Tax competition in federations and the welfare consequences of decentralization

Michael J. Keen and Christos Kotsogiannis

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Abstract: This paper explores the impact of intensified tax competition within federal systems characterized by the presence of both horizontal tax externalities between the states and vertical tax externalities between states and federal government. It shows that although these point in opposite directions (horizontal towards state taxes that are too low, vertical towards state taxes that are too high), leaving the net outcome unclear, intensified tax competition always worsens their combined effect. That is, intensified lower-level tax competition—in the form of an increase in the number of lower-level jurisdictions—is sure to reduce welfare, but this is not because, as usually supposed, it makes excessively low state taxes even lower; rather, it is welfare-reducing either for that reason or because it makes excessively high state taxes even higher. (*JEL* H20, H23)

1 Introduction

Until quite recently, the theory of tax competition in federal economies (meaning ones in which there is tax setting autonomy at more than one level of policy-decision making) has focused on the welfare consequences of horizontal externalities arising from the mobility of tax bases between lower-level jurisdictions.[1] The central conclusion from this work has been that horizontal externalities tend to leave equilibrium lower-level ('state') taxes too low, since each state ignores the benefit it confers on other states by raising its tax rate and so inducing outward movement of its tax base.[2] More recently, attention has turned to the key feature of the fiscal architecture of federal systems that tax bases are co-occupied, implicitly if not explicitly, by both federal and state governments. This co-occupation gives rise to vertical externalities between federal and state governments,[3] which tend to leave state taxes too high: each state ignores the harm it does others by raising its tax rate in so far as the induced contraction in the federal tax base leads to a reduction in federal spending that harms other states too.

With horizontal externalities pointing towards state taxes that are inefficiently low and vertical externalities towards state taxes that are inefficiently high, it is natural to ask which will dominate. The answer, assuming governments act benevolently, is: it depends. In a model of competition for mobile capital, Keen and Kotsogiannis (2000), in particular, show that whether equilibrium taxes are too high or too low in equilibrium depends on the elasticity of the demand for capital and supply of savings. But another question then arises: Does an intensification of tax competition amongst the state governments within federal systems—conveniently parameterized as an increase in the number of states—lead to a better outcome or a worse one? That is the question addressed in this paper. We show that in this case the answer is unambiguous: it makes it worse.

This result may seem reminiscent of Hoyt (1991), who shows that an increase in the number of states in the standard model of horizontal tax competition causes welfare to fall. Here, it should be emphasized, the context and mechanisms at work are quite different. In Hoyt's model there is no purposive federal government, so that state taxes are too low and are made lower by intensified tax competition. In the present federal context, in contrast, state taxes may be either too low or too high: the point is that whatever the nature of the inefficiency, intensified tax competition makes it worse. If taxes are too low, it makes them lower; if too high, it makes them higher. One does not need to know whether state taxes are too low or too high in order to know that intensified tax competition is harmful.

The organization of the paper is as follows. Section 2 provides the background against which the analysis is conducted; it presents a simple model of federal fiscal arrangements,

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[1]Important contributions to the literature on horizontal externalities include Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (1989), Hoyt (1991), Dahlby (1996), and Keen and Marchand (1997).

[2]There are cases, however, in which tax exporting motives can leave equilibrium taxes too high; see, for instance, Mintz and Tulkens (1986).

[3]Contributions to this literature include Cassing and Hillman (1982), Flowers (1988), Wrede (1996), Boadway, Marchand and Vigneault (1998), Keen and Kotsogiannis (2000, 2001) and Dahlby and Wilson (2001). Keen (1998) surveys externalities, while Wilson (1999) provides a thorough review of the tax competition literature.

based on Keen and Kotsogiannis (2000), and briefly discusses inefficiencies in state tax-setting. Section 3 contains our main result. Section 4 summarizes and concludes.

2   Background

2.1   The model

The economy consists of one federal and $N \geq 1$ identical state governments. Output in state j is $F(K^j)$, where K^j denotes the amount of capital located in state j, with[4]

$$F'(K^j) > 0 > F''(K^j) , \tag{1}$$

and $F(K^j)$ at least three times continuously differentiable. Capital is costlessly mobile across the states and so relocates until it earns the same post-tax return ρ in each state. Capital can be taxed by both levels of government. State j levies a source-based tax t_j on each unit of capital in its jurisdiction while the federal government levies a unit tax—common to all states—at the rate T. The consolidated tax rate in state j is then $\tau_j \equiv t_j + T$. Capital moves until it earns the same post-tax return in each state, so that

$$F'(K^j) - \tau_j = \rho , \tag{2}$$

which defines the demand for capital $K^j(\rho + \tau_j)$ with

$$K'(\rho + \tau_j) = \frac{1}{F''} < 0 . \tag{3}$$

Rents to the fixed factor in state j are denoted by

$$\Pi^j(K^j) \equiv F(K^j) - F'(K^j)K^j , \tag{4}$$

with, from (3),

$$\Pi'(\rho + \tau_j) = -K(\rho + \tau_j) . \tag{5}$$

Rents in state j are taxed at the (exogenous) rate $\theta \in (0,1)$ by state j, and are not taxed by any other government. In each state there is a single consumer with preferences defined over first- and second-period private consumption, C_1 and C_2, the level g of a local public good provided by the government of the state in which she lives, and federal spending per state G. That is,

$$U(C_1, C_2, g, G) = u(C_1) + C_2 + \Gamma(g, G) . \tag{6}$$

Both u and Γ are strictly increasing and concave. Each consumer in state j has an endowment e of first period income; in the second, she receives principal and interest on her first-period savings, S, plus after-tax rents earned in her jurisdiction. This specification of preferences implies that $S'(\rho) \geq 0$, with indirect utility

$$U(\rho, \tau, g, G) \equiv u[e - S(\rho)] + (1 + \rho)S(\rho) + (1 - \theta)\Pi(\rho + \tau) + \Gamma(g, G) . \tag{7}$$

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[4]Derivatives of functions of one variable are indicated by primes and of many variables by subscripts.

Making use of (5),

$$U_\rho = S - (1-\theta)K \,, \tag{8}$$

$$U_\tau = -(1-\theta)K \,. \tag{9}$$

Denoting the N-vector of consolidated tax rates by $\vec{\tau} \equiv (\tau_1, ..., \tau_N)$, the net return $\rho(\vec{\tau})$ is implicitly defined by the market-clearing condition

$$NS(\rho) = \Sigma_{i=1}^N K(\rho + \tau_i) \,, \tag{10}$$

so that

$$\frac{\partial \rho}{\partial \tau_j} = \frac{K'(\rho + \tau_j)}{NS'(\rho) - \Sigma_{i=1}^N K'(\rho + \tau_i)} \,. \tag{11}$$

Throughout the analysis attention is confined to symmetric equilibria: ones, that is, in which all states set the same tax rate ($\tau_j = \tau, \forall j$). The net return in such an equilibrium is $p(\tau) \equiv \rho(\tau, .., \tau)$, with

$$p'(\tau) = \frac{K'(\rho + \tau)}{S'(\rho) - K'(\rho + \tau)} \in [-1, 0) \,. \tag{12}$$

Hence, using (11), in symmetric equilibrium

$$p'(\tau) = N\frac{\partial \rho}{\partial \tau_j} \,. \tag{13}$$

There are no inter-governmental transfers, either vertically between the levels of government or horizontally across the states, so that state and federal tax receipts (per state) respectively are

$$g_j = t_j K(\rho + \tau_j) + \theta\Pi(\rho + \tau_j) \,, \tag{14}$$

$$G = \frac{1}{N}\Sigma_{i=1}^N TK(\rho + \tau_i) = TS(\rho) \,. \tag{15}$$

State (and federal) policy makers are assumed to be benevolent, in the sense that they look only to the welfare of their own constituents.

Consider then the problem that the policy maker of the typical state j faces. Making use of (4), (10), (14) and (15) in (7), welfare in state j is given by

$$W_j(\tau_j, \vec{\tau}) \equiv U\left[\rho(\vec{\tau}), \tau_j, t_j K(\rho(\vec{\tau}) + \tau_j) + \theta\Pi(\rho(\vec{\tau}) + \tau_j), TS(\rho(\vec{\tau}))\right] \,. \tag{16}$$

State government j then chooses its tax rate, taking all other state and federal tax rates as given, to maximise (16). The necessary condition for this, evaluated in symmetric equilibrium and making use of (8), (9) and (13), is that

$$\frac{\partial W_j}{\partial t_j} = \frac{1}{N}\theta K p' - (1-\theta)K + \Gamma_g\left(K + (tK' - \theta K)(1 + \frac{1}{N}p')\right) + \frac{1}{N}\Gamma_G TS'p' = 0 \,, \tag{17}$$

which implicitly defines the state tax as a function of the federal tax and the number of states in the federation.

In choosing T, the federal government, playing Nash relative to the states, maximizes

$$W(\tau, \vec{\tau}) \equiv U[\rho(\vec{\tau}), \tau, tK(\rho(\vec{\tau}) + \tau) + \theta\Pi(\rho(\vec{\tau}) + \tau), TS(\rho(\vec{\tau}))] \, . \qquad (18)$$

The necessary condition for this, evaluated in symmetric equilibrium and making use of (8), (9) and (13), is that

$$W_T(t, T) = \theta K p' - (1 - \theta)K + \Gamma_g(tK' - \theta K)(1 + p') + \Gamma_G TS'p' = 0 \, , \qquad (19)$$

which implicitly defines the federal tax as a function of the state tax.

2.2 Over or under taxation at the state level?

To bring out the potential inefficiencies in state taxation, write welfare in symmetric equilibrium as

$$W(t, T) \equiv U[p(\tau), \tau, tK(p(\tau) + \tau) + \theta\Pi(p(\tau) + \tau), TS(p(\tau))] \, , \qquad (20)$$

and differentiate with respect to the common state tax rate to find

$$W_t(t, T) = \theta K p' - (1 - \theta)K + \Gamma_g\Big(K + (tK' - \theta K)(1 + p')\Big) + \Gamma_G TS'p' \, . \qquad (21)$$

Using (17) to evaluate this in a symmetric equilibrium gives, after some rearrangement,

$$W_t(t^*, T^*) = \left[\Gamma_g t^* K' + \theta K(1 - \Gamma_g) + \frac{\Gamma_G}{N} T^* NS'\right]\left(1 - \frac{1}{N}\right)p' \, . \qquad (22)$$

The first two terms within the square brackets capture horizontal externalities from tax-induced movements of capital between the states, affecting revenues from both the state capital tax t and the state rent tax θ. The third term captures the vertical externality, acting through tax-induced changes in the federal tax base, S. The precise details need not concern us here; Keen and Kotsogiannis (2000) establish conditions under which either the horizontal externalities dominate (in the sense that $W_t(t^*, T^*) > 0$, so that the state tax is too low), or the vertical externality dominates (with $W_t(t^*, T^*) < 0$, the state tax being too high).[5]

The concern here is with the welfare effect of an increase in N.

3 The welfare effects of intensified tax competition

In exploring the effects of increasing N it is useful first to consider each externality in isolation. And here the key observation is that both become worse as N increases. For the horizontal externalities—isolated by temporarily removing the federal government—this is essentially the point made by Hoyt (1991), referred to above. (The result here is somewhat more general, however, in allowing for a state rent tax; the proof, which requires an additional and apparently mild condition—that each state's optimal response

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[5]Consistent with, and rationalizing, this usage, Appendices A and B show that $W_t > (<) \, 0$ in the special cases of this model in which only horizontal (vertical) externalities are present.

to an increase in the tax rate in all other states does not involve increasing its own tax rate by even more—is given in Appendix A. That the vertical externality—isolated by supposing there to be no inter-state mobility of the tax base—increases with the number of states is shown in Appendix B. This reflects the common pool aspect of the situation: as N increases, each state recognizes that a \$1 reduction in federal expenditures induced by an increase in its tax rate (through the consequent reduction in the federal tax base) is now shared amongst more states, with less harm consequently suffered by itself.

Consider then the effects of increasing N in the general case in which both externalities are at work. Denoting the equilibrium state and federal taxes by $t^*(N)$ and $T^*(N)$ respectively, the effect on equilibrium welfare $W(t^*(N), T^*(N))$ of an increase in N, treated as a continuous variable, is $W_t t^{*\prime}(N) + W_T T^{*\prime}(N)$. Since Nash behavior by the federal government implies that $W_T(t^*, T^*) = 0$, this reduces to $W_t t^{*\prime}$. Assume again that the equilibrium response of each state j to an increase in the tax charged by all other states is to increase its own tax by a lesser amount. With this and a standard stability-type condition, it is shown in Appendix C that $t^{*\prime}(N)$ has the opposite sign to $W_t(t^*, T^*)$. Thus:

PROPOSITION: *Suppose that federal and state governments play Nash, and that each state would increase its own tax rate less than one-for-one in response to a tax increase by all other states. Then an increase in the number of states strictly reduces welfare.*

That is, whichever externality dominates in the setting of the state tax, an increase in the number of states is sure to make matters worse. If the state tax rate tends to be too high because of a dominant vertical externality, an increase in the number of states will raise it still further; and if a dominant horizontal externality leaves the state tax rate too low, an increase in N will reduce it still further.

4   Summary and concluding remarks

Previous work on the fiscal architecture of federal systems has shown there is a fundamental ambiguity in the direction of inefficiency in tax-setting implied by the simultaneous operation of horizontal and vertical externalities. This paper, however, has established that this ambiguity does not extend to the question of whether this inefficiency is more or less important in federations with more lower-level jurisdictions: they are more important.

The model used here clearly has many special features, including, to give just one example, the assumption that all states are identical. The assumption that all policy makers act benevolently is especially critical.[6] It is striking, nevertheless, that the conventional wisdom that, when governments are benevolent, intensified inter-state competition worsens inefficiencies, based on models which ignore the vertical externalities that are a key feature of federal systems, tends to be confirmed. The underlying reason, however, is quite different from the conventional one: the reason that increasing the number of states

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[6]Keen and Kotsogiannis (2001), for example, show when governments are Leviathans an increase in the number of lower-level jurisdictions within a federal structure analogous to that considered here tends to increase welfare.

is harmful is not—as is conventionally supposed—that intensifying horizontal competition makes excessively low taxes even lower; rather it is that it will either do or it will make excessively high taxes even higher.

APPENDICES

Appendix A: Horizontal externalities in isolation

This appendix verifies the claim in the text that an increase in N reduces welfare when only the horizontal externalities are at work.

Suppose then that there is no federal government and (as for example in the benchmark model of Zodrow and Mieszkowski (1986)) that the aggregate capital stock is fixed (so that $S' = 0$). From (17), and noting that now $p' = -1$, the necessary condition for the typical state j, evaluated in symmetric equilibrium, can be written as

$$\frac{\partial W_j}{\partial t_j} = (\Gamma_g - 1)K\left(1 - \theta\left(1 - \frac{1}{N}\right)\right) + \Gamma_g t K'\left(1 - \frac{1}{N}\right) = 0 \equiv Z(t, N)\,, \qquad (A.1)$$

which implicitly defines the equilibrium state tax as a function of the number of states in the federation, $t^*(N)$. That the equilibrium state tax is below welfare-maximizing level follows on noting that in the present circumstances (21) reduces to $W_t(t, 0) = (\Gamma_g - 1)K$, with (A.1) implying that $\Gamma_g > 1$.

The conclusion that an increase in N further reduces welfare then follows on showing that $t^{*\prime}(N) < 0$. For this, note first that $t^{*\prime}(N) = -Z_N/Z_t$. Starting with the denominator, note—from (A.1)—that the effect on $\partial W_j/\partial t_j$ of an increase in the tax charged by all states is the sum of an own-effect from the increase in t_j and a cross-effect from the increase in the tax in all states other than j, so that

$$Z_t(t, N) = \frac{\partial^2 W_j(t_j, x, N)}{\partial t_j^2} + \frac{\partial^2 W_j(t_j, x, N)}{\partial x^2}\,, \qquad (A.2)$$

where x denotes the common tax charged by all states other than j, and evaluation is at $t_j = x = t^*, \forall j$. Now assume the second-order condition for the state's problem is satisfied, so that $\partial^2 W_j/\partial t_j^2 < 0$. It then follows from (A.2) that Z_t takes the opposite sign of $1 - dt_j/dx$, where $dt_j/dx = -(\partial^2 W_j/\partial x^2)/(\partial^2 W_j/\partial t_j^2)$. Under the condition stated in the text, Z_t is thus strictly negative.

For the numerator, note that

$$Z_N = \left(\frac{1}{N}\right)^2 \left[\Gamma_g t^* K' + \theta K(1 - \Gamma_g)\right] < 0\,, \qquad (A.3)$$

with the inequality following from the observation above that $\Gamma_g > 1$. Thus $t^{*\prime}(N) < 0$ follows. $\qquad\square$

Appendix B: The vertical externality in isolation

This appendix verifies the claim that an increase in N reduces welfare when only the vertical externality is at work.

Suppose that there are no capital flows between states, so that the net interest rate in j, $p(t_j)$, is determined by the market-clearing condition that $S(p_j) = K(p_j + t_j)$. The typical state j now seeks to maximize

$$W(\tau_j) = U\left(p(\tau_j), \tau_j, t_j K(p(\tau_j) + \tau_j) + \theta\Pi(p(\tau_j) + \tau_j), \frac{1}{N}\Sigma_i TS(p(\tau_i))\right), \qquad \text{(B.1)}$$

the necessary condition, evaluated in symmetric equilibrium, being

$$\frac{\partial W_j}{\partial t_j} = \theta K p' - (1-\theta)K + \Gamma_g\left(K + (tK' - \theta K)(1 + p')\right) + \frac{1}{N}\Gamma_G TS'p' = 0 \equiv D(t, T, N) .$$
$$\text{(B.2)}$$

Comparing this with the effect on welfare of an increase in all state tax rates, (21), one finds that $W_t = (1 - (1/N))\Gamma_G TS'p' < 0$, confirming that the common state tax rate is too low in equilibrium.

Thus it remains to show that in this case $t^{*\prime}(N) > 0$. For this, denote by $H(t)$ the best response function of the federal government, implicitly defined by (19), but with $S(p_j) = K(p_j)$, and by $h(T, N)$ the best response function of the state government implicitly defined by (B.2), but again with $S(p_j) = K(p_j)$.

Perturbing the equilibrium conditions $t^* = h(T^*, N)$ and $T^* = H(t^*)$ gives,

$$\begin{bmatrix} dt \\ dT \end{bmatrix} = \frac{h_N}{1 - H'h_T} \begin{bmatrix} 1 \\ H' \end{bmatrix} dN , \qquad \text{(B.3)}$$

and thus

$$t^{*\prime}(N) = h_N/(1 - H'h_T) . \qquad \text{(B.4)}$$

Assuming that $H'h_T < 1$ (a stability-type condition), $t^{*\prime}(N)$ then has the same sign as h_N.

Note now that $h_N = -D_N/D_t$. Assuming that $D_t < 0$ (a condition related to, but not quite identical with, the second order condition for the typical state's problem) h_N takes the sign of

$$D_N = -\left(\frac{1}{N}\right)^2 \Gamma_G T^* S'p' > 0 . \qquad \text{(B.5)}$$

That $t^{*\prime}(N) > 0$ then follows. $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\square$

Appendix C: Proof of the main Proposition

The claim is that $t^{*\prime}(N)$ has the opposite sign to W_t. To see this, denote by $R(t)$ the best response function of the federal government and by $r(T, N)$ the best response function of the state government, implicitly defined by (17) and (19) respectively. Perturbing the equilibrium conditions $t^* = r(T^*, N)$ and $T^* = R(t^*)$, gives

$$t^{*\prime}(N) = r_N/(1 - R'r_T) . \qquad \text{(C.1)}$$

Assuming that the best response functions are stable, in the sense $R'r_T < 1$, $t^{*\prime}(N)$ then takes the same sign as $r_N = -E_N/E_t$, where $E(t, T, N)$ is the implicit representation of (17). E_t can be decomposed into the two effects identified in Appendix A, and so is strictly negative if the condition stated in the Proposition holds.

For the numerator,

$$E_N = -\left(\frac{1}{N}\right)^2 p'\left[\Gamma_g t^* K' + \theta K(1 - \Gamma_g) + \Gamma_G T^* S'\right], \tag{C.2}$$

$$= -\left(\frac{1}{N(N-1)}\right) W_t, \tag{C.3}$$

the second equality making use of (22). Thus r_N has the opposite sign to W_t, and the result follows. $\qquad\square$

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