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REVENUE EQUALIZATION SYSTEMS IN A FEDERATION WITH TAX EVASION

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Abstract

We analyse how vertical or horizontal fiscal equalization affects the overprovision of local public goods due to vertical fiscal externality, when there is tax evasion. The regional governments overspending incentive is examined both in case of a fiscal equalization based on pretax earned income and reported taxable income.

Keywords: Fiscal federalism; Equalization; Marginal Cost of Public Funds, Tax evasion

JEL Classification: H2; H41; H71; H77.

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1 Introduction

It is well-known in the literature on fiscal federalism that a vertical fiscal externality arising from a two-level taxation on the same tax base may imply overprovision of local public goods. Local governments perceive a marginal cost of public funds lower than the (true) social one, and thus are subject to a sort of soft budget costraint (Dahlby (2008)). Morevoer, it has been shown that such incentive to overprovide increases if an equalization system is applied. However, such an incentive may change also for other reasons. For example, the introduction of sheltering, i.e. illegal tax evasion and/or legal tax avoidance, may affect the efficiency of local public good provision through its effects on the criterion to measure the excess burden (Chetty (2009)), and thus also the marginal cost of public funds. Accordingly, when the effects of equalization and sheltering are considered simultaneously, one interesting question to raise is whether the incentive to overprovide local public goods will be enforced or not.

To analyse such an issue, we consider a federation where a central government is pre-committed, i.e. it is a Stackelberg leader while regional governments are followers (Köthenbürger (2008a), (2008b)). Local public expenditures are financed through two different instruments: local governments choose a surtax on the local fiscal base of a national tax, and may be entitled to receive an equalization grant. In particular, we suppose that a linear labour income tax is devoted to finance public expenditure, both at central and local level, so that a federal tax rate plus a local one are applied to the same basis. Further, the equalization system is like that described by Smart (1998), and is based on the so-called 'fiscal capacity equalization criterion',[1] a scheme of transfers applied in many countries as Australia, Canada, Germany, Switzerland and now, after a recent reform, Italy too. Accordingly, regions are (partially or totally) compensated by federal revenues for the difference between a standard level of tax revenue and the revenue regions are deemed to be able to raise if standard tax rates were applied to their tax basis.[2]

Different specifications of the equalization system (ES) are analysed in this note: vertical versus horizontal, and based on actual versus taxable income. With a vertical, or 'gross', (horizontal, or 'net') ES, 'poor' regions, whose fiscal capacity is lower than the average or standard one, receive a grant from the central government (directly from 'rich' regions). Further, both vertical and horizontal ES may be implemented with a fiscal capacity based on pretax earned income or reported taxable income, i.e. the former net of sheltering. For instance, art. 9(g) of the recent Italian bill n. 42/2009 on fiscal federalism reform applies a horizontal ES by referring to the comparison between the regional per capita tax yield and the average tax revenue over all regions. The tax considered as a proxy of fiscal capacity is a regional income surtax at a standardised rate. Therefore, it seems

[1] The system of equalization has been originally proposed in his seminal work by Musgrave (1961).

[2] See, in particular, Bucovetsky and Smart (2002), Boadway et al. (2002), Baretti et al. (2002), Dahlby and Warren (2003), Köthenbürger (2002), Boadway (2004), Figueiras et al. (2004), Buettner (2006), Grazzini and Petretto (2006), Smart (2007), Hindriks et al. (2008), Egger et. al. (2010). Most of these papers deals with horizontal tax competition vs. equalization, while in this note we concentrate on vertical tax competition. Kotsogiannis (2010) deals with both tax competition typologies vs. equalization. Finally, Kotsogiannis and Schwager (2008) study the impact of equalization on local politicians accountability.

that the ES in Italy will be horizontal and in terms of reported taxable income.

When there are sheltering phenomena, in particular tax evasion on which we are focusing here, it is interesting to consider the activity of an Authority devoted to auditing and monitoring of tax compliance, and the degree of cooperation between regional and federal governments on running it.[3] Usually, both government levels participate to this activity providing resources and agreeing on the way for sharing the clawed back tax revenue.[4] Such aspects are also analysed in the present note.

Our main results are the following. For a poor region, a shift from a vertical to a horizontal ES or viceversa does not change the incentive to overprovision of a public service, both in the case of an ES based on pretax earned income and reported taxable income (a poor region is always a receiving one). However, such an incentive for a poor region is strengthened (reduced), when an ES based on pretax earned (reported taxable) income is substituted by one based on reported taxable (pretax earned) income, both in the case of a vertical and a horizontal ES. For a rich region, a shift from a vertical (horizontal) to a horizontal (vertical) ES increases (decreases) the incentive to overprovision of a public service, both in the case of an ES based on pretax earned income and reported taxable income. Further, such an incentive for a rich region does not change when a vertical ES based on pretax earned income is substituted by one based on reported taxable income. Instead, in the case of a horizontal ES, a shift from one based on pretax earned (reported taxable) income to another based on reported taxable (pretax earned) income increases (decreases) the incentive for a rich region to overprovision of a public service.

To conclude, a more efficient level of regional public expenditures is associated with a vertical ES based on pretax earned income at regional level.[5] However, such a scheme could be more demanding in terms of information to be gathered. Indeed, it is known that tax records containing data on reported taxable income are widely available, while getting data on earned incomes at regional level is quite difficult and the use of proxy variables would be easily contrastred by local governments. Further, this solution is probably opposed by local politicians who may desire to favour their costituencies with a generally permissive fiscal legislation, and symultaneously to compensate the loss of tax revenues due to evasion with the equalization.

The plan of the paper is as follows. In section 2, we analyse consumers behaviour with tax evasion, and we design the tax structure of the federation according to the type of ES (vertical versus horizontal), and the basis with respect to which the grant is calculated (pretax earned income versus reported taxable income). In section 3, the incentive to overprovide local public goods when there is tax evasion at local level is compared according to different typologies of ES. Section 4

[3] For a treatment of evasion and auditing issue in a federal context, see Cremer and Gahvari (2000), Stowhase and Traxler (2005) and Bartolini and Fiorillo (2009).

[4] The quoted bill on fiscal federalism in Italy explicitely considers the possibility that a regional agency can cooperate with the *Agenzia delle Entrate*, the national tax Authority. For speficic taxes, regional Authorities may even fully substitute the *Agenzia delle Entrate*.

[5] Thus, such a solution is contrary to the one established by the quoted Italian reform on fiscal federalism.

contains some concluding remarks. Finally, in the Appendix, we model the behaviour of an efficient tax Authority against evasion, and the consequences for the efficiency of local public expenditures.

2 The model

We analyse a federation of regions, i, $i = 1, ..., n$, each with population size normalized to unity. In each region i, consumers are immobile, and preferences of the representative consumer are described by the following additively separable utility function

$$U^i(x_i, l_i, g_i, G) = u^i(x_i, l_i) + b(g_i) + B(G), \qquad i = 1, ..., n, \tag{1}$$

where $u^i(.)$ is a strictly quasi-concave sub-utility function of private consumption, x_i (taken as the numeraire), and leisure, l_i; and the $b(g_i)$ and $B(G)$ functions measure the benefits of a local public good, g_i, $i = 1, ..n$, and a federal public good, G, respectively.[6] Both federal and local public goods are pure in nature, but the benefits of the latter do not spill over across regions, while the benefits of the former accrue to all households irrespective of where they live. Both public goods are financed through a labour income tax (a pay-roll tax). Let t be the tax rate chosen by the federal government, and let ρ_i, $i = 1, ..n$, be the surtax on the regional fiscal base, decided by the regional government, with the consolidated tax rate given by $\tau_i \equiv t + \rho_i$, $i = 1, ..., n$.

In each region i, $i = 1, ..., n$, $Y_i = w_i L_i$ is the pretax earned income from labour, with w_i denoting the gross wage paid by firms, and $L_i = 1 - l_i$ denoting labour.[7] Thus, the net wage rate received by a consumer in region i obtains as $\widetilde{w_i} = (1 - \tau_i)w_i$, $i = 1, ..., n$. Further, let us suppose that a tax-payer living in region i may evade s_i euros of income from taxation. Thus, his reported taxable income obtains as $TY_i = Y_i - s_i$.

Following the distinction proposed by Chetty (2009), tax evasion in region i implies a resource cost given by $h_i(s_i)$, $h_i'(.) > 0$ and a transfer cost given by $z_i(\tau_i, s_i)$, with $\frac{\partial z_i}{\partial \tau_i} > 0$, $\frac{\partial z_i}{\partial s_i} > 0$.[8] In our case, the resource cost function $h_i(s_i)$ describes the cost beared by a tax Authority which is engaged in monitoring and auditing procedures[9] and the transfer cost function $z_i(\tau_i, s_i)$ describes the expected private cost of tax evasion, mainly due to the risk to be caught and to pay a fine (see the Appendix for a specification of these functions). The latter cost implies a transfer of resources from tax-payer to the tax Authority.

Accordingly, the budget constraint of a consumer in region i obtains as

$$x_i = (1 - \tau_i)TY_i + s_i - z_i(\tau_i, s_i), \qquad i = 1, ..., n. \tag{2}$$

Each consumer leaving in region i, $i = 1, ..., n$, chooses leisure and how much income to evade by maximising the utility function in (1) subject to his budget constraint (2). From the first order

[6] The separability assumption in the utility function implies that g_i, $i = 1, ..., n$, and G do not affect households' leisure-consumption decisions.

[7] We suppose that w_i, $i = 1, ..., n$, is constant, and thus it is not affected by taxation.

[8] We also assume $\frac{\partial z_i(\tau_i, 0)}{\partial s_i} = 0$ and $\frac{\partial z_i(\tau_i, Y_i)}{\partial s_i} = \infty$, to guarantee an interior optimum in s_i.

[9] Actually in Chetty (2009) there is also a direct cost beared by the tax-payer, for instance, for shifting reported money rewards to untaxable fringe benefits in order to reduce his taxable income.

condition with respect to s_i, the following standard condition in tax evasion literature obtains[10]

$$\tau_i = \frac{\partial z_i}{\partial s_i}, \qquad i = 1, ..., n. \tag{3}$$

At equilibrium, the marginal private benefit of raising s_i by 1 euro (saving τ_i euro) has to be equal to the marginal private cost, $\frac{\partial z_i}{\partial s_i}$. The solution of this maximisation problem implies the following indirect utility function

$$V^i(\widetilde{w}_i, g_i, G) = v^i(\widetilde{w}_i) + b(g_i) + B(G), \qquad i = 1, ..., n, \tag{4}$$

and, by using Roy's identity, the following condition

$$\frac{\partial v^i}{\partial \tau_i} = -v_I^i \left(TY_i + \frac{\partial z_i}{\partial \tau_i} \right), \qquad i = 1, ..., n, \tag{5}$$

where $v_I^i = u_x^i$ is the marginal utility of income. This means that the marginal cost for the tax-payer due to the cost of tax evasion, $-v_I^i \frac{\partial z_i}{\partial \tau_i} < 0$, adds to the standard cost of the increase of the tax payment, $-v_I^i TY_i$ (see Appendix).

The structure of federal and regional public budget constraints depends on the agreement between federal and regional governments on running the tax Authority, i.e. how the expected benefits and costs of monitoring and auditing activity are shared between central and local governments. Moreover, the two-levels budget constraints depend on whether the adopted equalization scheme is vertical or horizontal, and on whether it is based on pretax earned income or reported taxable income.

Let R_i denote the revenue available for a region i, $i = 1, ..., n$. The regional public budget constraint obtains as

$$R_i = \rho_i TY_i + e_i + \beta_i T_i = g_i, \qquad i = 1, ..., n. \tag{6}$$

Each region finances a local public good through three types of revenue: the yield from regional taxation, $\rho_i TY_i$, the yield from a federal government grant, e_i and the yield from monitoring activity, $\beta_i T_i$. The latter represents the fraction of the tax Authority's budget devoted to region i, where $T_i = z_i(\tau_i, s_i) - h_i(s_i) \geqslant 0$ and $0 < \beta_i < 1$. Hence, we assume the existence of an agreement between central and regional governments according to which each region yields a share β_i of the difference between the transfer from tax-payers and the cost of monitoring and auditing. This division might occur according to a political deal related to the ratio of the regional tax rate over the effective one, i.e. $\beta_i \left(\frac{\rho_i}{\tau_i} \right)$, with $\frac{\partial \beta_i}{\partial \rho_i} = \frac{\beta_i' t}{\tau_i^2} > 0$.

By denoting R_F^V and R_F^H the federal revenue with a vertical and a horizontal equalization scheme, respectively, the federal public budget constraint obtains as

$$R_F^V = tTY + \sum_{k=1}^{n} (1 - \beta_k) T_k - \sum_{k \in N^p} e_k = G, \tag{7}$$

[10] The condition derives from $u_x^i > 0$ and envelope theorem, for which it turns out that $\frac{\partial x_i}{\partial s_i} = -(1 - \tau_i) - \frac{\partial z_i}{\partial s_i} + 1$.

and

$$R_F^H = tTY + \sum_{k=1}^{n}(1-\beta_k)T_k = G. \tag{8}$$

A federal public good is financed through the revenue from taxing labour income, tTY, with $TY = \sum_{k=1}^{n} TY_k$ plus the central government's fraction of the tax Authority's budget, $\sum_{k=1}^{n}(1-\beta_k)T_k$, and in the case of a vertical equalization scheme, minus the sum of the grants to poor regions, $\sum_{k\in N^p} e_k$. The latter term does not appear in (8) because a horizontal equalization scheme does not imply any transfer from the federal government to regions.

We are now in a position to describe the structure of regional and federal budget constraints depending on the type of equalization scheme, and on the type of income with respect to which the grant is calculated.

2.1 Vertical equalization on pretax earned income (VY)

When pretax earned income is the basis for the equalization scheme, let us define a poor (rich) region i, if $Y_i < (\geq)\overline{Y}$, with $i \in (\notin) N^p$, where N^p denotes the set of poor regions, and $\overline{Y}$ denotes the standard tax base. Specifically, $\overline{Y}$ is usually chosen as the average per-capita tax base, $\overline{Y} \equiv \sum_{k=1}^{n} Y_k/n = Y/n$. With a vertical equalization scheme, the federal government only pays grants to poor regions $i \in N^p$. When such a scheme is based on pretax earned income, the equalization grants paid by the federal government are of the following type

$$e_{i\in N^p}^{VY} = \alpha\overline{\rho}(\overline{Y} - Y_i) > 0, \tag{9}$$

$$e_{i\notin N^p}^{VY} = 0, \tag{10}$$

where the parameter α, $0 < \alpha \leqslant 1$, describes the chosen degree of equalization ($\alpha = 1$ is the case of 'full equalization'), and $\overline{\rho}$ denote the standard regional tax rate. In particular, $\overline{\rho}$ could be a given reference surtax rate, established at a federal level, or a weighted average surtax rate, $\overline{\rho} \equiv \sum_{k=1}^{n} \rho_k Y_k/\overline{Y}$.[11] Let us define $A^Y \equiv \alpha\overline{\rho}\overline{Y}$, and use it into (9). The equalization grant for a poor region rewrites as

$$e_{i\in N^p}^{VY} = A^Y - \alpha\overline{\rho}Y_i. \tag{11}$$

For poor regions, this equalization scheme works as a linear (affine) matching grant based on (inversely correlated to) actual local tax base.

Let R_i^{VY} denote the total revenue available for a region i, $i = 1, ..., n$, with a vertical equalization on pretax earned income. By substituting (11) into (6), the regional public budget constraint obtains as

$$R_{i\in N^p}^{VY} = (\rho_i - \alpha\overline{\rho})TY_i - \alpha\overline{\rho}s_i + A^Y + \beta_i T_i = g_i, \tag{12}$$

[11] Alternatively, $\overline{Y}$ and $\overline{\rho}$ could be interpreted as parameters relative to the region with median income or the richest one. In any case, we assume that the standard tax base and the standard tax rate are fixed. Such an assumption is in line with the case of a high number of small regions (Grazzini and Petretto 2006).

for a poor region, and by substituting (9) into (6), it obtains as

$$R^{VY}_{i\notin N^p} = \rho_i TY_i + \beta_i T_i = g_i, \tag{13}$$

for a rich region.

Let R^{VY}_F denote the federal revenue with a vertical equalization on pretax earned income. By using (11) into (7), the federal public budget constraint obtains as

$$R^{VY}_F = tTY + \sum_{k=1}^{n}(1-\beta_k)T_k - \sum_{k\in N^p}(A^Y - \alpha\overline{\rho}Y_i) = G. \tag{14}$$

2.2 Horizontal equalization on pretax earned income (HY)

With a horizontal equalization scheme, poor regions receive a subsidy while rich regions pay for them. When such a scheme is based on pretax earned income, the structure of the yields is as follows

$$e^{HY}_{i\in N^p} = e^{VY}_{i\in N^p}, \tag{15}$$

$$e^{HY}_{i\notin N^p} = \alpha\overline{\rho}(\overline{Y} - Y_i) \leqslant 0, \tag{16}$$

with $\sum_{k\in N^p} e^{HY}_k + \sum_{k\notin N^p} e^{HY}_k = 0$.

Let R^{HY}_i denote the total revenue available for a region i, $i = 1, ..., n$, with a horizontal equalization on pretax earned income. Since the grant received by a poor region is the same as in the case with vertical equalization based on pretax earned income, the regional public budget constraint for a poor region is also the same, i.e.

$$R^{HY}_{i\in N^p} = R^{VY}_{i\in N^p} = g_i.$$

By substituting (16) into (6), the regional public budget constraint for a rich region obtains as

$$R^{HY}_{i\notin N^p} = (\rho_i - \alpha\overline{\rho})TY_i - \alpha\overline{\rho}s_i + A^Y + \beta_i T_i = g_i.$$

Finally, the federal public budget constraint is (8).

2.3 Vertical equalization on reported taxable income (VTY)

When reported taxable income is the basis for the equalization scheme, let us define a poor (rich) region i, if $TY_i < (\geq)\overline{TY}$. With a vertical equalization scheme, the grants paid by the federal government are of the following type

$$e^{VTY}_{i\in N^p} = \alpha\overline{\rho}(\overline{TY} - TY_i) > 0, \tag{17}$$

$$e^{VTY}_{i\notin N^p} = 0. \tag{18}$$

Let us define $A^{TY} \equiv \alpha\overline{\rho}\overline{TY}$, and use it into (17). The grant for a poor region rewrites as

$$e^{VTY}_{i\in N^p} = A^{TY} - \alpha\overline{\rho}(Y_i - s_i). \tag{19}$$

Given the actual earned income, the grant is increasing with the level of tax evasion.

Let R_i^{VTY} denote the total revenue available for a region i, $i = 1, ...n$, with a vertical equalization on reported taxable income. By substituting (19) into (6), the regional public budget constraint obtains as

$$R_{i\in N^p}^{VTY} = (\rho_i - \alpha\overline{\rho})TY_i + A^{TY} + \beta_i T_i = g_i, \tag{20}$$

for a poor region, and by substituting (18) into (6), it obtains as

$$R_{i\notin N^p}^{VTY} = \rho_i TY_i + \beta_i T_i = g_i, \tag{21}$$

for a rich region. Thus $R_{i\notin N^p}^{VTY} = R_{i\notin N^p}^{VY}$.

Now let R_F^{VTY} denote the federal revenue with a vertical equalization on reported taxable income. By using (19) into (7), the federal public budget constraint obtains as

$$R_F^{VTY} \equiv tTY + \sum_{k=1}^{n}(1-\beta_k)T_k - \sum_{k\in N^p}(A^{TY} - \alpha\overline{\rho}TY_k) = G. \tag{22}$$

2.4 Horizontal equalization on reported taxable income (HTY)

With a horizontal equalization based on reported taxable income, the structure of the yields is as follows

$$e_{i\in N^p}^{HTY} = e_{i\in N^p}^{VTY}, \tag{23}$$

$$e_{i\notin N^p}^{HTY} = \alpha\overline{\rho}(\overline{TY} - TY_i) \leqslant 0, \tag{24}$$

with $\sum_{k\in N^p} e_k^{HTY} + \sum_{k\notin N^p} e_k^{HTY} = 0$.

Let R_i^{HTY} denote the total revenue available for a region i, $i = 1, ..., n$, with a horizontal equalization on reported taxable income. Since the grant received by a poor region is the same as in the case with vertical equalization based on pretax earned income, the regional public budget constraint for a poor region is also the same, i.e.

$$R_{i\in N^p}^{HTY} = R_{i\in N^p}^{VTY} = g_i. \tag{25}$$

By substituting (24) into (6), the regional public budget constraint for a rich region obtains as

$$R_{i\notin N^p}^{HTY} = (\rho_i - \alpha\overline{\rho})TY_i + A^{TY} + \beta_i T_i = g_i. \tag{26}$$

Finally, the federal public budget constraint is (8).

3 The overprovision of a local public good with different equalization schemes and tax evasion

We suppose that a regional government does play a non-cooperative game without taking into account the effects of its fiscal decisions on the federal government budget constraint. In particular,

ρ_i and g_i are chosen in order to maximise the welfare of a representative consumer in region i (see (4)), given the regional public sector budget constraint, and taking both federal government's and other regions' fiscal decisions as given.[12]

On the basis of a wide agreement in the literature, we adopt the following

Definition *In a noncooperative fiscal equilibrium, the incentive to overprovide local public services is measured by the gap between the regional perceived marginal cost of public fund (MCF_i) and the social one ($SMCF_i$), i.e. the one perceived in a second best cooperative equilibrium.*

According to such a definition, the wider is the wedge between MCF_i and $SMCF_i$, the higher is the incentive to soft budget constraint.

3.1 Benchmark case: No equalization and no tax evasion

Without an equalization scheme and tax evasion, by solving the maximisation problem of a region i, $i = 1, ..., n$, the following noncooperative equilibrium condition obtains[13]

$$\frac{b'}{v_I^i} = \frac{Y_i}{\frac{\partial R_i}{\partial \rho_i}} = \frac{1}{1 - \rho_i \Delta_i \varepsilon_i} = MCF_i, \qquad i = 1, ..n, \tag{27}$$

where $v_I^i \equiv -\frac{\partial v^i / \partial \tau_i}{Y_i}$, $\Delta_i \equiv \frac{1}{1-\tau_i}$, and $\varepsilon_i \equiv \frac{\partial L_i}{\partial \widetilde{w}_i} \frac{\widetilde{w}_i}{L_i}$. This means that the marginal benefit of one euro invested in the local public good provision is equal to the regionally perceived marginal cost of it. Instead, the second best cooperative equilibrium condition which takes into account the negative tax externality, $\frac{\partial R_F}{\partial \rho_i} < 0$, obtains as follows

$$\frac{b'}{v_I^i} = \frac{Y_i}{\frac{\partial R_i}{\partial \rho_i} + \frac{\partial R_F}{\partial \rho_i}} = \frac{1}{1 - \tau_i \Delta_i \varepsilon_i} = SMCF_i, \qquad i = 1, ..n. \tag{28}$$

This means that the social perceived marginal cost of public fund, $SMCF_i$, takes into account the fact that the 'true' tax distortion depends on τ_i and not only on ρ_i. Thus, it is easy to check that

$$MCF_i < SMCF_i, \qquad i = 1, ..n,$$

i.e. without an equalization scheme, the noncooperative equilibrium results in an incentive to overprovision.

3.2 Case with different equalization schemes and no tax evasion

When an equalization scheme is introduced, the grants are as in (9) and (10) in case of a vertical equalization, and as in (15) and (16) in case of a horizontal equalization. Without tax evasion, let $R^V_{i \in N^p}$ and $R^H_{i \in N^p}$ denote the total revenue available for a poor region with a vertical and a

[12] As it is well known, this corresponds to the case when regions are fiscally independent (Köthenbürger (2008a) and (2008b)). A possible interaction is investigated in Kotsogiannis (2010).

[13] See, for example, Dahlby (2008).

horizontal equalization, respectively. By using (9) and (15), the regional public budget constraint for a poor region obtains as

$$R^V_{i\in N^p} = R^H_{i\in N^p} = (\rho_i - \alpha\overline{\rho})Y_i + A^Y = g_i. \tag{29}$$

Since a rich region does not receive any grant with a vertical equalization, (see(10)), its public budget constraint is the same as in the benchmark case

$$R^V_{i\notin N^p} = \rho_i Y_i = g_i. \tag{30}$$

Instead, a rich region pays a transfer (16) with a horizontal equalization, and thus its public budget constraint obtains as

$$R^H_{i\notin N^p} = (\rho_i - \alpha\overline{\rho})Y_i + A^Y = g_i. \tag{31}$$

Let MCF_i^V and MCF_i^H denote the marginal cost of public fund without tax evasion and with a vertical and a horizontal equalization, respectively. By using (29), it is easy to check that the following condition for a poor region holds

$$MCF^V_{i\in N^p} = MCF^H_{i\in N^p} = \frac{1}{1-(\rho_i - \alpha\overline{\rho})\Delta_i\varepsilon_i} < MCF_i < SMCF_i. \tag{32}$$

Condition (32) shows that the perceived marginal cost of public fund is lower with both vertical and horizontal equalization than without an equalization scheme. Accordingly, the incentive to overprovision of public goods is strengthened when an equalizing grant is directed to a poor region, for which the effective tax rate becomes $(\rho_i - \alpha\overline{\rho})$.[14] Indeed, the increase in the regional tax rate ρ_i by a poor region results in a decrease in the regional income due to the elasticity of labour supply. However, such a decrease in regional income allows to receive a greater equalization grant. Accordingly, the perception of the marginal cost of taxation decreases.

By using (30) and (31), it is easy to check that the following condition for a rich region holds

$$MCF^H_{i\notin N^p} = \frac{1}{1-(\rho_i - \alpha\overline{\rho})\Delta_i\varepsilon_i} < MCF^V_{i\notin N^p} = MCF_i < SMCF_i. \tag{33}$$

The result in terms of overprovision of the public service also applies for a rich region in the case of horizontal equalization. Actually, if region $i \notin N^p$ increases its tax rate ρ_i, by decreasing its income, it obtains to pay less for the transfer to the set of poor regions, so also its perceived marginal cost of taxation is lower.

3.3 Case with different equalization schemes and tax evasion

Now let us introduce the possibility of tax evasion. We will compare the social marginal cost of public fund with tax evasion, denoted by $SMCF_i^S$, with the perceived marginal cost of public fund, depending on the type of equalization scheme adopted, and on the basis with respect to which the grant is calculated.

[14] This incentive to overprovision is increasing with α, the equalization rate. For a analogous statement, see Proposition 1 in Kelders and Köthenbürger (2010).

Since the $SMCF_i^S$ is calculated taking into account the sum of all regional and federal public budget constraints, it is easy to check that it is independent not only of the type of equalization scheme (vertical or horizontal), but also of the basis with respect to which the yield is calculated (pretax earned income or reported taxable income). Indeed, when all regional public budget constraints are summed up with the federal one, positive and negative equalization transfers cancel out. Thus, the social marginal cost of public fund obtains as[15]

$$SMCF_i^S = \frac{TY_i + \frac{\partial z_i}{\partial \rho_i}}{TY_i\left(1 - \tau_i \Delta_i \varepsilon_i^{TY}\right) + \frac{\partial T_i}{\partial \rho_i}}, \qquad i = 1, .., n, \tag{34}$$

where $\varepsilon_i^{TY} \equiv \frac{\partial TY_i}{\partial \widetilde{w}_i}\frac{\widetilde{w}_i}{TY_i}$ denotes the elasticity of reported taxable income. Let us briefly consider the differences with respect to the previous scenario without tax evasion. Now at the numerator of $SMCF_i^S$, there is the sum of two types of marginal cost of taxation for the tax-payer in region i: TY_i and $\frac{\partial z_i}{\partial \rho_i}$. In the Appendix, we show that the total cost for the tax-payer is reduced with respect to the case of no evasion if the probability to be caught is not so high. Two observations can be made for the denominator of $SMCF_i^S$. First, the tax distortion is measured, not in terms of the elasticity of labour supply, but in terms of the elasticity of reported taxable income, which is now considered as the 'most correct' method for calculating the excess burden of income taxation.[16] Second, there is the term $\frac{\partial T_i}{\partial \rho_i}$, which is positive if the marginal revenue coming from the transfer cost is higher than the marginal cost of organizing the tax Authority (which is a plausible assumption, see the Appendix, Lemma 1). This means that the Authority can translate the increase of evasion, coming from a tax rate increase, in an opportunity of more yield, partially compensating the reduction of revenue due to the taxable income decrease. The latter effect is, of course, captured by the term with the elasticity of taxable income in the formula.

3.3.1 The incentive to overprovision for poor regions

With both a vertical and a horizontal equalization scheme based on pretax earned income, for a poor region $i \in N^p$, the local marginal cost of public funds obtains as

$$MCF_{i\in N^p}^{VY} = MCF_{i\in N^p}^{HY} = \frac{TY_i + \frac{\partial z_i}{\partial \rho_i}}{TY_i\left(1 - \rho_i \Delta_i \varepsilon_i^{TY}\right) + \alpha\overline{\rho}\Delta_i\varepsilon_i Y_i + \frac{\partial(\beta_i T_i)}{\partial \rho_i}}. \tag{35}$$

Let us now compare the local marginal cost of public fund in (35) to the social one in (34). The numerator of the two expressions is the same, $TY_i + \frac{\partial z_i}{\partial \rho_i}$, as it captures the full impact of taxation for a tax-payer in region i. The denominator is instead different. In particular, the denominator in (35) contains three terms. The first term, $TY_i\left(1 - \rho_i \Delta_i \varepsilon_i^{TY}\right)$, represents the net gain in terms of yield from an increase of regional tax rate. The second term, $\alpha\overline{\rho}\Delta_i\varepsilon_i Y_i$, represents the compensation coming from the equalization scheme, measured in terms of the labour supply elasticity and pretax earned income. Finally, the third term, $\frac{\partial(\beta_i T_i)}{\partial \rho_i} = \frac{\partial \beta_i}{\partial \rho_i}T_i + \beta_i\frac{\partial T_i}{\partial \rho_i} > 0$, describes the impact of

[15] See the similarity with condition (27) in Chetty (2009), although drawn in a different context.

[16] See Chetty (2009) and the quoted literature.

the regional tax rate on the share of the Authority budget going to region i. More precisely, the three terms underline three types of fiscal externalities due to an increase of regional tax rate which determine the difference between the local marginal cost of public fund and the social one. The first term corresponds to a tax distortion depending on τ_i and not only on ρ_i; the second term corresponds to the compensation received by region i according to the vertical or horizontal equalization scheme, which cancels out at social level; and finally, the third term captures the fact that region i perceives only a fraction of the increase of tax Authority yield from monitoring activity. In Appendix (Lemma 2) we show the conditions according to which it may be $\frac{\partial T_i}{\partial \rho_i} \gtreqless \frac{\partial(\beta_i T_i)}{\partial \rho_i}$. If $\frac{\partial T_i}{\partial \rho_i} > \frac{\partial(\beta_i T_i)}{\partial \rho_i}$ (alternatively $<$) the MCF tends to be greater (lower) than the $SMCF$. It turns out that the relative sizes of elasticity of evaded income w.r.t. the tax rate vs. the share of auditing costs on the totale tax Authority's revenue are crucial.

Similarly, with both a vertical and a horizontal equalization scheme based on reported taxable income, for a poor region $i \in N^p$, the local marginal cost of public funds obtains as

$$MCF^{VTY}_{i\in N^p} = MCF^{HTY}_{i\in N^p} = \frac{TY_i + \frac{\partial z_i}{\partial \rho_i}}{TY_i\left(1 - \rho_i \Delta_i \varepsilon_i^{TY}\right) + \alpha\overline{\rho}\Delta_i \varepsilon_i^{TY} TY_i + \frac{\partial(\beta_i T_i)}{\partial \rho_i}}. \tag{36}$$

By comparing the regional marginal costs of public fund in (36) to the ones in (35), notice that the only different term is the second one at the denominator: the elasticity of labour supply times the pretax earned income, $\varepsilon_i Y_i$, in (35) is replaced by the elasticity of reported taxable income times reported taxable income, $\varepsilon_i^{TY} TY_i$ in (36).

To conclude, for a poor region, in the case of an equalization scheme based on both pretax earned income and reported taxable income, a vertical and a horizontal equalization scheme provide the same incentive to overprovide the public service, i.e. $MCF^{VY}_{i\in N^p} = MCF^{HY}_{i\in N^p}$, and $MCF^{VTY}_{i\in N^p} = MCF^{HTY}_{i\in N^p}$. Instead, both in the case of a vertical and a horizontal equalization scheme, the incentive to overprovide the public service is higher when the equalization scheme is based on reported taxable income instead of pretax earned income, i.e. $MCF^{VTY}_{i\in N^p} < MCF^{VY}_{i\in N^p}$ and $MCF^{HTY}_{i\in N^p} < MCF^{HY}_{i\in N^p}$, under the plausible assumption that $\frac{\partial s_i}{\partial \rho_i} = (\varepsilon_i^{TY} TY_i - \varepsilon_i Y_i) > 0$.[17]

We summarize the previous reasonings with the following

Proposition 1 *(i) For a poor region, in the case of an equalization scheme based on both pretax earned income and reported taxable income, a shift from a vertical to a horizontal one or viceversa does not change the incentive to overprovision of the local public service.*

(ii) For a poor region, both in the case of a vertical and a horizontal equalization, a shift from a scheme based on pretax earned (reported taxable) income to one based on reported taxable (pretax earned) income increases (decreases) the incentive to overprovision.

[17] The assumption is sustained by several empirical investigations in optimal income taxation, where it is found that the elasticity of taxable income is much higher than the labour supply elasticity.

3.3.2 The incentive to overprovision for rich regions

With a vertical equalization scheme based on both pretax earned income and reported taxable income, the local marginal cost of public funds, for a rich region $i \notin N^p$, obtains as

$$MCF^{VY}_{i\notin N^p} = MCF^{VTY}_{i\notin N^p} = \frac{TY_i + \frac{\partial z_i}{\partial \rho_i}}{TY_i\left(1-\rho_i\Delta_i\varepsilon_i^{TY}\right) + \frac{\partial(\beta_i T_i)}{\partial \rho_i}}.$$

Since a rich region does pay nothing in case of vertical equalization scheme, its local marginal cost of public funds does not depend on the fact that the equalization scheme is based on pretax earned income or reported taxable income.

The local marginal cost of public fund obtains as

$$MCF^{HY}_{i\notin N^p} = \frac{TY_i + \frac{\partial z_i}{\partial \rho_i}}{TY_i\left(1-\rho_i\Delta_i\varepsilon_i^{TY}\right) + \alpha\overline{\rho}\Delta_i\varepsilon_i Y_i + \frac{\partial(\beta_i T_i)}{\partial \rho_i}}, \tag{37}$$

with a horizontal equalization scheme based on pretax earned income, and

$$MCF^{HTY}_{i\notin N^p} = \frac{TY_i + \frac{\partial z_i}{\partial \rho_i}}{TY_i\left(1-\rho_i\Delta_i\varepsilon_i^{TY}\right) + \alpha\overline{\rho}\Delta_i\varepsilon_i^{TY} TY_i + \frac{\partial(\beta_i T_i)}{\partial \rho_i}}, \tag{38}$$

with a horizontal equalization scheme based on reported taxable income.

Two remarks are in order. First, $MCF^{HY}_{i\notin N^p} > MCF^{HTY}_{i\notin N^p}$ because $\varepsilon_i Y_i < \varepsilon_i^{TY} TY_i$. Second, both in the case of an equalization scheme based on pretax earned income and reported taxable income, the comparison between the local marginal costs of public fund shows that $MCF^{HY}_{i\notin N^p} < MCF^{VY}_{i\notin N^p}$ because of the term $\alpha\overline{\rho}\Delta_i\varepsilon_i Y_i > 0$ at the denominator of (37), and $MCF^{HTY}_{i\notin N^p} < MCF^{VTY}_{i\notin N^p}$ because of the term $\alpha\overline{\rho}\Delta_i\varepsilon_i^{TY} TY_i > 0$ at the denominator of (38). In particular, the tax distortion perceived by a rich region is lower with a vertical than a horizontal equalization scheme, i.e. if a rich region increases its local tax rate ρ_i, its income decreases, but it obtains to pay less for the transfer to poor regions. Accordingly, a shift from a horizontal to a vertical equalization scheme augments the marginal cost of public fund, and thus reduces the gap with respect to the social marginal cost of public fund.

We summarize the previous reasonings with the following

Proposition 2 *(i) For a rich region, in the case of an equalization scheme based on both pretax earned income and reported taxable income, a shift from a vertical (horizontal) to a horizontal (vertical) equalization scheme increases (decreases) the incentive to overprovision of the local public service.*

(ii) For a rich region, in the case of a vertical equalization, a shift from a scheme based on pretax earned income to one based on reported taxable income does not change the incentive to overprovision. Instead, in the case of a horizontal equalization, a shift from a scheme based on pretax earned (reported taxable) income to one based on reported taxable (pretax earned) income increases (decreases) that incentive.

4 Conclusion

When the central government is pre-committed, it is well known that a vertical fiscal externality originated from an increase of a local surtax on a federal income tax base implies the overprovision of local public goods. This is due to the fact that local governments perceive a marginal cost of public funds lower than the (true) social one. The incentive to such a soft budget costraint phenomenon further increases if it is in charge an equalization system based on 'fiscal capacity', like that one studied by Smart (1998), and now applied in many federal countries.

In this note, we have analysed how such an incentive to overprovide local public goods is changed when the model also allows for income evasion. Indeed, as shown by Chetty (2009), with tax sheltering the criterion to measure tax distorion and excess burden must be changed in order to take into account the elasticity of taxable income instead of the elasticity of labour supply. Consequently, the formula of marginal cost of public funds must be changed too, and this has an impact on the overprovision concern. In this respect, we have shown how the local public good overprovision phenomenon is affected by considering simultaneously tax evasion and different specifications of an equalization system, i.e. vertical or horizontal, and based on pre-tax earned income or reported taxable income.

In terms of normative design of the equalization system, our main result shows that a more efficient level of regional public expenditures is better achieved with a vertical equalization system based on pre-tax earned income. It should be stressed that such a normative prescription may be more difficult to apply because more demanding in terms of informations to be gathered. Further, although the level of evasion is a household's choice, it can be influenced by regional fiscal legislation within which the household makes his choices. Indeed, the level of evasion depends on local tax rates but can be also somewhat influenced by the struggle of local governments against underreporting tax base. Thus, the opportunity of limiting tax payments by local voters can be strategically played by local politicians to gain electoral consensus.

5 Appendix

The tax Authority cost function can be written as

$$h_i(s_i, \eta_i) = c_i \left[p_i(\eta_i)\right] s_i, \tag{39}$$

where $c_i[.]$ is the unitary cost of auditing, as an increasing function of $p_i(\eta_i)$, which denotes the probability that a tax-payer living in region i is audited, with η_i denoting the effort variable measuring the x-efficiency of the tax Authority. The probability is clearly an incresing function of the effort, $p'(\eta_i) > 0$. The transfer cost function $z_i(\tau_i, s_i)$ describes the expected private cost of tax evasion. If the tax-payer has evaded and is audited, he has to pay his tax bill on the evaded amount, $\tau_i s_i$, and a fine $F(s_i, \tau_i)$. Let us suppose that the latter is linear, i.e. $F(s_i, \tau_i) = f_i \tau_i s_i$. Therefore the transfer cost obtains as the sum of the expected re-paied tax plus a fine, i.e.

$$z_i(\tau_i, s_i) = p_i(\eta_i)(\tau_i s_i + f_i \tau_i s_i). \tag{40}$$

By the envelope theorem, we get $\frac{\partial z_i}{\partial \tau_i} = p_i(\eta_i)s_i(1+f_i)$. Thus now we may rewrite condition (5) of the text as

$$\frac{\partial v^i}{\partial \tau_i} = -v_I^i \left[TY_i + p_i(\eta_i)s_i(1+f_i)\right] = -v_I^i \left\{Y_i - \left[1 - p_i(\eta_i)(1+f_i)\right] s_i\right\}, \qquad i = 1, ..., n.$$

This condition shows us that the traditional individual welfare cost of a tax increase, $v_I^i Y_i$, is reduced by the expected net benefit from evasion, $v_I^i \left[1 - p_i(\eta_i)(1+f_i)\right] s_i$. Therefore, if $p_i(\eta_i) < \frac{1}{1+f_i}$, i.e. evasion is convenient ($s_i > 0$), the numerator of the marginal cost of public funds formula with tax evasion, as for instance (34), is reduced w.r.t. the numerator of the marginal cost of public funds formula without tax evasion, as for instance (28), where there is only Y_i.

By substituting (39) and (40) into the tax Authority budget $T_i = z_i(\tau_i, s_i) - h_i(s_i)$, we obtain:

$$T_i(\eta_i) = \left\{p_i(\eta_i)(1+f_i)\tau_i - c_i\left[p_i(\eta_i)\right]\right\} s_i. \tag{41}$$

If the tax Authority is efficient in choosing the effort level, and evasion is increasing with the tax rate, the following Lemma shows that an increase of the local tax rate increases Authority's yield.

Lemma 1 *If* $\tau_i(1+f_i) \geq c_i'\left[p_i(\eta_i^*)\right]$, *where* $\eta_i^* = argmax_{\eta_i}\ T_i(\eta_i)$, *and* $\frac{\partial s_i}{\partial \rho_i} > 0$, *then* $T_i(\eta_i^*) \geq 0$, *and* $\frac{\partial T_i(\eta_i^*)}{\partial \rho_i} > 0$.

Proof. The F.O.C. of the maximization of (41) w.r.t. η_i is as follows:

$$\left\{\tau_i(1+f_i) - c_i'\left[p_i(\eta_i)\right]\right\} p'(\eta_i)s_i + \left\{p_i(\eta_i)(1+f_i)\tau_i - c_i\left[p_i(\eta_i)\right]\right\} \frac{\partial s_i}{\partial p_i} p'(\eta_i) = 0,$$

or

$$\tau_i(1+f_i) - c_i'\left[p_i(\eta_i)\right] - \left[\tau_i(1+f_i) - \frac{c_i\left[p_i(\eta_i)\right]}{p_i(\eta_i)}\right] \xi_i^p = 0,$$

where $\xi_i^p \equiv -\frac{\partial s_i}{\partial p_i}\frac{p_i}{s_i} > 0$, because s_i is decreasing in p_i for a risk-averse tax-payer. If $\tau_i(1+f_i) \geq c_i'\left[p_i(\eta_i^*)\right]$, it must be $\tau_i(1+f_i) \geq \frac{c_i\left[p_i(\eta_i^*)\right]}{p_i(\eta_i^*)}$, and then $T_i(\eta_i^*) \geq 0$.

Let us now compute the following derivative:

$$\frac{\partial T_i(\eta_i^*)}{\partial \rho_i} = p_i(\eta_i^*)(1+f_i)s_i + \left\{p_i(\eta_i^*)(1+f_i)\tau_i - c_i\left[p_i(\eta_i^*)\right]\right\} \frac{\partial s_i}{\partial \rho_i}. \tag{42}$$

Thus, from (42), $T_i(\eta_i^*) \geq 0$, with $\frac{\partial s_i}{\partial \rho_i} > 0$, implies $\frac{\partial T_i(\eta_i^*)}{\partial \rho_i} > 0$.□

The following Lemma 2 shows the conditions under which a regional government perceives a gain from the tax Authority activity lower (or higher) than the social one, given that only a fraction of controlling and auditing evasion goes directly to it. Consequently, the regional marginal cost of public funds may be higher (or lower) than the social one, depending on the elasticity of evasion w.r.t. the tax rate. If β_i is exactly equal to the ratio of local tax rate on federal tax rate, $\frac{\rho_i}{\tau_i}$, and tax evasion s_i is relatively elastic (inelastic) w.r.t. the total tax rate τ_i, the Lemma 2 shows that the regionally perceived MCF_i tends to be higher (lower) than the social one $SMCF_i$ (the benchmark being the share of auditing costs on the total tax Authority's revenue).

Lemma 2 *If* $\beta_i = \frac{\rho_i}{\tau_i}$, *and* $\xi_i^\tau \equiv \frac{\partial s_i}{\partial \tau_i}\frac{\tau_i}{s_i} \gtreqless \frac{c_i s_i}{T_i} \equiv \theta_i$, *then* $\frac{\partial T_i}{\partial \rho_i} \gtreqless \frac{\partial(\beta_i T_i)}{\partial \rho_i}$.

Proof. It is easy to check that

$$\frac{\partial T_i}{\partial \rho_i} - \frac{\partial(\beta_i T_i)}{\partial \rho_i} = (1-\beta_i)\frac{\partial T_i}{\partial \rho_i} - \frac{\beta_i' t}{\tau_i^2} T_i. \tag{43}$$

By substituting $\beta_i = \frac{\rho_i}{\tau_i}$ and $\beta' = 1$, in the r.h.s. we get that $\frac{\partial T_i}{\partial \rho_i} \gtreqless \frac{\partial(\beta_i T_i)}{\partial \rho_i}$ if $\frac{\partial T_i}{\partial \tau_i}\frac{\tau_i}{T_i} \gtreqless 1$. Further, by substituting $\frac{\partial T_i}{\partial \tau_i}$ from (42) and taking into account (41), we obtain that

$$\begin{aligned}
\frac{\partial T_i}{\partial \tau_i}\frac{\tau_i}{T_i} &= \frac{p_i \tau_i (1+f_i) s_i}{T_i} + \frac{\partial s_i}{\partial \tau_i}\frac{\tau_i}{s_i} = \\
&= \frac{T_i - c_i s_i}{T_i} + \frac{\partial s_i}{\partial \tau_i}\frac{\tau_i}{s_i} = \\
&= 1 - \theta_i + \xi_i^\tau > 0.
\end{aligned}$$

Thus, it follows that, if $\xi_i^\tau \gtreqless \theta_i$, $\frac{\partial T_i}{\partial \rho_i} \gtreqless \frac{\partial(\beta_i T_i)}{\partial \rho_i}$. □

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