around unity.

In Section 3 we assume that the government attaches a weight of π to revenue maximization (Leviathan behavior) and a weight of $1 - \pi$ to welfare maximization. The critical values for π, at which point Leviathan behavior exactly offsets the fiscal externality, leaving

government spending and taxation at socially optimal levels in the local outcome, lie anywhere between 0 and about 0.6 (above these critical values the public sector is excessive). In fact, the welfare losses from the fiscal externality can fall substantially even when the government maximizes welfare 85% of the time (and maximizes revenue 15% of the time).

Section 4 introduces monopsony power and strategic behavior. The key point here is that when a region increases its capital tax, it anticipates some fall in the after-tax return to capital, either directly because it has some monopsony power, or indirectly because it expects other regions to respond by raising their taxes. The fall in the after-tax return limits the expected capital outflow to the region, and therefore it is locally optimal to set a higher tax rate. Under plausible parameter scenarios, this effect further reduces the welfare losses from the fiscal externality by a notable amount. This section also shows that—when we attach some weight to Leviathan behavior—there is a very wide range of parameter scenarios under which taxation can be too high or too low, but the welfare effects are empirically small (less than 3% of capital tax revenues).

The general message of the paper, summarized in Section 5, is that the welfare losses from capital tax competition seem to be fairly modest or quite small in magnitude (aside from some special cases). Thus the results appear to cast some doubt, for example, on the economic case for harmonizing capital taxes across the EU. However, Section 5 also notes some complicating factors that are omitted from the analysis, some of which would strengthen our findings, and others that might weaken them.

2. The Basic Model and Initial Results

A. Model Assumptions[5]

Consider a static model with a bloc of *N* homogeneous regions representing, for example, countries in the EU or states in the United States. The government of each region taxes a

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[5] The model described in this section is similar to the standard tax competition model presented in Wildasin 1989 and Wilson 1999 (pp. 273–276). However, it generalizes those models by incorporating a non-zero aggregate supply elasticity for capital.

perfectly mobile factor of production, capital, to finance public spending. Capital benefits the residents of a region by increasing labor productivity and hence wages. We assume that the population and labor force of each region is fixed, and there is no tax on labor.[6]

The amount of capital in a region is denoted k, and the value of output is $f(k)$, where variables are defined in per capita terms. In equilibrium, the net of tax rate of return on capital, r, is equated across regions, because capital is perfectly mobile. Each government imposes a tax of t per unit on capital. In equilibrium:

$$(2.1)\ f'(k) = r + t \Rightarrow k = k(r + t)$$

That is, (competitive) firms in each region employ capital until the marginal value product of capital equals the gross cost of capital, which equals the return that must be paid to owners of capital plus the tax rate. We assume that r is unaffected by the tax policies of any individual region (this is relaxed in Section 4).

The benefit to a region in terms of higher labor income from having an amount of capital k is:

$$(2.2)\ f(k) - (r + t)k$$

f(k) is the total income generated from capital, *rk* is the compensation paid to owners of capital, and *tk* is taxes paid to the government. Because individual regions take the net return on capital as given, tax revenues come entirely at the expense of surplus to labor/domestic residents. The tax causes capital to fall from *k** in Figure 1 to k^p, and the welfare cost of the tax from the perspective of the individual region is the shaded triangle.

Each government spends g per capita on public goods (defense, schools, welfare, roads, etc.). For simplicity we assume that the benefits of this spending, denoted $b(g)$, accrue only to local residents and not to firms or residents in other regions. Government spending must equal tax revenue, thus:

$$(2.3)\ g = tk$$

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[6] These are standard simplifying assumptions in the literature. Wilson 1999 (pp. 282–286), discusses the implications of allowing for labor taxes and labor mobility. Lee 1997 discusses the intermediate case of imperfect

Finally, we assume that the aggregate supply of capital for the region bloc is $K_S = K_S(r)$ where $K_S'(r) \geq 0$. An increase in the net of tax return on capital in the region bloc may increase the supply of capital by increasing savings.[7] Figure 2 shows the capital market for the region bloc [the demand curve is the aggregation of the $f'(k)$ curves across the n regions]. The equilibrium quantity of capital is $K^p = nk^p$, and the welfare cost from the bloc perspective of a uniform tax of t across all regions is the shaded triangle. This triangle is smaller than the summation of the shaded triangles in Figure 1 across the n regions, if the aggregate capital supply curve is upward sloping rather than flat.

B. Policy Outcomes

(i) *Local Outcome.* For the moment, we assume that each government maximizes the welfare of its citizens. The local outcome, when governments ignore the benefits of capital flight to other regions in the bloc, is defined by (see Appendix)

$$(2.4)\, b'(g^p) = 1 + MEB_R^p$$

where

$$(2.5)\, MEB_R = \frac{-t\dfrac{\partial k}{\partial t}}{k + t\dfrac{\partial k}{\partial t}}\,;$$

(superscript *p* denotes a value in the local, or private, outcome).

Equation (2.4) equates the marginal benefit from public spending with the marginal cost to domestic residents from raising an additional dollar of revenue. The marginal cost equals the dollar plus the marginal excess burden of taxation from an individual region's perspective, defined in (2.5). The numerator in (2.5) is the welfare loss to the region from an incremental

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capital mobility.

[7] More generally, a higher *r* could also attract more capital from regions outside the bloc. However, allowing for this would introduce the possibility that taxes at the bloc level are in part borne by foreign suppliers. This may raise the socially optimal level of taxation for the bloc, but it would also introduce the possibility of retaliation by governments outside the bloc.

increase in the tax rate, or the increase in the shaded triangle in Figure 1. It equals the tax rate times the incremental reduction in capital for the region. The denominator in (2.5) is marginal revenue from increasing the tax rate, equal to $\partial(tk)/\partial t$. Thus, the marginal excess burden is the welfare cost per dollar of extra revenue raised.

Equation (2.5) is easily manipulated to give:

$$(2.6)\ MEB_R = \frac{\eta_{kt}}{1 - \eta_{kt}}\ ; \eta_{kt} = -\frac{\partial k}{\partial t}\frac{t}{k}$$

η_{kt} is the tax elasticity of demand for capital, expressed as a positive number. It shows the percentage change in the demand for capital in a region in response to a 1% increase in the tax rate when there is no change in r or the tax rates of other regions (η_{kt}^{p} will denote the tax elasticity evaluated at the local outcome). η_{kt} is larger the higher the tax rate and the greater the proportionate reduction in capital in response to higher taxes.

Figure 3 shows the privately optimal amount of public spending g^{p}, where $b'(g)$ intersects the marginal cost curve from a region's perspective, equal to $1 + MEB_R$. Note that the marginal cost curve is convex because MEB_R increases by more than in proportion to government spending.[8] The curve becomes vertical at g^{max} in Figure 3 when η_{kt} is one and MEB_R becomes infinite: This point corresponds to the peak of the Laffer curve.[9]

(ii) *Social Optimum*. The social optimum defines the amount of public spending/level of taxation common to all regions that maximizes aggregate welfare for the region bloc. Aggregate welfare is the benefits from public spending, plus the area between the demand and supply curves in Figure 3 between the origin and the quantity of capital, after netting out tax payments (tK). The condition for the social optimum is (see Appendix):

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[8] From (2.3), since $dk/dt < 0$, an increase in government spending requires a more than proportionate increase in t. From (2.6), an increase in t leads to a more than proportionate increase in MEB_R (at least for the cases when either dk/dt or η_{kt} are constant).

[9] The Laffer curve shows the inverse-U relation between tax revenues and tax rates.

$$(2.7)\, b'(g^s) = 1 + MEB_B^s \,;\, MEB_B = \frac{\eta_{kt}\{1+r'\}}{1 - \eta_{kt}\{1+r'\}}$$

where

$$(2.8)\, r' = \frac{dr}{dt} = -\left\{\frac{t}{r}\frac{\varepsilon_{KS}}{\eta_{kt}} + 1\right\}^{-1}$$

$\varepsilon_{KS} = K_S' r / K$ is the capital supply elasticity with respect to the net of tax return on capital (superscript s denotes a value in the social optimum), and MEB_B is the marginal excess burden of taxation from the region bloc perspective.

Suppose the supply of capital is perfectly inelastic (ε_{KS}=0). In this case $r' = -1$ and $MEB_B = 0$. The other extreme is when the supply of capital is perfectly elastic ($\varepsilon_{KS} = \infty$). In this case $r' = 0$ and $MEB_B = MEB_R$. Therefore in general, the marginal excess burden of taxation from the region bloc perspective is positive but less than the marginal excess burden of taxation from the individual region perspective. This is because at the bloc level, a higher tax will depress the net return on capital, thereby limiting the increase in the gross return on capital r + t and hence limiting the reduction in demand for capital.

This means that the marginal social cost of public spending for a region is less than $1 + MEB_R$ in Figure 3, and the socially optimal amount of public spending, g^s, exceeds g^p. The shaded triangle in Figure 3 is the welfare loss from suboptimal government spending in the local outcome—it equals the gap between $b'(g)$ and $1 + MEB_B$, integrated between g^p and g^s. Put another way, the local amount of public spending/taxation is lower than the socially optimal levels due to a fiscal externality: individual regions do not take account of the efficiency benefits of capital flight to other regions within the bloc when choosing their tax rates (see, e.g., Wildasin 1989 for more discussion).

(iii) *The Welfare Cost of the Fiscal Externality*. To calculate welfare effects, we need to specify functional forms for f' and b'. For simplicity, we assume that both these curves are linear over the relevant range; the former assumption, along with (2.1), also implies that $\partial k / \partial t$ is constant. Therefore:

$$(2.9)\, k(t) = k^{p} + \frac{\partial k}{\partial t}(t - t^{p}) = k^{p}\left\{1 - \eta_{kt}^{p}(\tilde{t} - 1)\right\}$$

where $\tilde{t} = t/t^{p}$ is a given tax rate expressed relative to t^{p}. In addition, we define the magnitude of the demand elasticity for public goods in the private outcome by:

$$(2.10)\, \eta_{G}^{p} = -\frac{dg}{db'}\frac{b'}{g} = -\frac{b'(g^{p})}{gb''}$$

(b' is the shadow price of public spending).

The empirical literature provides estimates of parameters in the local outcome, such as η_{kt}^{p} and η_{G}^{p}, but not estimates of parameters in the socially optimal outcome, since the former is the observed, existing equilibrium and the latter outcome is not observed. Therefore, we need to obtain solutions for t^{s}, g^{s}, and the welfare loss, in terms of parameters in the local outcome. Despite our assumptions that f' and b' are linear, the $1 + MEB_{B}$ curve in Figure 3 is still nonlinear (MEB_{B} is convex in government spending). This means that we cannot obtain explicit analytical solutions for t^{s} and g^{s}. However, it is straightforward to obtain two equations that can easily be solved numerically for t^{s} and g^{s}.

First, socially optimal public spending, expressed relative to locally optimal spending, $\tilde{g}^{s} = g^{s}/g^{p}$, equals $t^{s}k^{s}/t^{p}k^{p}$. Using (2.9) gives:

$$(2.11)\, \tilde{g}^{s} = \tilde{t}^{s}\left\{1 - \eta_{kt}^{p}(\tilde{t}^{s} - 1)\right\}$$

Second, we can obtain the following expressions (see Appendix):

$$(2.12)\, b'(g) = (1 + MEB_{R}^{p})\left\{1 - \frac{\tilde{g} - 1}{\eta_{G}^{p}}\right\}; \eta_{kt} = \frac{\eta_{kt}^{p}\tilde{t}}{1 - \eta_{kt}^{p}(\tilde{t} - 1)}; r' = -\left\{\frac{t^{p}}{r^{p}}\frac{\varepsilon_{KS}^{p}}{\eta_{kt}^{p}} + 1\right\}^{-1}$$

Evaluating these expressions at the social optimum, and substituting into the optimality condition (2.7), gives a second equation in $\tilde{g}^{s}$ and $\tilde{t}^{s}$. Using the resulting equation, and (2.11), we can solve numerically to obtain $\tilde{g}^{s}$ and $\tilde{t}^{s}$ as functions of η_{kt}^{p}, η_{G}^{p}, ε_{KS}^{p}, and t^{p}/r^{p}. Finally, the shaded welfare cost triangle in Figure 3, when expressed relative to g^{p}, is defined by:

$$(2.13) \frac{1}{g^P} \int_{g=g^P}^{g^s} \{b'(g) - (1 + MEB_B)\} dg$$

This can be computed using the expressions for $b'(g)$ and MEB_B from (2.8) and (2.12).

C. Initial Empirical Results

(i) *Parameter Values*. In our model, η_{kt}^p could be anywhere between 0 and one, and for completeness this is the range we consider. η_{kt}^p cannot exceed unity, because this would imply that regional economies were on the downward sloping part of the Laffer curve, in which case cutting taxes would both reduce deadweight loss and raise more revenue.[10] Based on the empirical evidence, a range of about 0.1 to 0.6 seems the most plausible.[11] From (2.6), this narrower range of values would imply a marginal excess burden of taxation from a local perspective of between 0.11 and 1.5.

There is also considerable uncertainty over the elasticity of capital supply for the United States and for the EU. We consider a range of between 0 and 1 for ε_{KS}^p (see, e.g., the discussion in Ballard et al. 1985, p. 131). Larger values might be plausible, and would imply a smaller welfare loss from the fiscal externality, but this is not a major concern given that our purpose is mainly to put an upper bound on the welfare cost.

Empirical evidence suggests that the demand for public goods is fairly inelastic (e.g., Rubinfeld 1987; Oates 1996a);[12] based on the literature, we use values of 0.2, 0.4, and 0.6 for the

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[10] In practice, η_{kt}^p could exceed one if, for example, policy makers are unaware that they are on the wrong side of the Laffer curve. Our model rules out this possibility because we assume governments are perfectly informed about parameter values. Note that the elasticity of demand for capital with respect to the gross price of capital ($r + t$) could exceed one, because this elasticity is greater than the capital elasticity with respect to the tax rate only (t).

[11] See Bartik 1991, p. 43. The empirical estimates are for competition between different state governments or governments in different metropolitan areas of the United States.

[12] Perhaps this is because the marginal benefit from additional provision of public services (road infrastructure, garbage collection, etc.) declines fairly quickly once some satisfactory level of service has been provided.

magnitude of η_G^p. Finally, we consider a range of 0.2 to 0.6 for the capital tax rate (t^p / r^p) based on estimates for the United States and other industrial countries (e.g., Judd 1987, p. 695; Mendoza et al. 1994, Table 3).

For purposes of discussion we will say that the welfare cost of the fiscal externality is "significant" if it exceeds 3% of public spending/capital tax revenue. In practice this corresponds to around 0.15% to 0.45% of a region's GDP.[13] This threshold is probably conservative; however, it makes the main result from our paper—that the welfare cost of the fiscal externality is generally not significant—conservative. Note that the substantial uncertainty over parameter values is not a major problem if the welfare cost turns out to be insignificant over wide ranges of parameter scenarios.

(ii) *Results*. The upper three panels in Figure 4 show the welfare cost of the fiscal externality, expressed relative to the (existing) locally optimal level of capital tax revenue. The lower three panels show the percentage difference between g^s and g^p. On the horizontal axes in each panel, we vary the capital tax elasticity (evaluated at g^p) between 0 and unity, and the lower, middle, and upper curves in each panel correspond to when the public goods demand elasticity is 0.2, 0.4, and 0.6, respectively. Panels (a), (b), and (c) correspond to different scenarios for the capital supply elasticity and capital tax rate (see below).

In panel (a) we set the capital supply elasticity equal to zero, thus $r' = -1$ and there is no reduction in the equilibrium quantity of capital when all tax rates are increased across the bloc. Clearly there is a range of parameter scenarios for which the welfare cost of the fiscal externality is significant—above 3% of capital tax revenues. Roughly speaking, this is when the tax elasticity is between approximately 0.3 and 0.9. However, it is certainly plausible that the tax elasticity is less than 0.3, in which case the welfare losses can be modest or quite small in magnitude (less than 3% of tax revenues). Note that the welfare loss is zero in the extreme cases

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[13] Assume capital income is 25% of GDP and multiply by our range for the capital tax rate and by 0.03. For comparison, Harberger (1954) once estimated that the welfare costs from monopoly pricing in product markets in the United States amount to about 0.1% of GDP, which is regarded as a "small" number. Lucas (1990) estimated that the welfare gains from eliminating all taxes on capital and replacing the revenues from higher labor taxes would amount to about 1% of GDP, which is regarded as a fairly substantial welfare gain.

when the tax elasticity is zero (increasing taxes at the region level has no effect on the demand for capital) and one (tax revenues are at their maximum amount in the local outcome, the peak of the Laffer curve). Between these cases the welfare loss rises to a maximum of 10% of tax revenue when η_G^p is 0.6, or a maximum of 7% of tax revenues when η_G^p is 0.2.[14] The optimum increase in public spending is anything between 0 and 23%, under different scenarios for η_{kt}^p and η_G^p (lower left panel).[15]

In panel (b) we assume that the capital supply elasticity is 0.5 and $t^P / r^P = 0.2$. Using (2.8), this implies that, when η_{kt}^p is above 0.2, about 10–30% of a tax increase across the bloc would be reflected in a higher gross cost of capital (70–90% is still reflected in a lower r).[16] Comparing the top panels (a) and (b), we see that the welfare cost of the fiscal externality falls by roughly 25%, and the range of values for the capital tax elasticity for which the welfare cost is above our threshold of 3% narrows somewhat. In panel (c) we assume the capital supply elasticity is 1 and $t^P / r^P = 0.6$. In this case, around 50% or more of a coordinated tax increase is passed on in a higher gross cost of capital (50% or less is reflected in a lower r), which greatly reduces the optimal size of the public sector (relative to when $\varepsilon_{KS}^P = 0$). The range of values of the capital tax elasticity for which the welfare cost is above 3% shrinks to about 0.5 to 0.85, and the upper bound for the welfare cost is about 6% of tax revenues. In this case, the optimal increase in public spending is between 0 and 10% (lower right panel).

Summing up our initial results, the welfare cost of the fiscal externality may be significant under some plausible parameter values, but it can easily be small under others. For the welfare cost to exceed 3% of capital tax revenue, the capital tax elasticity has to be in the

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[14] The larger the public goods demand elasticity, the flatter the $b'(g)$ curve in Figure 3 (the benefits from additional public spending diminish at a slower rate). This implies a larger $\widetilde{g}^s$ and welfare loss from the fiscal externality.

[15] The results from panel (a) are roughly consistent with earlier calculations by Wildasin (1989), who assumed a vertical capital supply curve.

[16] When η_{kt}^p is below 0.2, a much higher portion can be passed on in a higher gross cost, because the aggregate demand for capital is inelastic relative to the aggregate supply curve.

upper half of the plausible range noted above (0.1–0.6), *and* the capital supply elasticity must not be "too large."

3. Alternative Assumptions about Government Behavior

One assumption in the above model that is sometimes criticized in the literature is that governments seek to maximize social welfare. In particular, the public choice school views the government as, at least in part, a Leviathan seeking to maximize tax revenues for spending purposes.[17] On the other hand, the welfare-maximizing view of government receives some theoretical support from the median voter theorem, at least when preferences are symmetric or residents of a region are fairly homogeneous (Bergstrom 1979). In this section we assume that government behavior is partly the result of revenue maximization and partly the result of welfare maximization.[18]

A. Model Solution

We now assume that the government attaches a weight of π to maximizing revenues and a weight of $1-\pi$ to maximizing the welfare of its citizens. In this case the local outcome is defined by (see Appendix):

$$(3.1)\, b'(g^p) = (1-\pi)(1+ MEB_R^p)\ \ g^p \le g^{\max}$$

Compared with (2.4), governments now attach a weight of $1-\pi$ to the local marginal private costs of public spending. Note that g^p can never exceed g^{max} in Figure 3, the maximum amount of public spending allowed by the Laffer curve. The local marginal cost, $1+ MEB_R$,

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[17] See, for example, Brennan and Buchanen (1980), Edwards and Keen (1996), and Rauscher (1998). It is difficult empirically to judge whether the welfare maximizing or the Leviathan view of government is the more accurate, because both views predict that an increase in the number of competing governments should reduce public spending and taxation (see Oates 1989 for more discussion).

Another strand of the public choice school views politicians as redistributing rents among competing pressure groups in order to maximize political support (e.g., Stigler 1971; Peltzman 1976; and Becker 1983). Introducing competition among interest groups would substantially complicate our analysis and might be difficult to implement empirically.

[18] Other political economy models (e.g., Edwards and Keen 1996; Rauscher 1998) also assume governments are concerned partly with maximizing social welfare and partly with maximizing tax revenues.

becomes infinity at g^{max} in Figure 3; therefore $1-\pi$ times the local marginal cost must also be infinity.[19]

Maximizing welfare from the region bloc perspective still yields the same first-order condition as in (2.7). In theory, government spending in the local outcome can now be below or above the socially optimal amount. We define $\bar{\pi}$ as the critical value of π such that $g^p = g^s$. This occurs when $(1-\pi)(1+MEB_R)=1+MEB_B$, or, using (2.6) and (2.7):

$$(3.2)\,(1-\bar{\pi})\left\{1+\frac{\eta_{kt}}{1-\eta_{kt}}\right\}=\left\{1+\frac{(1+r')\eta_{kt}}{1-(1+r')\eta_{kt}}\right\}$$

Rearranging gives:

$$(3.3)\,\bar{\pi}=\frac{-r'\eta_{kt}}{1-(1+r')\eta_{kt}}$$

If π is greater (less) than $\bar{\pi}$, then g^p is greater (less) than g^s.

Using (2.8) and (3.3), Table 1 shows the values of $\bar{\pi}$ for selected values of η_{kt}, ε_{KS}, and t/r. When the tax elasticity is 0.2, the critical values of π lie between 0.06 and 0.2. In other words, if the government attaches a weight of more than 0.2 to revenue maximization (and a weight of less than 0.8 to welfare maximization), then public spending exceeds the socially optimal amount. But if the tax elasticity is 0.8, then public spending in the local outcome is excessive only if the weight attached to Leviathan behavior exceeds 0.7–0.8. Thus, whether the public sector is too large or too small crucially depends on the size of the tax elasticity. Intuitively, the larger the tax elasticity, the larger the gap between the $1+MEB_R$ curve and the $1+MEB_B$ curve in Figure 3 (when $\pi=0$), and hence the larger the value of π necessary for $(1-\pi)(1+MEB_R^p)$ to be less than $1+MEB_B^p$. Note that there is likely to be some correlation between the tax elasticity and π because $\eta_{kt}=1$ is the pure revenue-maximizing Leviathan

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[19] Government spending may equal g^{max}, even if π is less than one and even if some weight is attached to welfare maximization.

outcome ($\pi = 1$), an observed value for η_{kt}^p closer to one suggests a higher weight attached to Leviathan behavior.

B. Welfare Calculations

Figure 5 illustrates the welfare effects (see Appendix for details on these calculations). The top panels show welfare costs due to government spending differing from the optimal level (again, welfare costs are a percentage of capital tax revenue), and the bottom panels show the percentage difference between g^s and g^p. Along the horizontal axis we vary the weight attached to Leviathan behavior between 0 and 0.6.[20] In panel (a) we choose the values for η_G^p and ε_{KS}^p that maximize the welfare cost from the fiscal externality ($\eta_G^p = 0.6$, $\varepsilon_{KS}^p = 0$); in panel (b) we choose intermediate values ($\eta_G^p = 0.4$, $\varepsilon_{KS}^p = 0.5$); and in panel (c) we use values that imply the smallest welfare cost from the fiscal externality ($\eta_G^p = 0.2$, $\varepsilon_{KS}^p = 1$).[21] There are a number of noteworthy points from Figure 5.

First, as we increase π, g^p approaches g^s and the welfare cost of the fiscal externality declines. At some critical value for π, g^p equals g^s, and the welfare costs and the optimal change in public spending are zero. Beyond this point, the welfare costs rise because public spending is excessive in the local outcome, and the optimal change in public spending becomes negative. The critical values for π, at which point Leviathan behavior exactly offsets the fiscal externality, lie anywhere between about 0 and 0.6.

Second, the magnitude of the welfare cost from the fiscal externality is sensitive to even fairly small values for π. For example, when the tax elasticity is 0.35, the welfare cost falls from 5.5% of government spending to 2.1% in panel (a) as we increase π from 0 to 0.15; in panel (b) the welfare cost falls from 2.5% to 0.7% of government spending. In other words, even attaching

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[20] We ignore cases when π takes a very high value and the tax elasticity a very low value, because these cases appear inconsistent.

[21] The intercepts of the curves in Figure 5 correspond to various points in Figure 4. For example, in the top of panel (a), the curve with triangles has an intercept of 5.5. This corresponds to the point on the upper curve in the top panel of Figure 4(a), when the tax elasticity is 0.35.

a weight of 0.15 to Leviathan behavior (and 0.85 to welfare maximizing behavior) can substantially reduce the welfare costs from the fiscal externality. If π exceeds about 0.3, the welfare cost of the fiscal externality is not significant (i.e., it is below 3% of capital tax revenue) for all the parameter scenarios in Figure 5.

Third, there are some cases when public spending is excessive, and the resulting welfare costs are empirically significant; however, these cases are fairly limited. For example, when the tax elasticity is 0.6, the welfare losses from excessive public spending (when the curves in the upper panels are upward sloping) are always well below 3%. When the tax elasticity is 0.35, π has to be above about 0.5 for the welfare losses to exceed 3% of tax revenue.

Therefore the final point is that we are left with a wide range of outcomes under which public spending/capital taxation is either too low or too high, but the resulting welfare costs are not empirically large.

4. Monopsony Power and Strategic Behavior

We now make two extensions to the model of Section 2 that relax the assumption of perfectly competitive or "small" regional governments. First, we incorporate monopsony power in the capital market by individual regions. That is, when a region raises its tax rate, the net of tax return for the bloc as a whole falls, even when all other governments keep their tax rates constant. Second, we incorporate strategic behavior by assuming that other governments react to a tax increase in an individual region by also increasing their taxes. This effect also (indirectly) reduces the net return on capital. Thus, both of these effects dampen the increase in the gross cost of capital for an individual region, following an increase in the region's tax rate. Section A examines the welfare-maximizing model and Section B incorporates Leviathan behavior.

A. Model Solution with Welfare Maximization

In this extended model, the local outcome when governments maximize welfare is now defined by (see Appendix):

$$(4.1)\, b'(g^p) = 1 + \frac{\eta_{kt}^p \left\{ 1 + \frac{dr}{dt_R} \right\}}{1 - \eta_{kt}^p \left\{ 1 + \frac{dr}{dt_R} \right\}}$$

where

$$(4.2)\, \frac{dr}{dt_R} = \mu \frac{dr}{dt}\,;\, \mu = \frac{1}{n} + \frac{n-1}{n}\frac{dt_{-R}}{dt_R}$$

In this case the marginal cost of public spending for an individual region is lower than in the model of Section 2 to the extent that $dr/dt_R < 0$ [see (2.4), (2.6), and (4.1)]. dr/dt_R is the effect on the net of tax return throughout the region bloc when an individual region increases its tax rate. Equation (4.2) expresses dr/dt_R as the product of dr/dt, the effect on the net return when all regions increase their tax rates by dt, and μ, where μ has two components.

The first component is $1/n$, which reflects the degree of monopsony power. When one region incrementally increases its tax rate and no other regions respond, the effect on the average tax rate across the region bloc is $1/n$ times the region's tax increase. The second component of μ reflects the response of the other $n-1$ governments. If all other governments respond by raising their tax rates by dt_{-R}/dt_R, the average tax rate across the region will be further increased by $((n-1)/n)(dt_{-R}/dt_R)$. Note that (so long as $dt_{-R}/dt_R \leq 1$), μ cannot exceed one. Therefore, comparing (4.1) with (2.7), government spending and taxation in the local outcome cannot be socially excessive. Finally, note that $n \to 1$ implies $\mu \to 1$ and $g^p \to g^s$. That is, the fiscal externality disappears as the number of competing regions converges to one (Hoyt 1991).

Table 2 shows calculations of μ as we vary the number of regions between 2 and 20, and dt_{-R}/dt_R between 0 and 0.5. In the first column there is no strategic behavior ($dt_{-R}/dt_R = 0$). Here the value of μ varies between 0.05 and 0.5 as we vary the number of regions between 20 and 2, reflecting the pure monopsony power effect. Incorporating strategic behavior can noticeably increase μ. For example, when $n = 5$, μ increases from 0.2 to 0.44 when other

regions would respond to one region's tax change by each changing their own taxes by 30% of the tax change (compare the first and third columns).[22] Based on Table 2, we illustrate scenarios where the combined effect of monopsony power and strategic behavior imply values for μ of between 0 and 0.5.

B. Welfare Calculations

Figure 6 shows how μ affects the welfare cost of the fiscal externality (see Appendix for details on the welfare calculations). Along the horizontal axes we vary μ between 0 and 0.5. In each panel, the lower, middle, and upper curves correspond to when the tax elasticity of demand for capital is 0.1, 0.35, and 0.6. In panels (a) and (c) we choose the demand elasticity for public goods and the capital supply elasticity to maximize and minimize the welfare cost of the fiscal externality, respectively, and in panel (b) we use intermediate values for these parameters.

The main point here is simply that the welfare cost of the fiscal externality is sensitive to μ. For example, in panel (a) as we increase μ from 0 to 0.2, the welfare cost of the fiscal externality falls from 9.1% to 5.4% of capital tax revenue when the tax elasticity is 0.6, and from 5.7% to 3.3% when the tax elasticity is 0.35. Put another way, a positive μ further restricts the range of scenarios under which the welfare cost of the fiscal externality exceeds 3% of tax revenues.

C. Leviathan Behavior and Summary of Results

Finally, we put together the extensions in Sections 3 and 4A. That is, we assume that each government attaches a weight of π to revenue maximization and a weight of $1-\pi$ to welfare maximization, taking into account its monopsony power and the reaction of other governments. For this case the local outcome is defined by (see Appendix):

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[22] In practice, $dt_{\_R}/dt_R$ and n are likely to be inversely related—the smaller the number of regions, the greater the likelihood of strategic behavior.

$$(4.3)\, b'(g^{p}) = (1-\pi)\left\{1 + \frac{\eta_{kt}^{p}\left\{1 + \dfrac{dr}{dt_{R}}\right\}}{1 - \eta_{kt}^{p}\left\{1 + \dfrac{dr}{dt_{R}}\right\}}\right\};\, g^{p} \leq g^{\max}$$

In the case when $\pi = 0$, the local outcome is the same as in the welfare-maximizing case [Equation (4.1)]. Allowing for a positive π raises government spending and taxation in the local outcome relative to that in the socially optimal outcome. The rest of this section summarizes the combinations of parameter values under which the welfare costs of fiscal competition are and are not significant (see Appendix for more details on the welfare calculations).

For given values of η_{kt}^{p}, ε_{KS}^{p}, η_{G}^{p}, and μ, Table 3 indicates the values of π below which the welfare cost of the fiscal externality exceeds 3% of capital tax revenues. "na" denotes a case where, even when the weight attached to Leviathan behavior is zero, the welfare cost of the fiscal externality is below 3% of tax revenues.

In the first three columns we see that when the tax elasticity is 0.85, if μ is 0.1 or greater, the welfare cost is never significant. If $\mu = 0$ (no monopsony power or strategic behavior), the welfare cost is not significant when the capital supply elasticity is unity. In addition, even when $\mu = 0$ and the capital supply elasticity is 0.5 or less, the welfare cost is significant only if the weight attached to Leviathan behavior is below 0.14–0.17.

In the middle three columns of Table 3, the tax elasticity is 0.6. When the supply elasticity is unity, the welfare cost is not significant when μ is equal to or above 0.1, and when $\mu = 0$ it is not significant if the weight attached to Leviathan behavior is above 0.04 or 0.14. However, when the supply elasticity is 0.5 or less, there are some plausible cases when the welfare costs are significant. For example, when $\mu = 0$ they are significant so long as the weight attached to Leviathan behavior is not above 0.25–0.39.

In the last three columns, the tax elasticity is 0.35. Here the welfare cost is significant in only 2 out of 18 cases, and in no cases if π exceeds 0.11. The welfare cost is never significant when the tax elasticity is 0.1.

Finally, Table 4 shows the minimum values of π under which public spending/taxation is excessive—that is, the effect of Leviathan behavior more than compensates for the fiscal externality—and the welfare costs exceed 3% of capital tax revenues. In the first three columns, when the tax elasticity is 0.85, π has to exceed 0.58–0.91 for the welfare costs to be significant, for different values of μ, ε_{KS}^p, and η_G^p. When the tax elasticity is 0.6, π has to be above 0.46–0.77 for the welfare costs to be significant, and when the tax elasticity is 0.35, π has to be above 0.34–0.62. In short, Table 4 shows that the weight attached to Leviathan behavior has to be fairly substantial for the welfare costs from excessive taxation to be significant.[23]

To sum up, we have to make fairly special parameter assumptions in order for taxation to be too low *and* for the resulting welfare costs to be empirically significant in magnitude. But in addition, the parameter scenarios under which taxes are too high and the welfare costs are significant are also pretty limited. In short, there is a wide range of plausible parameter scenarios under which taxation could be either too high or too low, but the welfare effects are empirically small.

5. Conclusions and Caveats

This paper presents extensive calculations of the empirical magnitude of the welfare effects of capital tax competition among regional governments in a model that allows for welfare-maximizing and Leviathan behavior by governments, an upward sloping supply curve for capital, monopsony power for regional governments in the capital market, and strategic behavior among governments. The welfare costs from the fiscal externality that leads to suboptimal tax rates appear to be fairly modest (less than 3% of capital tax revenue) or quite small, aside from some special cases. Even these welfare costs may disappear quite quickly when some weight is attached to the possibility of Leviathan behavior, rather than assuming governments always maximize social welfare. The results therefore seem to cast some doubt on

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[23] Unfortunately, we do not have accurate estimates of π. However, as already mentioned, we can at least say that very high values for π (i.e., fairly close to one) appear to be inconsistent with empirically estimated tax elasticities of below 0.6.

the economic case for setting minimum rates of capital taxes across a bloc of regions, such as the European Union, to mitigate fiscal externalities.

The analysis omits several complicating factors, some of which would strengthen our findings, and others that might weaken them. For example, we make the common assumption that regions are homogeneous, and therefore we do not model the inefficiency due to the misallocation of capital when tax rates (and hence the marginal product of capital) differ across heterogeneous regions. Allowing for heterogeneity may increase the overall welfare losses from tax competition. But it may also greatly complicate the socially optimal set of tax rates across regions, since these must take into account different preferences for public spending and differences in key parameters such as the tax elasticity of demand for capital in each region. In addition, we do not consider other ways, beyond capital taxation, in which governments might compete for mobile factors, such as in the setting of environmental standards, welfare programs, or the provision of public inputs to improve the productivity of capital (e.g., Brown and Oates 1987; Keen and Marchand 1997; Oates 1996b; Wilson 1996). The economic case for harmonization might be stronger for some of these policies, for example, measures to address pollution spillovers across regions.

Finally, we use a static model, which is usual in the fiscal competition literature. However, more sophisticated welfare estimates might be obtained by using a dynamic optimization approach, which has been used in the literature on the efficiency costs of capital taxation (e.g., Judd 1987; Lucas 1990). Moreover, it might be useful to relax the assumption that capital is perfectly mobile by incorporating a cost function that depends on how quickly capital is moved across regions over time.

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Appendix: Analytical Derivations

Section 2

Deriving Eq. (2.4)

Domestic welfare, W^p, expressed as a function of government parameters is:

$$(A1)\quad W^p(t,g) = b(g) + f(k) - (r+t)k$$

This equals the benefits from public spending plus the surplus from capital net of taxes and compensation to capital owners. Differentiating yields:

$$(A2)\quad \frac{\partial W^p}{\partial t} = -k \; ; \; \frac{\partial W^p}{\partial g} = b'(g)$$

Maximizing (A1) subject to the government revenue constraint (2.3) gives:

$$(A3)\quad \frac{\partial W^p}{\partial t} = \lambda \left\{ k + t\frac{dk}{dt} \right\} \; ; \; \frac{\partial W^p}{\partial g} = -\lambda$$

where λ is a Lagrange multiplier. From (A2) and (A3) we obtain (2.4).

Deriving Eq. (2.7)

Welfare from the region bloc perspective is:

$$(B1)\quad W^s(t,g) = n\{b(g) + f(k) - tk\}$$

This is the expression in (A1) aggregated over *n* regions, except that we include income to savers *nrk* in the definition of social welfare. Thus we take account of the loss in surplus to savers in the region bloc from induced changes in *r*. Differentiating yields:

$$(B2)\quad \frac{\partial W^s}{\partial t} = -nk \; ; \; \frac{\partial W^s}{\partial g} = nb'(g)$$

The government budget constraint aggregated for the region bloc is $ng = ntk$. Maximizing (B1) subject to this constraint gives:

$$(B3) \frac{\partial W^s}{\partial t} = \mu n \left\{ k + t \frac{dk}{dt} \right\} ; \frac{\partial W^s}{\partial g} = -\mu n$$

where μ is a Lagrange multiplier. Note that:

$$(B4) \frac{dk}{dt} = \frac{\partial k}{\partial t} + \frac{\partial k}{\partial r} \frac{dr}{dt}$$

and that $\partial k / \partial r = \partial k / \partial t$. From (B2)-(B4), and using the definition of η_{kt}, we obtain (2.7).

Deriving Eq. (2.8)

Note that:

$$(C1) \frac{d(r+t)}{dt} = \frac{\partial(r+t)}{\partial t} + \frac{\partial(r+t)}{\partial r} \frac{dr}{dt} = 1 + \frac{dr}{dt}$$

In addition, using (2.6):

$$(C2) \frac{d(r+t)}{dt} = \frac{d(r+t)}{dk} \frac{dk}{dt} = \frac{-t}{k\eta_{kt}} \frac{dk}{dt}$$

since $dk / d(r+t) = \partial k / \partial t$. In equilibrium $ndk / dt = dK_S / dt$, that is, the change in aggregate demand for capital must equal the change in supply. Noting that $dK_S / dt = (\partial K_S / \partial r)(dr / dt)$, we can obtain:

$$(C3) \frac{dk}{dt} = \frac{K_S \varepsilon_{KS}}{nr} \frac{dr}{dt}$$

where

$$(C4) \varepsilon_{KS} = \frac{\partial K_S}{\partial r} \frac{r}{K_S}$$

ε_{KS} is the supply elasticity for capital. Substituting (C2) and (C3) in (C1), and noting that in equilibrium $nk = K_S$ gives (2.8).

Deriving Eq. (2.12)

Using (2.10), we can obtain:

$$(D1)\, b'(g) = b'(g^P) + b''(g - g^P) = b'(g^P)\left\{1 - \frac{\tilde{g} - 1}{\eta_G^P}\right\}$$

Substituting (2.4) gives:

$$(D2)\, b'(g) = (1 + MEB_R^P)\left\{1 - \frac{\tilde{g} - 1}{\eta_G^P}\right\}$$

Using (2.6) and (2.9):

$$(D3)\, \eta_{kt} = \eta_{kt}^P \frac{\tilde{t}}{k} k^P = \frac{\eta_{kt}^P \tilde{t}}{1 - \eta_{kt}^P (\tilde{t} - 1)}$$

To obtain an expression for r', note that, using (2.9):

$$(D4)\, \varepsilon_{KS} = \varepsilon_{KS}^P \frac{r}{r^P} \frac{k^P}{k} = \frac{\varepsilon_{KS}^P r / r^P}{1 - \eta_{kt}^P (\tilde{t} - 1)}$$

Substituting (D3) and (D4) into r' in (2.8), and using the definition of $\tilde{t}$, gives:

$$(D5)\, r' = -\left\{\frac{t^P}{r^P} \frac{\varepsilon_{KS}^P}{\eta_{kt}^P} + 1\right\}^{-1}$$

Section 3

Deriving Eq. (3.1)

The local optimization problem is to maximize:

$$(E1)\, W_L^P(t, g) = \pi b(t, g) + (1 - \pi) W^P(t, g)$$

subject to the government budget constraint. When $\pi = 0$, this is the same optimization problem as in Section 2. When $\pi = 1$, the problem boils down to maximizing revenues, which yields $\eta_{kt} = 1$. Following the same procedure as in the derivation of (2.4) above, but using the objective function in (E1), yields (3.1).

Welfare calculations

Following the derivation of (D2) above, but using (3.1) instead of (2.4) gives:

$$(F1)\ b'(g) = (1-\pi)(1+MEB_R^p)\left\{1-\frac{\tilde{g}-1}{\eta_G^p}\right\}$$

To solve for $\tilde{g}^s$ and $\tilde{t}^s$ we again use equations (2.11), and (2.7), after substituting the expressions from (2.12). The only difference is that the expression for $b'(g)$ is now given by (F1). Plugging the solutions into (2.13), we are able to calculate the welfare loss due to g^p differing from g^s.

Section 4

Deriving (4.1)–(4.3)

If an individual region increases its tax rate by dt, and other regions do not increase their taxes, this has the same effect on r as an increase in average rate of tax of all regions of dt/n. In addition, if an individual region expects all other governments to raise their tax rates by dt_{-R}/dt_R, this raises the (expected) average rate of tax across the bloc by $((n-1)/n)dt_{-R}/dt_R$. Thus, the region anticipates the net of tax return to change by:

$$(G1)\ \frac{dr}{dt}\left\{\frac{1}{n}+\frac{n-1}{n}\frac{dt_{-R}}{dt_R}\right\}=\mu\frac{dr}{dt}$$

Allowing for Leviathan behavior, the individual region has the same objective function as in (E1); however, it now takes into account the expected change in r according to (G1) when it raises its tax rate. Thus, instead of the first expression in (A2) we obtain:

$$(G2)\ \frac{\partial W^p}{\partial t}=-\left\{1+\mu\frac{dr}{dt}\right\}k$$

Following through the same derivation as before, we obtain (4.3), and setting $\pi=0$ gives (4.1) and (4.2).

Welfare Calculations

Following the derivation of (D2) above, but using (4.3) instead of (2.4) yields after some manipulation:

$$(\text{H1})\, b'(g) = (1-\pi)\left\{1 + \frac{MEB_R^p(1+\mu r')}{1 - MEB_R^p(1+\mu r')}\right\}\left\{1 - \frac{\tilde{g}-1}{\eta_G^p}\right\}$$

To solve for $\tilde{g}^s$ and $\tilde{t}^s$ we again use equations (2.11) and (2.7), after substituting the expressions from (2.12). The only difference is that the expression for $b'(g)$ is now given by (H1). Plugging the solutions into (2.13), we are able to calculate the welfare loss due to g^p differing from g^s.

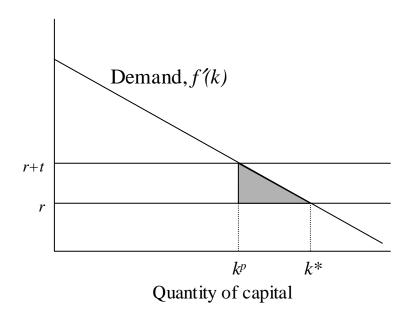**Figure 1. Capital Market for an Individual Region**

Demand, $f'(k)$

$r+t$

r

k^p $k*$

Quantity of capital

Figure 2. Capital Market for the Region Bloc

Demand, $nf'(k)$

Supply, $K_S(r)$

$r+t$

r

K^p $K*$

Quantity of capital

Figure 3. Welfare Cost of the Fiscal Externality
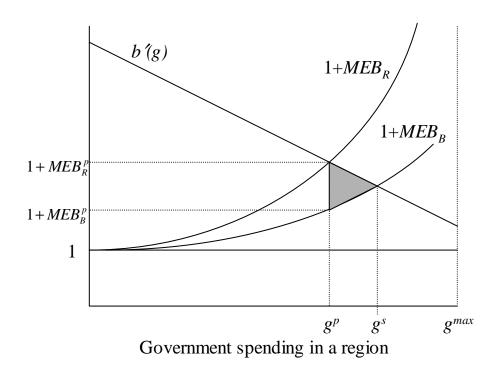

Government spending in a region

Figure 4. The Welfare Cost of the Fiscal Externality

Note: The lower, middle, and upper curves in each panel correspond to when the public goods demand elasticity is 0.2, 0.4, and 0.6.
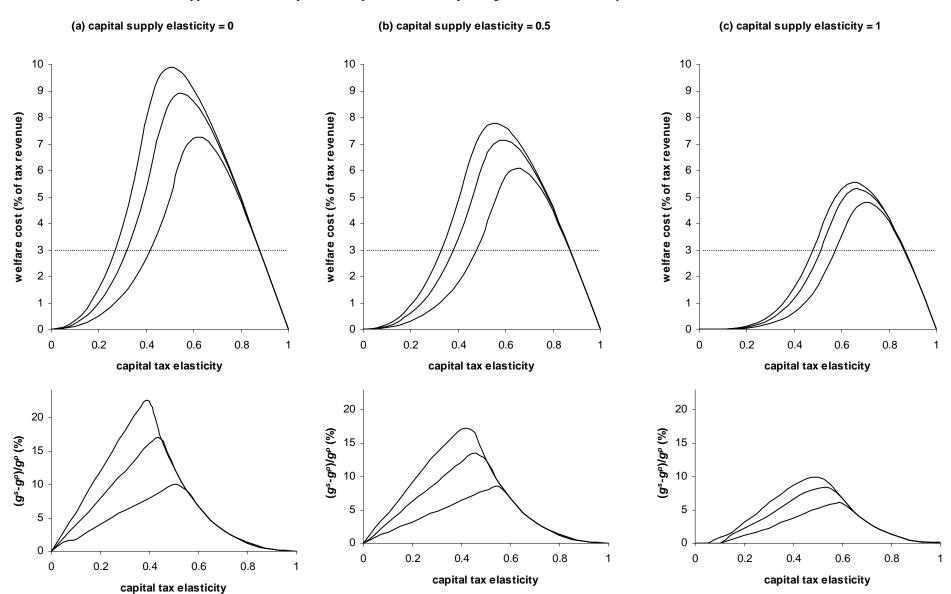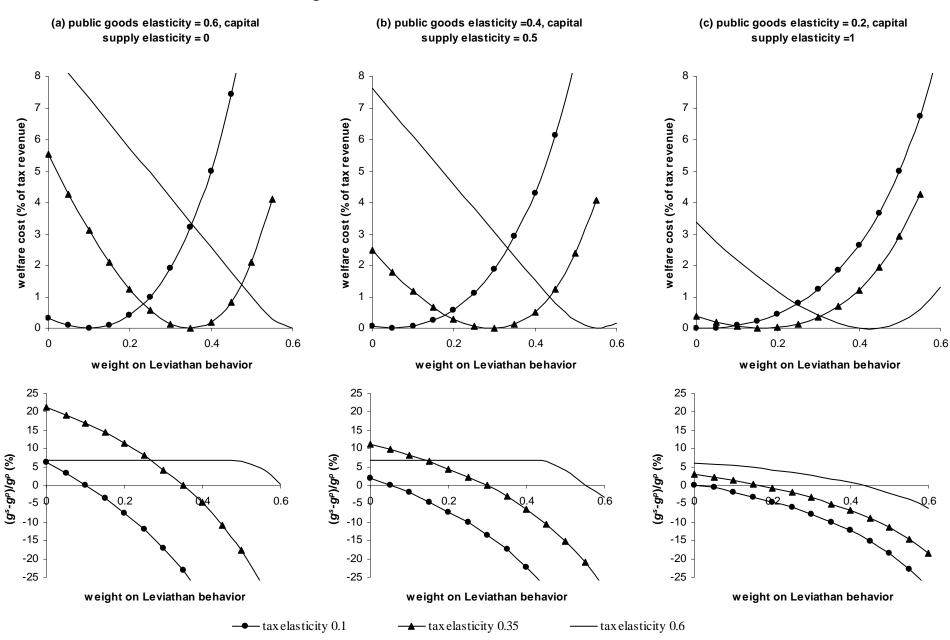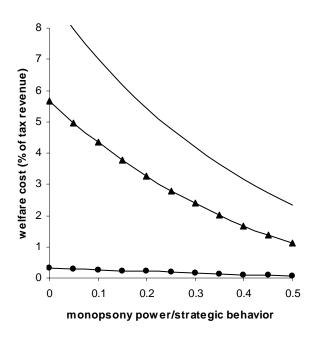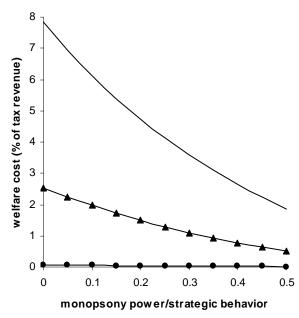
Figure 5. Welfare Losses and Leviathan Behavior

(a) public goods elasticity = 0.6, capital supply elasticity = 0

(b) public goods elasticity =0.4, capital supply elasticity = 0.5

(c) public goods elasticity = 0.2, capital supply elasticity =1

Figure 6. Welfare Losses and Monopsony Power/Strategic Behavior

(a) public goods elasticity = 0.6, capital supply elasticity = 0

(b) public goods elasticity =0.4, capital supply elasticity = 0.5

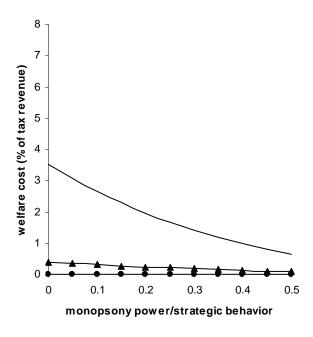**(c) public goods elasticity =0.2, capital supply elasticity = 1**

welfare cost (% of tax revenue) vs *monopsony power/strategic behavior*

Table 1. Critical Values of π for which Public Spending Is Socially Optimal

	η_{kt}			
	0.2	0.4	0.6	0.8
$\varepsilon_{KS} = 0$	0.20	0.40	0.60	0.80
$\varepsilon_{KS} = 0.5$, $t/r = 0.2$	0.14	0.35	0.56	0.78
$\varepsilon_{KS} = 1$, $t/r = 0.6$	0.06	0.21	0.43	0.70

Table 2. Illustrative Values for μ

n	dt_{-R} / dt_R			
	0	0.1	0.3	0.5
20	0.05	0.15	0.34	0.53
10	0.10	0.19	0.37	0.55
5	0.20	0.28	0.44	0.60
2	0.50	0.55	0.65	0.75

Table 3. Values for π below which the Welfare Cost from the Fiscal Externality Is Significant

μ	η_G^P	$\eta_{kt}^P=0.85$ $\varepsilon_{KS}^P=0$	$\eta_{kt}^P=0.85$ $\varepsilon_{KS}^P=0.5$	$\eta_{kt}^P=0.85$ $\varepsilon_{KS}^P=1$	$\eta_{kt}^P=0.6$ $\varepsilon_{KS}^P=0$	$\eta_{kt}^P=0.6$ $\varepsilon_{KS}^P=0.5$	$\eta_{kt}^P=0.6$ $\varepsilon_{KS}^P=1$	$\eta_{kt}^P=0.35$ $\varepsilon_{KS}^P=0$	$\eta_{kt}^P=0.35$ $\varepsilon_{KS}^P=0.5$	$\eta_{kt}^P=0.35$ $\varepsilon_{KS}^P=1$
0	0.2	0.16	0.14	na	0.30	0.25	0.04	na	na	na
	0.6	0.17	0.15	na	0.39	0.33	0.14	0.11	na	na
0.1	0.2	na	na	na	0.20	0.15	na	na	na	na
	0.6	na	na	na	0.29	0.25	na	0.06	na	na
0.3	0.2	na	na	na	na	na	na	na	na	na
	0.6	na	na	na	0.11	0.08	na	na	na	na

Table 4. Values for π above which the Welfare Cost from Excessive Taxes Is Significant

μ	η_G^p	$\eta_{kt}^p=0.85$ $\varepsilon_{KS}^p=0$	$\eta_{kt}^p=0.85$ $\varepsilon_{KS}^p=0.5$	$\eta_{kt}^p=0.85$ $\varepsilon_{KS}^p=1$	$\eta_{kt}^p=0.6$ $\varepsilon_{KS}^p=0$	$\eta_{kt}^p=0.6$ $\varepsilon_{KS}^p=0.5$	$\eta_{kt}^p=0.6$ $\varepsilon_{KS}^p=1$	$\eta_{kt}^p=0.35$ $\varepsilon_{KS}^p=0$	$\eta_{kt}^p=0.35$ $\varepsilon_{KS}^p=0.5$	$\eta_{kt}^p=0.35$ $\varepsilon_{KS}^p=1$
0	0.2	0.91	0.91	0.87	0.77	0.75	0.67	0.62	0.59	0.50
	0.6	0.89	0.88	0.85	0.71	0.69	0.61	0.53	0.52	0.40
0.3	0.2	0.77	0.76	0.75	0.66	0.65	0.59	0.56	0.53	0.47
	0.6	0.71	0.70	0.70	0.58	0.56	0.52	0.45	0.42	0.36
0.5	0.2	0.67	0.67	0.66	0.59	0.58	0.54	0.52	0.50	0.45
	0.6	0.58	0.59	0.60	0.49	0.48	0.46	0.40	0.38	0.34