On the states' behavior with equalization grants

Diego Martínez-López*
Centro de Estudios Andaluces and University Pablo de Olavide

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Abstract

This paper discusses how the state government's behavior is affected when the so called Representative Tax System equalization scheme is implemented. In particular, we study the changes in the marginal cost of the public funds, and in the first order conditions for the optimal provision of a public input. A reduction in the MCPF is to be expected when lump-sum grants are replaced by RTS equalization transfers. However, this result has to be qualified under certain assumptions. Also we find that there does not exist a clear relationship between the degree of fiscal equalization and the marginal cost of providing the public input and the tax setting.

Keywords: Fiscal federalism, MCPF, vertical transfers.

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1 Introduction

Equalization grants are commonly employed in federal countries. The aim guiding the design of these vertical transfers is principally to provide the subnational governments enough resources to deliver a determined level of public spending, regardless their tax capacity. Formulae implemented for that have been diverse, but a common underlying structure can be found (Zabalza, 2003). One of the most frequently used equalization schemes is the so-called representative tax system (RTS)[1], that attempts to equalize the differences in state tax bases taking as reference standard values for tax rate and tax base.

However, equalization systems such a RTS have a caveat: they can affect negatively efficiency of equilibria as long as tax policy may be modified by states in order to influence on the size of the grant. There are two channels through which subnational governments can alter the resources they receive from the equalization system. First one -equalization rate effect- arises when one or more states have enough market power to translate the variations in their own tax rates to the standard value used as benchmark in the equalization. The sense and the magnitude of this effect obsviously depend on the size of the state in relation to the remaining jurisdictions, and on the relative tax fiscal capacity of the subnational government.

The second negative implication from RTS is a federal version of the moral hazard problem: equalization base effect. Indeed, state governments can reduce their tax base by increasing tax rates and, consequently, to rise the grant they receive. This situation leads to an overprovision of public goods because subnational governments perceive a lower marginal cost of the public funds relative to a lump-sum grant system in which the size of the transfer is unaffected by state tax decisions.

Several papers have dealt with perverse effects of equalization system. The first papers by Courchene and Beavis (1973) and Bird and Slack (1990) focussed on the risk of manipulating the equalization formula by the subnational governments. Smart (1998) achieves the conclusion that RTS equalization grants tend to increase the tax rates set by state governments. Kothenburger (2002) uses precisely this fact to show the ability of equalization transfers for correcting tax competition. Similarly, Bucovetsky and Smart

[1] Countries such as Canada, Australia or Denmark employ this framework as a basis for their intergovermental relations.

(2002) find that equalization leads to an excessive taxation when tax bases are elastic, although it is able to correct tax competition and fiscal externalities. Lago (2002) distinguishes between public consumption and public investment, and concludes that tax rates are higher with RTS equalization grants under a Leviathan model.

From an empirical approach, Boessenkol (2002) provides an analysis for Canada which is consistent with many of the above theoretical predictions. Esteller and Sole (2002) estimate the impact of RTS grants on Canadian provinces income tax setting and finds that tax rates are positively affected at least in receiving jurisdictions. Baretti et al. (2002) illustrate for German states the dilemma between efficiency and equity coming from the implementation of a tax revenues equalization system. Dahlby and Warren (2003) obtain econometric results suggesting that the equalization system may have affected the Australian states' choice of tax rates.

This paper aims to translate some results from the above theoretical literature to the case of public input provision. In particular, we extend the standard findings by Smart (1998) to productive public spending, modifying part of them. Also we discuss the effect of the degree of equalization on the marginal cost of providing the public input and on the tax setting. We build a theoretical model based on Boadway and Keen (1996), where per unit taxes on labor are levied by state governments. A productive public good is also considered in line with Dahlby and Wilson (2003). Equalization is implemented through RTS-based grants.

Among the main results, we firstly find that although is to be expected that the MCPF lowers when RTS grants are used, this result must be qualified under certain assumptions. As a result of this, an infraprovision of the public good may be achieved with RTS transfers respect to lump-sum, unconditional grants. A second point is that under a RTS framework there does not exist an unambiguous relationship between the degree of fiscal equalization and the cost of public funds and the marginal cost of providing the public input.

The structure of the paper is as follows. Section 2 presents the theoretical model and the differences in terms of tax rates between lump-sum and equalization frameworks. Section 3 discusses how the degree of equalization affects optimality rules in the provision of public inputs and tax setting. Finally, section 4 concludes.

2 The model. Second-best allocations with equalization grants

Let a federal country consisting of k states indexed by i, $i = 1, 2, ..., k$. Each state is populated by n^i identical households that are assumed to be completely inmobile. The share of total population living in region i is $\gamma^i = \frac{n^i}{N}$, where $N = \sum_{i=i}^{k} n^i$. Preferences are represented by a common well-behaved utility function:

$$u\left(x^i, l_i\right), \tag{1}$$

where x^i is a private good used as numeraire and l_i is labor supplied[2]. Properties of function $u\left(x^i, l_i\right)$ are the standard ones. Representative household faces the following budget constraint:

$$x^i = \left(\omega^i - t^i\right) l_i, \tag{2}$$

where ω^i is the wage rate and t^i the per unit tax on labor. Household's optimization problem consists of maximizing (1) subject to (2) to yield labor supply $l_i\left(\omega^i - t^i\right)$ and indirect utility function $V\left(\omega^i - t^i\right)$. It is assumed that $l_i^{'} > 0$ and $l_i^{''} < 0$[3]. Output in the state is produced using labor services and a public input g^i according to the following aggregate production function (identical across jurisdictions):

$$F\left(L_i, g^i\right), \tag{3}$$

where $L_i = n^i l_i$. This function satisfies the usual assumptions: increasing in its arguments and strictly quasiconcave. Output can be used costlessly as x or g. Labor market is perfectly competitive so we can write:

$$\omega^i = F_{L_i}\left[n^i l_i\left(\omega^i - t^i\right), g^i\right] \tag{4}$$

Hence wage rate function is given by $\omega^i\left(g^i, t^i, n^i\right)$. In such a way, some results of comparative statics are now obtained to be used later:

$$\omega_g^i = \frac{F_{L_i g^i}}{1 - F_{L_i L_i} n^i l_i^{'}} > 0 \tag{5}$$

[2]In order to make easier the notation, state is denoted by a subindex when labor is involved.

[3]Henceforth, differentiation is denoted by primes for functions of a single variable, while a subscript is used for partial derivatives.

$$\omega_t^i = \frac{-F_{L_iL_i} n^i l_i'}{1 - F_{L_iL_i} n^i l_i'} > 0 \tag{6}$$

The economic profit generated in each state is equal to:

$$\pi^i\left(g^i, t^i, n^i\right) = F\left[n^i l_i\left(\omega^i\left(g^i, t^i, n^i\right) - t^i\right), g^i\right] - n^i \omega^i l_i\left[\omega^i\left(g^i, t^i, n^i\right) - t^i\right] \tag{7}$$

Again, it is useful to obtain some results for later use:

$$\pi_{g^i}^i = F_{g^i} - \left(F_{L^iL^i} n^i l_i' \omega_{g^i}^i + F_{L_i g^i}\right) n^i l_i \lesseqgtr 0 \tag{8}$$

$$\pi_{t^i}^i = \left(1 - \omega_t^i\right) F_{L_iL_i}\left(n^i\right)^2 l_i l_i' < 0 \tag{9}$$

Note that the effect of the public input on rents is ambiguous because g^i increases output (and hence, economic profit) but the productive public expenditure also exerts a positive impact upon wage rate, reducing rents.

We consider two different scenarios for state governments: lump-sum grants and equalization transfers. Regional governments behave as Nash competitors with respect to other regions and levels of government. Given the heterogeneity in sizes of state population and no mobility of households across the federation, an asymmetric equilibrium will be attained. First scenario we take into consideration is characterised by a lump-sum grant from the federal government to the states. Each region sets its own tax rates on labor t^i and the value of g^i to maximize the representative household's utility subject to the state budget constraint[4]. Formally,

$$\begin{aligned} & Max \quad V\left(\omega^i - t^i\right) \\ s.t. \quad : \quad & g^i = n^i t^i l_i\left(\omega^i\left(g^i, t^i, n^i\right) - t^i\right) + \pi^i\left(g^i, t^i, n^i\right) + n^i \overline{e^i}, \end{aligned} \tag{10}$$

where $\overline{e^i}$ is the per capita lump-sum received by the state. Note that all economic profits are taxed away by government because they are efficient

[4] Wildasin (1986) demonstrates that it is relevant to distinguish between to maximize the per capita utility or the total utility.

resources for the public sector[5,6]. First order conditions for g^i and t^i are as follows:

$$V^{'}\omega^i_{g^i} - \mu^i + \mu^i n^i t^i l^{'}_i \omega^i_{g^i} + \mu^i \pi^i_{g^i} = 0 \quad (11)$$

$$\left(\omega^i_{t^i} - 1\right) V^{'} + \mu^i n^i l_i + \mu^i \left(\omega^i_{t^i} - 1\right) n^i t^i l^{'}_i + \mu^i \pi^i_{t^i} = 0, \quad (12)$$

where μ^i is the Lagrange's multiplier. After some manipulation with equations (11) and (12), using Roy's identity, and (6) and (9), the second best condition for the optimal provision of g^i is obtained:

$$\frac{n^i V^{'} \omega^i_{g^i}}{\lambda^i} = \frac{1}{1 - \frac{t^i l^{'}_i}{l_i}} \left(1 - n^i t^i l^{'}_i \omega^i_{g^i} - \pi^i_{g^i}\right), \quad (13)$$

where λ^i is the private marginal utility of income. LHS of equation (13) shows the sum of marginal benefits received by all households living in the state i from one additional unit of g^i. RHS of equation (13) is the marginal cost of providing the public input (MCP). In this regard, it may be worth noting that two terms can be distinguished here. The first one is the marginal cost of the public funds (MCPF); the second one is the marginal production cost net of tax revenue effect that arises so long as g^i may affect positively or negatively the tax base (MCPT). Whereas in the case of a consumption public good the MCPF and the MPC are equal, a distinction is required when a public input is considered.

If Roy's identity is used again in the LHS of expression (13), and expressions (5) and (8) are inserted in (13), manipulation gives:

$$F_{g^i} = 1, \quad (14)$$

that is, the production efficiency condition for the provision of public inputs (Diamond and Mirrlees, 1971). It means that the production effects of the public input are equal to its marginal production cost, though distortionary (but optimally set) taxation is used. At this point, this model does not

[5] We establish here that the country is under-populated in order to avoid that a tax on rents may suffice to finance the first-best level of public good (Wildasin, 1986).

[6] Sharing tax on pure economic profits between different levels of government would substantially complicate our analysis because not only vertical tax externalities would have to be considered but also expenditures ones as well (Dahlby and Wilson, 2003). In this context, many of the effects of vertical externalities would overlap with those corresponding to equalization.

deviate from the results obtained by Feehan and Matsumoto (2002), and Dahlby and Wilson (2003).

The introduction of a RTS equalization grant may distort the state governments' behavior. Consider now that a new vertical transfer is implemented in favor of the regional governments. Unlike the above lump-sum grant, the new per capita transfer is defined to equalize states' tax capacities, so its design is according to the following expression:

$$e^i = \alpha \bar{t} \left(\bar{l} - l_i \right), \text{ with} \tag{15}$$

$$\bar{t} = \frac{\sum_{i=1}^{k} \gamma^i t^i l_i}{\sum_{i=1}^{k} \gamma^i l_i} \text{ and } \bar{l} = \sum_{i=1}^{k} \gamma^i l_i, \tag{16}$$

where $\alpha \in (0, 1]$ is the policy parameter determining the extent in which the equalization system responds to deviations of region i's tax base from the standard tax base, $\bar{t}$ is the standard tax rate and $\bar{l}$ is the standard tax base. This form for the equalization grant is usual in the literature and it is straightforward to show that it is budget-balancing. Each state government is assumed to be small enough to not affect the value of $\bar{t}$ and $\bar{l}$.

Substituting the new expression for e^i into the state budget constraint and solving the government problem for g^i and t^i, the next first order conditions are obtained:

$$V' \omega^i_{g^i} - \eta^i + \eta^i n^i \left(t^i - \alpha \bar{t} \right) l'_i \omega^i_{g^i} + \eta^i \pi^i_{g^i} = 0 \tag{17}$$

$$\left(\omega^i_{t^i} - 1 \right) V' + \eta^i n^i l_i + \eta^i \left(\omega^i_{t^i} - 1 \right) n^i \left(t^i - \alpha \bar{t} \right) l'_i + \eta^i \pi^i_{t^i} = 0, \tag{18}$$

where η^i is the Lagrange multiplier. Manipulation gives the condition for the optimal provision of g^i:

$$\frac{n^i V' \omega^i_{g^i}}{\lambda^i} = \frac{1}{1 - \frac{\left(t^i - \alpha \bar{t} \right) l'_i}{l_i}} \left[1 - n^i \left(t^i - \alpha \bar{t} \right) l'_i \omega^i_{g^i} - \pi^i_{g^i} \right] \tag{19}$$

In essence, the economic interpretation of this expression is the same than before. Some new results on the behavior of the state government can be achieved under the RTS equalization system.

Proposition 1 *Let t_0^i and t_1^i be the tax rates solving government i's problem with a lump-sum grant and with a RTS equalization grant, respectively. If the tax base $l_i\left(w^i - t^i\right)$ is non-increasing in t^i, then $t_1^i \geq t_0^i$ (Smart, 1998).*

Proof. See the proof of the proposition 1 by Smart (1998). The tax base we consider here is decreasing in t^i ($l_{i,t} = l_i'\left(\omega_{t^i}^i - 1\right) < 0$), given (6) and the assumptions of the model. ■

This statement shows that RTS equalization grants cause an increase in the taxes levied by the state government. In such a way, RTS equalization grants reduce the social cost of the distortionary taxation perceived by the regional authorities, and it encourages setting higher tax rates.

Proposition 2 *Let t_1^i and $\bar{t}_1$ be the tax rate solving government i's problem with a RTS equalization grant and the standard tax rate in the federation, respectively. Case a) if $t_1^i \leq \alpha\bar{t}_1$, the MCPF with a RTS equalization system is lower than with a lump-sum grants system. Case b) if $t_1^i > \alpha\bar{t}_1$, the MCPF with a RTS equalization system is higher than with a lump-sum grants system if $\varepsilon > \alpha\bar{t}_1$, where ε is the increase in the tax rate when the lump-sum grant is substituted by a RTS equalization grant.*

Proof. *Case a) It is straightforward from the expression for the MCPF with equalization grants in (19): $\frac{1}{1-\frac{\left(t^i-\alpha\bar{t}\right)l_i'}{l_i}}$.*

Case b) When $MCPF_{RTS} > MCPF_{LS}$, $t_1^i - \alpha\bar{t}_1 > t_0^i$. Given proposition 1, both t_1^i and $\bar{t}_1$are higher or equal than t_0^i and $\bar{t}_0$. Let $t_1^i = t_0^i + \varepsilon$ and $\bar{t}_1 = \bar{t}_0 + \delta$ be, where $\varepsilon, \delta \geq 0$. Then $t_1^i - \alpha\bar{t}_1 = t_0^i + \varepsilon - \alpha\bar{t}_0 - \alpha\delta > \bar{t}_0$ when $\varepsilon > \alpha\bar{t}_1$. ■

Case b) of proposition 2 shows that an increase in tax rates can be compatible with elevations in the MCPF. In other words, endogeneity of tax policy with respect to equalization policy and to the magnitude of MCPF is not so straightforward as might seemed. Indeed, in equilibrium, if tax rate rises by so much to compensate the income effect generated by the RTS equalization system through the effective standard tax rate $\alpha\bar{t}_1$, a higher MCPF is to be expected. Welfare analysis could be a natural extension of this point (Smart, 1998). From another view, case b) is a good illustration of the different results that can be obtained regarding the study of optimality *rules* and first order conditions versus the investigation into the optimal *levels* of policy variables. In addition, proposition 2 admits the possibility that infraprovision of public spending takes place when comparing a lump-sum framework with a RTS scheme. A higher MCPF desincentives its provision.

Definition of the equalization system and above proposition yield the following two results:

Corollary 1 to Proposition 2 *If the tax rate of region i with respect to the standard one is below equalization parameter α, region i receives a negative RTS grant.*

Proof. If $\frac{t_1^i}{\bar{t}_1} < \alpha$, with $\alpha \in (0,1]$, then $t_1^i < \bar{t}_1$; hence, $l_1^i > \bar{l}_1$ and, consequently, $e_1^i < 0$. ■

This refers to a particular situation of case a) in proposition 2. Corollary 1 suggests that with a determined tax effort, equalization system not only induce to higher tax rates through a substitution effect in the MCPF, but also can lead to a negative income effect (from a negative grant) reinforcing the trend towards overprovision of public inputs. Contrary to Smart (1998), our model does not require a quasi-linear utility function in public spending or the comparison between a RTS equalization system and no grants scheme, in order to get that both substitution and income effects go in the same sense.

Corollary 2 to Proposition 2 *When the MCPF increases by substituing lump-sum grants by RTS equalizations transfers, the tax rate of region i is above the standard tax rate.*

Proof. According to proposition 2, case b, the MCPF increases when $\varepsilon > \alpha\bar{t}_1$. It means that $\frac{t_1^i - \bar{t}_1}{\bar{t}_1} > \alpha$. Manipulation on this inequality gives that $\frac{t_1^i}{\bar{t}_1}$ must be bigger than 1 if $\varepsilon > \alpha\bar{t}_1$ has to be fulfilled, $\forall \alpha \in (0,1]$. ■

Corollary 2 additionally characterizes the situation in which the MCPF goes up. In such a context, state governments receive a positive equalization grant as long as their tax bases are below the standard ones. It should be noted that a state tax rate higher than $\bar{t}_1$ does not always coincide with an elevation of the MCPF; it only happens under the assumptions of case b) in proposition 2.

On the other hand, it is straightforward to show that efficiency production condition is also satisfied in the provision of public inputs when a RTS equalization system is used. In line with Blackorby and Brett (2000) and

Kotsogiannis and Makris (2002), this is an indication that considering production efficiency as criterion for assessing optimality in federal system may be inappropiate[7].

3 Redistribution through equalization and state tax policy

Degree of redistribution is a key issue by designing fiscal equalization schemes. Kothenburger (2002) studies the effect of parameter α on state tax rate describing several scenarios according the size of the region. Buettner (2004) analyses the impact of redistribution through equalization on the taxing effort of German local jurisdictions. Here we are interested in knowing the influence of the degree of fiscal equalization on the marginal cost of providing the public input (the RHS of expression (19)) -as a whole and distinguishing its two components-, and on the state tax setting.

Proposition 3 *Changes in parameter α affect the MCPF ambiguously. Only if $t_1^i \geqslant \alpha \bar{t}_1$, increases in α are followed by decreases in the MCPF.*

Proof. The sign of following partial derivative is the relevant point in the demonstration: $\frac{\partial}{\partial \alpha}\left(\frac{1}{1-\frac{\left(t-\alpha \bar{t}\right)l'}{l}}\right) = \frac{\partial}{\partial \alpha}\left(\frac{l}{l-\left(t-\alpha \bar{t}\right)l'}\right)$, where indexes denoting states have been eliminated for convenience in notation. After algebra manipulation this derivative gives $\frac{\left[\left(l'\right)^2 \omega_g \left(-t+\alpha \bar{t}\right)+l'' \omega_g l \left(t-\alpha \bar{t}\right)-l' t l\right] \frac{\partial g}{\partial \alpha}}{\left(l-\left(t-\alpha \bar{t}\right)l'\right)^2}$. The sign of this expression is not determined and hence the effect of α on the MCPF is ambiguous. By contrast, if we set that $t_1^i \geqslant \alpha \bar{t}_1$, and given that $\frac{\partial g}{\partial \alpha} > 0$, the sign is negative. ■

At this point, we move away from the methodology followed by Buettner (2004), who discusses on the basis of direct changes in the MCPF but ignoring indirect effects from equalization resources on public spending and, hence on the variables involved in the expression of the MCPF. In other words, as

[7] Martínez (2005) reaches the same conclusion in a similar model than presented here.

Kothenburger (2002) does, we consider that parameter α has an impact on public spending ($\frac{\partial g}{\partial \alpha} \neq 0$) and, consequently, it affects tax base elasticities.

Another issue that it is worth to note is the influence of α on the marginal production cost of the public input net of tax revenue effect (MCPT), i. e., the second term in the RHS of expression (19).

Proposition 4 *Changes in parameter α affect the MCPT ambiguously. Only if $t_1^i \geqslant \alpha \bar{t}_1$ and the effect of g on economic profit is non-increasing ($\pi^i_{g^i g^i} \leq 0$), increases in α are followed by increases in the MCPT.*

Proof. Derivative of the MCPT with respect to α is as follows (indexes have been removed): $\frac{\partial}{\partial \alpha}\left(1 - n\left(t - \alpha \bar{t}\right) l' \omega_g - \pi_g\right) =$

$\left[-ntl''\left(\omega_g\right)^2 - ntl'\omega_{gg} + n\bar{t}l'\omega_g + n\alpha\bar{t}l''\left(\omega_g\right)^2 + n\alpha\bar{t}l'\omega_{gg} - \pi_{gg}\right]\frac{\partial g}{\partial \alpha}$. As $l'' < 0$, $\omega_{gg} < 0$ (by the assumptions of the production function) and the sign of π_{gg} is indetermined, nothing can be said about the sign of this partial derivative. However, if two conditions are imposed: $t_1^i \geqslant \alpha t_1$ and $\pi^i_{g^i g^i} \leq 0$, manipulation in the expression of the above derivative gives a positive sign. ■

Second condition requiring π_g to be non-increasing in g is not certainly a very restrictive assumption. Indeed, a production function such a Cobb-Douglas allows to achieve this situation only imposing a bounded value for the third cross-partial derivative with respect to labor and public input. Intuition behind the result of proposition 4 is related to the impact of α upon the tax revenue effect. Regarding that increases in α lead to rises in g, a variation in the equalization parameter can affect tax revenue effect in a double way. First, public input provision elevates tax base, and hence it reduces the MCPT. Second, a higher tax base lowers entitlement payments received from equalization system, rising the MCPT. Hence, it is not clear which the final impact on the MCPT will be[8].

As a result of both ambiguities, it is straightforward to show that the effect of parameter α on state tax setting is unknown. Contrary to Kothenburger (2002), next Proposition states formally this result.

[8]Moreover, it must be noted that the reasoning followed in the proposition 4 considers second partial derivatives because the discussion is on the basis of FOC.

Proposition 5 *In a model with public input provision and tax base equalization it is not possible to elucidate the sign of the effect of changes in* α *on state tax rate.*

Proof. Using Roy's identity in the LHS of expression (19) and applying the implicit function theorem we have:

$$\frac{\partial t^i}{\partial \alpha} = -\frac{\frac{\partial}{\partial \alpha}\left(n^i l_i \omega^i_{g^i}\right) - \frac{\partial}{\partial \alpha}(MCP)}{\frac{\partial}{\partial t^i}\left(n^i l_i \omega^i_{g^i}\right) - \frac{\partial}{\partial t^i}(MCP)}$$

Although the second order condition of the government optimization problem guarantees a negative denominator, the sign is indetermined in the numerator due to the statements from proposition 3 and 4. ■

While Kothenburger (2002) detects a positive relationship between α and t^i, our model finds that the degree of equalization captured by parameter α may reduce marginally the MCPF but the impact on the MCPT may be the opposite, so the combined effect is not obvious. In such a way, policymakers must be aware that increasing the redistribution component of the equalization grant does not lead to higher tax rates necessarily, that is, to a bigger deviation of the second best outcome.

4 Concluding remarks and further research

One of the most important states' revenues sources comes from the vertical transfers implemented by federal government. These grants can be designed in different ways, and the so called RTS equalization grants are ones of the most frequently used. The main objective of the RTS equalization schemes is providing enough resources to subcental levels of government, regardless their tax capacities but taking their tax efforts into consideration.

Although RTS revenue equalization grants are able to reduce some inefficiencies linked to the federal structure of the countries, this paper aims to highlight the inefficiency derived from the implementation of these vertical grants. In particular, we study how the conditions for the optimal provision of public inputs are affected when a RTS equalization system is used instead of lump-sum transfers, and also the consequences in terms of FOC coming from increasing the degree of fiscal equalization.

Our model consists of different state governments providing a public input and behaving as Nash competitors. These governments obtain resources from labor taxes, profit taxes as well as grants given by federal government. In such a way, we have firstly compared two different scenarios: lump-sum grants and a RTS equalization system. As was proved by Smart (1998), this paper also finds that state tax rates are higher in the equalization framework. However, we admit the possibility that the MCPF increases when RTS transfers are considered. It allows to show that the traslation from the discussion on optimality *rules* to the optimal *levels* is not straightforward. Also in this part we provide a sufficient condition for defining a negative grant for the state, and information about the relative tax effort by a regional government when the MCPF goes up.

Secondly, we have studied the impacts of modifying the parameter α on some relevant variables involved in the optimal conditions. At this regard, we have shown that nothing can be said about the sign of the effect of α on the state tax rate setting. It is caused by the opposite behavior of the MCPF and the marginal cost of production net of tax revenue effect (MCPT) with respect to the degree of fiscal equalization.

This paper suggests a couple of policy implications. First one highlights the relevance of the degree of equalization on the efficiency of equilibria. In particular, we have seen that the magnitude of α determines, among others, whether a state receives a positive grant or not. In such a way, policy-makers must be aware that a high equalization can amplify the overprovision of public inputs in a sense of adding a negative income effect to the substitution effect derived from the RTS transfers. Secondly, and contrary to the case of consumption public goods, there does not exist a clear theoretical relationship between the degree of equalization and the tax setting; in fact, federal government by defining equalization schemes should pay attention upon the sign of the tax revenue effect because reforms of equalization formula not only affect the MCPF but also the impact of public inputs on tax revenues and, consequently, on the optimality of the equilibrium.

Further research on this issue can be initiated. Given that some of the results are theoretically ambiguous, it could be useful to test them empirically. Particularly, a special interest can be found in determining whether a more intense equalization leads to higher state tax rates when the provision of public inputs is involved. Other extensions from this paper can consist of broadening the theoretical framework here used. Fiscal competiton (through taxes on mobile bases and public spending as well), vertical externalities (as a result of sharing taxes or linked to public expenditure with spillovers towards other level of government) or assuming a Stackelberg behavior for federal government are interesting examples for such as theoretical extensions. Finally, as a suggestion provided by a referee, above discussion could be carried out mainly in terms of levels of public inputs and tax rates, instead of optimality rules; at this point, more details on specific functional forms would have to be studied.

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