

Do vertical tax externalities lead to tax rates being too high? A note

Thierry Madiès

Received: 15 June 2006 / Accepted: 19 June 2007 / Published online: 11 July 2007
© Springer-Verlag 2007

Abstract When both vertical and horizontal externalities are at work in a federation, they generally distort levels of taxation in opposite directions. This article is an extension of the Keen and Kotsogiannis (Am Econ Rev March: 363–370, 2002) model. It focuses on state tax policy when states provide an industrial public good increasing firms' marginal productivity rather than a residential public good intended to households. We find that some results related to whether equilibrium state taxes are likely to be too high or too low are much more complex when state-provided industrial public goods are considered. First, we show that in the presence of industrial public goods, a dominant vertical externality may result in state tax rates being too low (and not too high as it is the case with residential public goods). Second, we find that under certain conditions, horizontal and vertical externalities may point in the same direction and reinforce each other towards tax rates being too high or too low.

JEL Classification H21 · H42 · H79 · R50

1 Introduction

The extensive literature devoted to public finance has focused on fiscal interdependence caused by tax mobility among similar types of local jurisdictions, generating what is now called “tax competition literature” [see Wilson's (1999) survey]. However, the essence of federalism is multileveled government. It is thus surprising to find that

T. Madiès (✉)
Department of Political Economics, University of Fribourg,
Boulevard de Pérolles 90, 1700 Fribourg, Switzerland
e-mail: thierry.madies@unifr.ch

T. Madiès
Centre National de la Recherche Scientifique (CREM-CNRS), Rennes, France

until recently, almost all the theoretical literature on fiscal federalism has ignored the possibility of vertical externality arising from the existence of a federal government that acts as a player (in the sense that it exercises some discretion over tax rates) and not only as a mechanical device aimed at internalising fiscal inefficiencies at the local level. In the following, we will focus on a particular vertical externality that arises from interactions between overlapping governments that share the same tax base (see the seminal paper by [Flowers 1988](#)). Tax base sharing (“concurrent taxation”) is a common feature of fiscal arrangements in both federal and unitary countries ([Keen 1998](#)). For example in Canada, 70% of provincial governments’ tax revenues come from overlapping taxes. In the United States, overlapping taxes account for nearly 44% of state-level government tax resources. In France, the main tax revenue source for local jurisdictions comes from overlapping direct taxes, which account for nearly 80% of local tax revenues.

In order to show the consequences of concurrent taxation, theoretical analysis assumes that each layer of government acts either as a Leviathan (see papers by [Flowers 1988](#); [Keen 1995](#); [Wrede 1996](#); [Flochel and Madiès 2002](#); [Madiès and Ventelou 2005](#)) or as benevolent ([Keen 1998](#); [Keen and Kotsogiannis 2002](#)). As pointed out by [Keen and Kotsogiannis \(2002, p. 363\)](#), when both vertical and horizontal externalities are at work in a federation, “they are likely to distort levels of taxation in opposite directions.” On the one hand, inter-jurisdictional tax competition (that some observers also call horizontal tax competition) leads to lower tax rates since each local government ignores that it harms others when it cuts its tax rate in order to attract a mobile base (which is generally “industrial capital”). On the other hand, co-occupation of a common tax base results in taxes being too high: When a policy-maker raises its tax rate unilaterally, it ignores the loss that the other level of government will endure owing to the induced contraction of the common tax base. More precisely, [Keen and Kotsogiannis \(2002\)](#) show that the relative strengths of vertical and horizontal externalities is based on the balance between the interest responsiveness of the aggregated supply of savings (which determines the vertical externality), state demand for capital (which shapes the horizontal externality), the extent to which immobile factors are taxed by the states, and the strength of preferences between federal and state-public provided goods.

However, as we will show, the common wisdom according to which horizontal and vertical externalities point in opposite directions strongly depends on the [Keen and Kotsogiannis’s](#) assumption that states provide public goods that only benefit citizens. In opposition to them (and more generally to the literature on tax competition—[Noiset 1995](#); [Upmann-Bayindir 1999](#); [Matsumoto 1998](#), are exceptions), we assume that states supply an industrial public good that increases the productivity of firms located in their jurisdiction, whereas the federal government provides the representative household of each state with a residential public good. It is far from being only a theoretical question since provision of industrial public services account for a large part of expenditures of lower levels of governments ([Pola 1990](#); [Oakland and Testa 1995](#)). Furthermore, the empirical literature (see [Fisher 1997](#), for a survey) underlines that government spending (especially education) may have a positive effect on business activity. Finally, in a recent and stimulating paper, [Bell and Gabe \(2004\)](#) show that a policy featuring additional spending and higher taxes may lead to more business

investment than a local fiscal policy of reduced government spending to balanced a tax cut.

The purpose of this article is to analyse the way vertical and horizontal externalities interact when states provide industrial public goods. Assuming that states provide an industrial public good (rather than a residential public good) leads to a trade-off between the two following effects (Noiset 1995; Upmann-Bayindir 1999). On the one hand, a higher tax rate in one state leads to an outflow of capital towards other states. On the other hand, a higher tax rate may induce larger supply of the industrial public good and hence a capital influx which harms the other states. If the latter effect dominates the former, an increase in the tax rate in one state leads to a reduction of capital in other states. As a result, states competing for capital may have an incentive to over provide the industrial public good.

It is important to note that when industrial public goods are provided, the sign of the horizontal externality may have strong implications on the way the vertical externality influences the outcome. However, no article has addressed this issue since papers accounting for industrial public goods in tax competition models (see papers quoted above) ignore vertical externalities. We find that some results, as to the question of whether equilibrium states tax rates are likely to be too high or too low, turn out to be different from the case in which residential public goods are provided by states. Two interesting results emerge from our analysis. First, we show that in the presence of industrial public goods, a dominant vertical externality may result in state tax rates being too low (and not too high as it is the case with residential public goods). Second, we find that under certain conditions, horizontal and vertical externalities may point in the same direction and re-enforce each other towards tax rates being too high or too low.

The plan of this paper is as follows. Section 2 presents the basic model. Section 3 discusses the main results. Section 4 concludes.

2 The model

The basic structure of the model is based on the Keen and Kotsogiannis model. The federation we consider consists of two levels of government, a federal level and a state one, where each level of government has independent taxing and spending authority. We assume that the $N \geq 1$ states are identical in all relevant aspects. In each state i ($i \in \{1, \dots, N\}$), the federal government provides a public good G that benefits citizens only, whereas the government of the state provides a public good g^i that benefits the firms that are located within its jurisdiction only. Each state i sets a source-based tax t^i on each unit of capital located in its jurisdiction and the federal government levies a unit tax T on capital, identical in all states. We denote $\tau^i \equiv t^i + T$ as the combined tax rate on capital in state i . Since all other private inputs are assumed to be fixed in production, output in state i can be written as a function of capital located in i , K^i , and the industrial public good, $g^i : Y^i = F(K^i, g^i) \forall i = 1, \dots, N$.¹ The production function is assumed to be monotonously increasing in both variables with

¹ K^i is replaced by K when we confine attention to symmetric equilibria.

decreasing marginal products of capital, $F_{KK} = \frac{\partial^2 F}{\partial^2 K} < 0$. In addition, the marginal product of capital is higher, the more industrial public good is provided by the state government, $F_{Kg} = \frac{\partial^2 F}{\partial K \partial g} > 0$. Capital is freely mobile across the states so that the equilibrium after-tax return on capital, p , must be equal in all states. The arbitrage condition writes

$$F_K(K^i, g^i) - \tau^i = p \tag{1}$$

Equation system (1) implicitly defines each state's capital demand $K^i = K^i(p + \tau^i, g^i)$ with $K_1^i = \frac{\partial K^i}{\partial (p + \tau^i)} = \frac{1}{F_{KK}} < 0$ and $K_2^i = \frac{\partial K^i}{\partial g^i} = -\frac{F_{Kg}}{F_{KK}} > 0$, where K_j^i denotes the partial derivative of capital demand in state i with respect to the j th variable ($j = 1, 2$). Rents arising in state i , $\Pi^i = F(K^i, g^i) - F_K(K^i, g^i)K^i$, are assumed to be taxed by state i at the exogenous rate $\theta \in [0, 1]$, and to remain untaxed by the federal government.

Denoting the N -vector of consolidated tax rates by $\tau \equiv (\tau^1, \dots, \tau^N)$, the net return $p(\tau)$ on capital is implicitly defined by the capital-market clearing condition

$$NS(p) = \sum_{i=1}^N K^i(p + \tau^i, g^i) \tag{2}$$

We assume that there is a unique (immobile) resident in each state. Preferences are identical across states and write $U^i = U(C_1, C_2, G) = u(C_1) + C_2 + \Gamma(G) \forall i = 1, \dots, N$. The utility function above is defined over first- and second-period private consumption, C_1, C_2 [subscripts refer to the time period $t (t = 1, 2)$] and the federal spending per state, G . Both u and Γ are functions that are strictly increasing and concave. Each consumer has a fixed endowment e of first-period income, and receives principal and capital income (interest) on his savings in the second, S (with $S = e - C_1$), plus rents earned in his jurisdiction $\Pi(p + \tau, g)$. Savings are $S(p)$, with $S'(p) \geq 0$ and indirect utility is

$$U(p, \tau, g, G) \equiv u(e - S(p)) + (1 + p)S(p) + (1 - \theta) \Pi(p + \tau, g) + \Gamma(G) \tag{3}$$

Assuming that there are no intergovernmental transfers, state and federal budget constraints (per capita) write

$$G = \frac{1}{N} \sum_{i=1}^N T \cdot K^i(p + \tau^i, g^i) = T \cdot S(p) \tag{4}$$

$$g^i = t^i \cdot K^i(p + \tau^i, g^i) + \theta \Pi(p + \tau^i, g^i) \tag{5}$$

3 Results

Policy makers at both federal and state level are supposed to behave as Nash players and to be perfectly benevolent in the sense that they set their tax rate (taking the other

tax rates as given) in order to maximise the welfare of their residents. Furthermore, it is assumed that each policy maker takes full account of the revenue constraints (4) and (5) of all other governments. We take two kinds of externalities for granted in the federation. On the one hand, there is a horizontal tax externality resulting from capital mobility among states (with industrial public goods, this externality does not necessarily lead to state tax rates being too low). On the other hand, co-occupation of the same tax base leads to a “bottom-up” vertical externality: Since federal revenues are equally shared over all states, each state policy maker, when increasing unilaterally its tax rate, only takes into account the impact his decision has on federal revenues (and consequently on federal expenditure) in his jurisdiction.² With no top down externality, we focus on equilibrium state tax rates.

Let us write the welfare of the representative resident in state i as

$$W^i(\tau, \tau^i) \equiv u \left[p(\tau), \tau^i, TS(p(\tau)), t^i K(p(\tau) + \tau^i), g^i(\tau) + \theta \Pi(p(\tau) + \tau^i), g^i(\tau)) \right] \quad (6)$$

$i = 1, \dots, N$

Evaluated at symmetric equilibrium, the first-order condition for a given state i is

$$\frac{\partial W^i}{\partial t^i} = \theta K p' - (1 - \theta K) + F_g \left[\frac{K + (t^* K_1 - \theta K)(N + 1)p'}{1 - t^* K_2 - \theta F_g} \right] + \Gamma_G T^* S' p' = 0 \quad (7)$$

Departing from a symmetric equilibrium, we now investigate the effects of a co-ordinated increase in all state taxes

$$W_t(t^*, T^*) \equiv \frac{\partial W}{\partial t} = \theta N K p' - (1 - \theta K) + F_g \left[\frac{K + (t^* K_1 - \theta K)(1 + N p')}{1 - t^* K_2 - \theta F_g} \right] + \Gamma_G N T^* S' p' \quad (8)$$

At this stage, it is useful to contemplate the cases where rents are fully taxed and untaxed. In the case where rents are untaxed ($\theta = 0$), Eq. (8) turns out to be

$$W_t = \left[\frac{F_g t^* K_1}{1 - t^* K_2} + \Gamma_G T S' \right] (N - 1) p' \quad \text{where } p' = \frac{1}{N} \frac{K_1 + K K_2}{S'(1 - t^* K_2) - K_1} \quad (9)$$

The sign of W_t allows us to check whether equilibrium state tax rates are too low ($W_t > 0$) or conversely too high ($W_t < 0$). The first term into bracket in Eq. (9) captures the horizontal tax externality caused by the effects of tax-induced capital

² As pointed out by Keen and Kotsogiannis (2002), there is no “top down” vertical externality in this model since it is assumed that the federal policy-maker sees through the states’ budget constraints and consequently internalises the effects of its decisions. Obviously, assuming that the federal government neglects the impact of its own tax rate on the revenue, and hence expenditures of states, would result in reintroducing a “top down externality”.

movements on the private consumption through its effects on rents.³ The second effect stands for the vertical externality arising from tax-base overlap. In the presence of industrial public goods provided by the states, the vertical externality does not necessarily leave state taxes too high. An increase in the state tax rate can result in either reducing or increasing the federal supply of public good to states.

The sign of Eq. (9) and then the direction of inefficiency in the equilibrium tax rates depend on the sign of p' together with the two terms into square brackets and, in the end, on the sign of $1 - t^*K_2$ and $K_1 + K K_2$. The sign of these terms is ambiguous since it depends on the derivatives of the production function.⁴ The first term is smaller than and can be seen as a measure of the “fiscal feed-back effect” resulting from the effect of a higher provision of the industrial public good on the capital tax base and hence on capital tax income. This effect results in a reduction of the provision cost of the industrial good. The second term is a measure of the responsiveness of capital demand to a change in the cost of capital and in the industrial public good provision. In order to simplify the ongoing discussion and to state our results more formally, let us lay down the following conditions as a benchmark case:

Condition 1 *Evaluated in some suitable neighbourhood of an equilibrium, the derivative of the production function F suffices to ensure that $1 - t^*K_2 > 0$.*

Condition 2 *Evaluated in some suitable neighbourhood of an equilibrium, the derivative of the production function F suffices to ensure that $K_1 + K K_2 > 0$.*

If both conditions 1 and 2 hold, then p' is unambiguously positive. On the one hand, the elasticity of capital demand with respect to the provision level of the industrial public good is high enough to dominate the capital cost effect so that an increase in any state tax rate leads to a capital influx that obviously harms the tax base of the other states. This effect points to tax rates being too high (or equivalently to an over-provision of the industrial public good) as underlined by Noiset (1995) and Bayindir-Upmann (1999). On the other hand, each state ignores the benefit that it confers on others by raising its tax rate and thereby increasing the federal tax base and hence the level of federal-provided public good throughout the federation.⁵ This effect points to tax rates being too low. The vertical externality dominates and state tax rates are too low if the after-tax return on capital responsiveness of savings is high enough (in absolute value) compared with the one of capital demand. Formally, this writes $|S'(1 - t^*K_2)/K_1| > F_g g / \Gamma_G G$.

We can state the following proposition:

Proposition 1 *Assuming that conditions 1 and 2 hold and that rents are not taxed, then horizontal tax competition results in tax rates being too high whereas tax base overlap leads to tax rates being too low.*

³ In Keen and Kotsogiannis (2002), the horizontal externality arises from the effect of tax-induced capital movement on states' capital revenue.

⁴ As shown by Bayindir Upmann (1999) who derive similar conditions in a “horizontal tax competition” model.

⁵ The explanation is straightforward: since federal revenues are shared equally over all states, each state policy maker considers that an increase of \$1 in federal revenue induced by a rise in the tax rate they set will only increase the provision of the federal government-provided good by $\$1/N$.

It is clear from proposition 1 that allowing states to provide industrial public goods rather than residential ones has strong implication in terms of tax policy at the state level. As a matter of fact, when residential public goods are provided, a dominant vertical externality always results in state taxes being too high. Conversely, we show that if the vertical externality outweighs the horizontal tax externality, then state taxes may tend to be too low.⁶

Interesting as well is the case where condition 1 does not hold since the following result can only arise when industrial public goods are provided at the state level. In this case, both horizontal and vertical externalities point in the same direction.

Proposition 2 *If condition 1 does not hold and rents remain not taxed, horizontal tax competition and tax base overlap reinforce each other towards equilibrium state tax rates being too low or too high.*

Conditions under which equilibrium state tax rates are too low or too high also crucially depend on the sign of p' , and then on whether condition 2 is fulfilled. As a result, one can easily verify that equilibrium tax rates are too low if $|S'(1 - t^*K_2)/K_1| > (<)1$ when condition 2 hold (does not).

Finally, let us suppose that rents are fully taxed ($\theta = 1$), then Eq. (9) rewrites as

$$W_t = \left(\frac{F_g t K_1}{1 - t^* K_2 - F_g} \right) (1 - N) \quad (10)$$

We can state the following proposition:

Proposition 3 *(a) Assuming that rents are fully taxed, the horizontal externality always dominates. (b) State taxes are too low (too high) if $1 - t^* K_2 - F_g > 0 (< 0)$.*

Proposition 3 shows that in the presence of tax-base overlap with a federal government, whether the standard result from horizontal tax competition literature still holds depends on the magnitude “fiscal feed-back effect”. That is, equilibrium tax rates are too low, if and only if this “fiscal feed-back effect” is not too large in the sense defined above. In this case, one can recognize Keen and Kotsogiannis key result with residential public goods.

4 Concluding remarks

Until now, we have supposed that the states only were taxing rents. It is interesting to investigate what would happen if the federal government fully taxed rents as well. As in the case of residential public goods, this assumption would not change our results qualitatively. The vertical externality would not necessarily dominate but it would introduce a trade-off between the horizontal externality and the vertical one, as in Proposition 1. Furthermore, the results obtained in this paper focused on the

⁶ One can easily verify that assuming that condition 2 does not hold (i.e. that the responsiveness of capital demand to a change in the industrial public good provision is too low) would reconcile our results with those of Keen and Kotsogiannis (2002).

state tax rates equilibrium only and did not require particular assumptions on the federal government behaviour. If the federal government acts as a Nash player, then it will set its tax rate optimally (given the equilibrium state tax) so that $W_T = 0$. However, the situation gets more complicated when the federal government acts as a Stackelberg leader. Keen and Kotsogiannis (2002) (see proposition 3) show that in general, whether the federal government sets its tax rate too high or too low depends on both (i) whether horizontal or vertical externality dominates in the tax setting of state taxes rate and (ii) whether federal taxes are strategic substitutes or complements. Consequently there is a very large range of possibilities and one cannot conclude unambiguously on whether the aggregated (federal plus state) tax rate is too low or too high. For instance, in the case in which states provide industrial public goods and fully tax rents, strategic substitutability will result in both federal and states taxes being too low (at least if the feedback effect coming from the industrial public good is not too large). Empirical papers focusing on the slope of the reaction function of overlapping government confirm the ambiguity of the theoretical predictions (see for instance Besley and Rosen 1998; Goodspeed 2000; Boadway and Hayashi 2001; Brett and Pinsky 2000; Esteller-Moré and Solé-Ollé 2001; Leprince et al. 2007).

Acknowledgments I am grateful to Jean-François Emmenegger, Timoty Goodspeed, Michela Redoano, Alberto Solé-Ollé, David Wildasin and Reiner Wolff for comments and advice on earlier versions of this paper.

References

- Bell P, Gabe T (2004) Tradeoffs between local taxes and government spending as determinants of business location. *J Reg Sci* 44:21–41
- Besley T, Rosen H (1998) Vertical externalities in tax setting: evidence from gasoline and cigarettes. *J Public Econ* 70:383–398
- Boadway R, Hayashi M (2001) An empirical analysis of intergovernmental tax interaction: the case of business income taxes in Canada. *Can J Econ* 34:481–503
- Brett C, Pinsky J (2000) The determinants of municipal tax rates in British Columbia. *Can J Econ* 33: 695–714
- Esteller-Moré A, Solé-Ollé A (2001) Vertical income tax externalities and fiscal interdependence: evidence from the US. *Reg Sci Urban Econ* 31:247–272
- Fisher R (1997) The effects of state and local public services on economic development. *N Engl Econ Rev* 53–67
- Flochel L, Madiès T (2002) Interjurisdictional tax competition in a model of overlapping Revenue-maximizing Governments. *Int Tax Public Finance* 9:121–141
- Flowers MR (1988) Shared tax sources in Leviathan model of federalism. *Public Finance Q* 16:67–77
- Goodspeed TJ (2000) Tax structure in federation. *J Public Econ* 75:493–506
- Keen M (1995) Pursuing Leviathan: fiscal federalism and international tax competition. Mimeo, University of Essex
- Keen M, Kotsogiannis C (2002) Does federalism lead to excessively high taxes? *Am Econ Rev*, March: 363–370
- Keen M (1998) Vertical tax externalities in the theory of fiscal federalism. *Int Monet Fund Staff Pap* 45:454–485
- Leprince M, Madiès T, Paty S (2007) Business tax interactions among levels of local governments: an empirical analysis of the French case. *J Reg Sci* (in press)
- Madiès T, Ventelou B (2005) Tax base sharing in an endogenous-growth model with heterogeneous public spending. *Pap Reg Sci* 84:1–24
- Matsumoto M (1998) A Note on tax competition and public input provision. *Reg Sci Urban Econ* 28: 465–473

- Noiset L (1995) Pigout, tiebout, property taxation, and the under provision of local public goods: comments. *J Urban Econ* 38:312–316
- Oakland WH, Testa WA (1995) State and local government taxation of business. *NTA Forum* 23
- Pola G (1990) Local Business taxation: an international overview Vita e Pensiero, Milan, Italy
- Upmann-Bayindir TB (1999) Two games of interjurisdictional competition when local governments provide industrial public goods. *Int Tax Public Finance* 5:471–487
- Wilson J (1999) Theories of tax competition. *Nat Tax J* 52:269–304
- Wrede M (1996) Vertical and horizontal tax competition: will uncoordinated Leviathans en up on the wrong side of the Laffer curve? *Finanzarchiv* 3:461–479