FISCAL EQUALIZATION AND YARDSTICK COMPETITION

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Abstract: A model of yardstick competition is presented where relative performance evaluation on the part of voters reduces the incentives for incumbents to divert resources away from public good provision to personal gain. Into this model, a horizontal intergovernmental transfer scheme is introduced where equalization entitlements depend on a noisy assessment of fiscal capacities. By reducing the informational content of the comparison across jurisdictions, this system tilts the incumbent politician's trade-off between current rents and the probability of winning the elections towards more rent diversion. Based on this effect, it is shown that the amount of rents taken in a symmetric Nash equilibrium increases in the intensity of the equalization system.

Keywords: Equalization entitlements; fiscal capacity; rent seeking; fiscal federalism.

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1 Introduction

A common feature of federal economies is equalization entitlements: transfers, that is, from jurisdictions ('states' or 'provinces') with above-average fiscal capacity to jurisdictions that do not have the necessary fiscal capacity to guarantee themselves a certain level of public goods provision. It is well understood that such equalization transfers may enhance efficiency by insulating jurisdictions from the tax externalities created from the existence of tax competition among lower level governments (see, for example, Wildasin, 1989, Köthenbürger, 2002, and Bucovetsky and Smart, 2006). But, of course, such systems may change the tax setting behavior of jurisdictions. For, under such transfers, the loss of tax base incurred as a consequence of tax competition is partly offset by an adjustment of revenues originating from the equalization system.

A largely unexplored aspect of such transfers is the extent to which, by equalizing fiscal capacity across provinces, they interact with the incentives of incumbents to divert resources away from public good provision and for personal gain. This interaction is at the heart of the present paper. It is shown that an equalization system, similar to its dampening effect on fiscal competition, reduces the intensity of political competition in a multi-jurisdictional system.

The analysis of political competition presented here takes up the idea of relative performance evaluation as analyzed by Besley and Case (1995) and Besley and Smart (2003). Both of these contributions consider the effect of 'yardstick' competition on rent extraction and in particular on the selection of 'good' incumbents. In these models, voters of a typical jurisdiction can evaluate the incumbent of their jurisdiction using information obtained from observing the behavior of the neighboring jurisdictions. These contributions do not, however, consider the interaction between equalization transfers and incentives arising from elections. The present paper explores this aspect by considering a simple two period model with career concerns and yardstick competition between the incumbents of two jurisdictions (Persson and Tabellini, 2000: chapter 9). In this model, the fiscal capacity and thus the supply of public goods in a jurisdiction are affected by the competence and the extent of rent seeking behavior of the local incumbent, but also by a shock which is common across jurisdictions. Since voters cannot observe competence and rent seeking behavior nor the common shock, they assess the performance of the incumbent in their own jurisdiction by comparing public goods supplies across jurisdictions. An incumbent who takes more rents will see her jurisdiction fare worse in this comparison, and thus her chances of re-election are reduced.

We introduce a system of horizontal intergovernmental transfers into this setup where the fraction t of the difference between the jurisdictions' fiscal capacities is equalized. The equalization payment is affected by a random element, for example due to an imperfect assessment of fiscal capacities. Therefore, even knowing the equalization rate t, citizens cannot perfectly derive fiscal capacities from the supplies of public goods observed in both jurisdictions. Hence the informational content of the comparison across jurisdictions is reduced. By consequence, the adverse effect of increased rent seeking by an incumbent on voters' assessment of her performance is mitigated by equalization. Thus, the incumbent politician's trade-off between current rents and the probability of winning the elections is tilted towards more rent diversion. Based on this effect, it is shown that the amount of rents taken in a symmetric Nash equilibrium increases in the equalization rate t. This suggests that equalization payments, while dampening inefficient tax competition, may adversely affect the working of the political system.

The organization of the paper is as follows. Section 2 introduces the model while Section 3 presents its equilibrium. Section 4 briefly concludes. Some more involved proofs are relegated to the Appendix.

2 The Model

We consider a model with two periods and two jurisdictions labelled i and j which are ex ante identical. There is electoral accountability in the sense that voters hold incumbents accountable ex post for incompetent behavior in office. This occurs in an election at the end of period 2 which will be described in subsection 2.3. There is a representative citizen in each jurisdiction whose income per period is normalized, for convenience, to 1. The citizen pays an exogenously fixed tax of $\bar{\tau}$ per period. The supplies of the public good in jurisdictions i and j in period 1 are denoted, respectively, by g_i and g_j, whereas g_i^2 and g_j^2 denote public goods supplies in period 2.[1] The supply of public goods in each period is determined by the fiscal capacity of a given jurisdiction, described in subsection 2.1, and the fiscal equalization scheme that is in place, described in subsection 2.2.

2.1 Fiscal capacity

Fiscal capacity τ_k in jurisdiction $k = i, j$ depends on the ability (equivalently competence) of the incumbent politician in the given jurisdiction, denoted by η_k, the common economic environment of the federation ε, and the actions of the incumbent politician in terms of the resources diverted away from public good provision towards own consumption, denoted by r_k. The competence levels η_k, which are a permanent feature of the particular incumbent, and the economic environment of the federation ε, which is common to both jurisdictions, are both stochastic and unkown to both voters and incumbents. In particular, the abilities of first period incumbents are identically and independently distributed normal random variables with mean $\mu_\eta = 1$ and variance σ_η^2. The common shock ε is normally distributed with mean $\mu_\varepsilon = 0$ and variance σ_ε^2, and is independent from both competence levels η_i and η_j.

In period 1, both incumbent politicians in jurisdictions i and j decide to take rent r_i and r_j, respectively, out of the tax revenues collected $\bar{\tau}$. These choices are not observed by voters before the election. Rents cannot, of course, be negative, and so $r_k \geq 0$, $k = i, j$. It is also assumed that rents satisfy $\bar{\tau} > \bar{r} \geq r_k$, $k = i, j$.[2] The remaining revenues $\bar{\tau} - r_i$ and $\bar{\tau} - r_j$ are transformed into fiscal capacities τ_i and τ_j as follows

$$\tau_k = (\eta_k + \varepsilon)(\bar{\tau} - r_k) \;\; k = i, j. \tag{1}$$

All other things being equal, the higher the level of competence of the incumbent of a jurisdiction the higher the fiscal capacity of that jurisdiction. Similarly, the better the

[1] We denote, throughout, second period variables by the superscript 2. Also, for ease of notation, we drop the time index for variables relating to the first period.

[2] A possible, and arguably convincing, reason for this restriction is the possibility that a zero provision of public goods triggers an immediate investigation by an independent authority into the workings of the government.

economic environment of the federation, all other things being equal, the better the fiscal capacity of both jurisdictions.

2.2 Fiscal equalization

In practice a typical tax-base-equalization scheme has the following structure. For the revenue source a base is chosen to represent, as closely as possible, the actual base of that revenue source. Total revenues for all jurisdictions from that source are then divided by the nationwide base to arrive at a 'national average revenue rate'. This rate is then applied to the base in a particular jurisdiction and the resulting tax is divided by the provincial population to obtain the per capita yield of the tax at the national average rate. The difference between the jurisdiction's per capita yield and the national per capita yield, multiplied by the jurisdiction's population, represents the base for calculating the equalization payments due to the jurisdiction with respect to that particular revenue source. If the difference is negative (positive), a certain fraction of the difference, called the equalization rate, is paid out to (collected from) the jurisdiction.[3]

Fiscal capacity in equalization programs is not, in practice, deterministic but it may be subject to measurement errors. To capture this we introduce the random variable Γ which captures an incorrect attribution of fiscal capacities across jurisdictions.[4] The fiscal capacity of jurisdiction j is understated by $\Gamma/2$ while the fiscal capacity of jurisdiction i is overstated by the same amount. This variable is unknown both to voters and incumbents, and is given by

$$\Gamma = \frac{(\bar{\tau} - r_j) + (\bar{\tau} - r_i)}{2}\gamma, \tag{2}$$

where γ is normally distributed with mean $\mu_\gamma = 0$ and variance σ_γ^2. The random variable γ is independent of η_i, η_j and ε. This formulation reflects the idea that there is an exogenous source of measurement error γ per unit of revenues so that the total error is proportional to the total revenues spent for public good provision.

The equalization transfer to jurisdiction j is, then, given by

$$z_j = t\left[\frac{(\tau_j - \Gamma/2) + (\tau_i + \Gamma/2)}{2} - \left(\tau_j - \frac{\Gamma}{2}\right)\right] = \frac{t}{2}(\tau_i - \tau_j + \Gamma), \tag{3}$$

where $1 \geq t \geq 0$ is the federation's equalization rate. Naturally, since the budget of the federal economy must balance, we also have that $z_j = -z_i$.

Following (3) (and its counterpart for jurisdiction i) public good provision in jurisdictions

[3]This is, for instance, the equalization system in Canada. In Germany, the equalization rate varies with the difference between the jurisdiction's own fiscal capacity and the the average fiscal capacity in the federation.

[4]While we rather interpret the shock Γ as a mistake in the assessment of fiscal capacities, one might also think of this as a deliberate deviation from pure equalization. Such a deviation might be enacted by the federal government so as to favor some particular jurisdiction. For the present analysis this interpretation would fit the model as long as this bias in the federal government's policy cannot be predicted by voters nor local incumbents. Another possible interpretation might be that citizens do not fully observe and understand the mechanics of the equalization system.

i and j is, then, given, respectively, by

$$g_i = \tau_i + z_i = \tau_i + \frac{t}{2}\left(\tau_j - \tau_i - \Gamma\right), \tag{4}$$

$$g_j = \tau_j + z_j = \tau_j + \frac{t}{2}\left(\tau_i - \tau_j + \Gamma\right). \tag{5}$$

Making now use of (2) in (4) and (5) and solving these equations simultaneously one obtains the level of fiscal capacities τ_j and τ_i, conditional upon the public good supplies g_j and g_i, that is

$$\tau_j = g_j + \theta(g_j - g_i - \Gamma), \tag{6}$$

$$\tau_i = g_i + \theta(g_i - g_j + \Gamma), \tag{7}$$

where

$$\theta = t/2(1-t) \geq 0. \tag{8}$$

The inequality in (8) follows from the restriction on the equalization rate. Notice now, for later use, that, following (8),

$$\frac{\partial\theta}{\partial t} = \frac{1}{2(1-t)^2} > 0, \tag{9}$$

and so θ is a monotonically increasing function of the equalization rate t. However, since citizens are not informed about γ, they cannot infer fiscal capacities from the observation of g_i and g_j. Instead, they must form expectations about fiscal capacities, and the underlying competence levels of the incumbents.

2.3 Payoffs and second period decisions

In period 2, fiscal capacities and the equalization scheme determine public goods supplies g_j^2 and g_i^2 just as in period 1, by equations analogous to (1) to (5). For the fiscal capacity, however, now the competence of the government in the second period is relevant. This is either the competence η_j or η_i of the first period incumbent, if the latter is re-elected, or, if she is defeated, the competence of a challenger which is drawn from the same normal distribution with mean $\mu_\eta = 1$ and variance σ_η. Moreover, the second period government decides on a second period rent r_k^2 which satisfies the same restrictions as the first period rent, i.e., $r_k^2 \geq 0$ and $\bar{\tau} > \bar{r} \geq r_k^2$, $k = i, j$.

Politicians are interested in expropriating rents r collected in both periods and in an exogenous additional rent from winning the elections, denoted by $R > 0$. Denoting by δ the discount factor and by p_I the probability that the incumbent is re-elected for office in the second period, the payoff to the incumbent of jurisdiction j is given by

$$r_j + p_I \cdot \delta(R + r_j^2). \tag{10}$$

Citizens value public goods more than private consumption. Thus, for some constant $\alpha > 1$, the utility of citizens in jurisdiction j is given by

$$u_j = 1 - \bar{\tau} + \alpha g_j + \delta\left(1 - \bar{\tau} + \alpha g_j^2\right). \tag{11}$$

In the second period there is no re-election motive anymore and thus every government will take the maximal rent $r_k^2 = \bar{r}, k = i, j$. Nevertheless, given that $\bar{\tau} > \bar{r}$, there always remains some tax revenue which is used for public good provision. Thus for given, maximal rent-taking behavior, a more competent incumbent still produces a higher fiscal capacity. Now for all equalization rates, the supply of public goods in a jurisdiction is increasing in the fiscal capacity of this jurisdiction. Therefore, a more competent government in a jurisdiction will deliver a higher quantity of the public good to the jurisdiction's citizens. Hence, the citizens in both jurisdictions have an incentive to elect the most competent incumbent. Consequently, in the election at the end of the first period voters vote for the incumbent if their estimate of the incumbent's ability $\tilde{\eta}_j$ exceeds the expected ability of the challenger, which is given by $\mu_\eta = 1$.

3 Equilibrium Analysis

The model is analyzed using a Nash equilibrium where the decisions by voters and incumbents in the first period are simultaneously optimal, given a correct assumption on the other players' behavior. Following the above reasoning, the optimal voting behavior of citizens in jurisdiction j is determined by the estimate $\tilde{\eta}_j$ they form about the competence of the incumbent in this jurisdiction. This estimate is based on the information citizens have at that moment and on an assumption about the rent taking behavior of both incumbents which we denote by $\tilde{r}_j$ and $\tilde{r}_i$.[5] In subsection 3.1, the formation of the expectation $\tilde{\eta}_j$ conditional on $\tilde{r}_j$ and $\tilde{r}_i$ is analyzed.

The incumbent of jurisdiction j decides abouts the rents r_j she actually wants to take, anticipating the impact of this decision on the estimate $\tilde{\eta}_j$ and hence on the probability of winning the election. This is described in subsection 3.2. An equilibrium requires that the actual decisions coincide with the assumptions used by the voters, i.e., $\tilde{r}_j = r_j$ and, similarly, for the other jurisdiction, $\tilde{r}_i = r_i$. To keep the analysis tractable, we restrict attention to symmetric equilibria where the incumbents of both jurisdictions take the same rent r, that is, $r_j = r_i = r$. In subsection 3.3 the rent taken in such a symmetric equilibrium is determined. The analysis is then completed by deriving the impact of an increase in the equalization rate on this rent.

3.1 The citizens' estimate of the incumbent's ability

To describe how voters in jurisdiction j rationally form the estimate $\tilde{\eta}_j$, consider the information they possess at the time of the elections. They know that the incumbent maximizes (10), and they also know the level of taxes $\bar{\tau}$ as well as the equalization rate t. Moreover, they observe the level of public good supplied in both jurisdictions $g_k, k = i, j$.

It is convenient to describe the citizens' estimate in terms of a statistic S_j defined by

$$S_j = \frac{g_j + \theta(g_j - g_i)}{\bar{\tau} - \tilde{r}_j}. \tag{12}$$

This statistic uses only the information available to the voters together with the assumption $\tilde{r}_j$ about the amount of rents diverted by incumbent j in period 1. With (6) and

[5] The supposed strategies $\tilde{r}_j$ and $\tilde{r}_i$, just as the rents r_j and r_i actually chosen, do not depend on the levels of competence η_j and η_i since an incumbent does not know her competence when choosing the first period rent.

(7), (12) becomes

$$S_j = \frac{\tau_j + \theta\Gamma}{\bar{\tau} - \tilde{r}_j}. \tag{13}$$

If citizens now believe that $\tilde{r}_j$ and $\tilde{r}_i$ are being chosen by the incumbents then they will believe that fiscal capacity is given by $\tau_j = (\eta_j + \varepsilon)(\bar{\tau} - \tilde{r}_j)$ and also that the measurement error is $\Gamma = [(\bar{\tau} - \tilde{r}_j) + (\bar{\tau} - \tilde{r}_i)]\gamma/2$. This, in turn, implies–following (13)–that

$$S_j = \eta_j + \varepsilon + \theta\tilde{\rho}_j\gamma, \tag{14}$$

where

$$\tilde{\rho}_j = \frac{(\bar{\tau} - \tilde{r}_j) + (\bar{\tau} - \tilde{r}_i)}{2(\bar{\tau} - \tilde{r}_j)}. \tag{15}$$

A similar condition, given by

$$S_i = \eta_i + \varepsilon - \theta\tilde{\rho}_i\gamma, \tag{16}$$

where

$$\tilde{\rho}_i = \frac{(\bar{\tau} - \tilde{r}_j) + (\bar{\tau} - \tilde{r}_i)}{2(\bar{\tau} - \tilde{r}_i)}, \tag{17}$$

applies to the voters of jurisdiction i.

The equations (14) and (16) show why it is useful to define the particular statistics S_j and S_i. The numerator in (12) is a naive estimate of fiscal capacity in jurisdiction j which is computed from the equalization formula by ignoring the mistake Γ. By dividing this naive estimate through the tax rate after the presumed rent as in (13), one obtains a random number which is additively composed of the competence of the incumbent in one's own jurisdiction and the two federation wide shocks. Thus, acording to (14), citizens' estimate of the ability η_j of the j-incumbent can now be determined additively from the observed statistic S_j and the expected values of ε and γ conditional on the information summarized in the statistics S_j and S_i, denoted by $E(\varepsilon|S_j, S_i)$ and $E(\gamma|S_j, S_i)$. This yields

$$\tilde{\eta}_j = S_j - E(\varepsilon|S_j, S_i) - \theta\tilde{\rho}_j E(\gamma|S_j,\ S_i)\,. \tag{18}$$

In (18), the four random variables $(\varepsilon,\ \gamma,\ S_j,\ S_i)$ determine the estimate $\tilde{\eta}_j$. Now following from (14) and (16), $(\varepsilon,\ \gamma,\ S_j,\ S_i) = (\varepsilon,\ \gamma,\ \eta_j + \varepsilon + \theta\tilde{\rho}_j\gamma,\ \eta_i + \varepsilon - \theta\tilde{\rho}_i\gamma)$. Hence the joint distribution of the random vecor $(\varepsilon,\ \gamma,\ S_j,\ S_i)$ as perceived by the citizens is the same as for the vector of random variables $(\varepsilon,\ \gamma,\ \eta_j + \varepsilon + \theta\tilde{\rho}_j\gamma,\ \eta_i + \varepsilon - \theta\tilde{\rho}_i\gamma)$. In Appendix A.1 it is shown that, based on this identity, the citizens' estimate of the incumbent's ability is given by

$$\begin{aligned} \tilde{\eta}_j \;&=\; \frac{\sigma_\eta^2(\sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\tilde{u}_i^2\sigma_\gamma^2)}{|\Sigma_{22}|}\cdot S_j - \frac{\sigma_\eta^2(\sigma_\varepsilon^2 - \theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2)}{|\Sigma_{22}|}\cdot S_i \\ &+\; \frac{2\sigma_\eta^2\sigma_\varepsilon^2 + \theta^2\sigma_\gamma^2[\tilde{\rho}_j(\tilde{\rho}_j - \tilde{\rho}_i)\sigma_\eta^2 + (\tilde{\rho}_j + \tilde{\rho}_i)^2\sigma_\varepsilon^2]}{|\Sigma_{22}|}, \end{aligned} \tag{19}$$

with

$$|\Sigma_{22}| = \sigma_\eta^2(\sigma_\eta^2 + 2\sigma_\varepsilon^2) \;+\; \theta^2\sigma_\gamma^2[(\tilde{\rho}_j^2 + \tilde{\rho}_i^2)\sigma_\eta^2 + (\tilde{\rho}_j + \tilde{\rho}_i)^2\sigma_\varepsilon^2]. \tag{20}$$

Equation (19) shows the working of yardstick competition in this model. When evaluating the performance of the incumbent in their own jurisdiction, citizens in jurisdiction

j do not only consider the signal S_j relating to fiscal capacity in jurisdiction j, but also the signal S_i relating to the neighboring jurisdiction. As apparent from the sign of the coefficient of S_i in (19), the better the signal from jurisdiction i, the less competent the incumbent of jurisdiction j appears to the citizens of this jurisdiction.

We now turn to analyzing how the incumbent in jurisdiction j uses (19) in order to assess her probability of winning the election.

3.2 The incumbent's decision in jurisdiction j

As explained in subsection 2.3, voters will re-elect the incumbent of jurisdiction j if the estimate in (19) is at least as large as the expected competence of the challenger, $\mu_\eta = 1$. Thus, when choosing rents r_j in period 1, the incumbent politician of jurisdiction j perceives the probability of her re-election to be $p_I = \text{Prob}\{\tilde{\eta}_j \geq \mu_\eta\} = \text{Prob}\{\tilde{\eta}_j \geq 1\}$. Central to her choice problem is the impact of an increase in the rent r_j on this probability, and so we start by determining the probability distribution of $\tilde{\eta}_j$.

This distribution naturally depends on the distribution of the two federation-wide shocks ε and γ, but also, because of yardstick competition, on the distribution of the competence η_i of the incumbent in the other jurisdiction. Moreover, since, by assumption, the incumbent does not know her competence, the distribution of $\tilde{\eta}_j$ also depends on the distribution of η_j (and not on the realization of η_j drawn by the particular incumbent). In addition to the random variables, $\tilde{\eta}_j$ is also affected by the presumed strategies $\tilde{r}_j$ and $\tilde{r}_i$ which are given for the politicians and hence can be treated as parameters. However, by choosing the actual strategy r_j, the incumbent of jurisdiction j affects fiscal capacity τ_j and hence, via the equalization scheme, both statistics S_j and S_i. Thus, by choosing the rent r_j the incumbent influences the observation available to voters. Similarly, the rent r_i actually taken by the incumbent in the other jurisdiction i affects $\tilde{\eta}_j$ by influencing τ_i and hence S_i and S_j.

To obtain the probability distribution of $\tilde{\eta}_j$ in (19) we follow this reasoning and replace $\tau_j = (\eta_j + \varepsilon)(\bar{\tau} - r_j)$, $\tau_i = (\eta_i + \varepsilon)(\bar{\tau} - r_i)$, and $\Gamma = [\bar{\tau} - r_j + \bar{\tau} - r_i]\gamma/2$ in S_j, S_i, from (13), and the counterpart for the i jurisdiction. In doing so one obtains

$$S_j = \frac{\bar{\tau} - r_j}{\bar{\tau} - \tilde{r}_j}(\eta_j + \varepsilon) + \frac{(\bar{\tau} - r_j) + (\bar{\tau} - r_i)}{2(\bar{\tau} - \tilde{r}_j)}\theta\gamma, \tag{21}$$

$$S_i = \frac{\bar{\tau} - r_i}{\bar{\tau} - \tilde{r}_i}(\eta_i + \varepsilon) - \frac{(\bar{\tau} - r_j) + (\bar{\tau} - r_i)}{2(\bar{\tau} - \tilde{r}_i)}\theta\gamma. \tag{22}$$

Using (21) and (22) in (19), it is shown in Appendix A.2 that the estimate $\tilde{\eta}_j$ can be written as a weighted sum of independent normal random variables

$$\tilde{\eta}_j = a_1(r_j)\eta_j + a_2(r_i)\eta_i + a_3(r_j, r_i)\varepsilon + a_4(r_j, r_i)\gamma + a_o\,. \tag{23}$$

The notation illustrates that the weights are functions of the strategies r_j and r_i, while their dependence on the equalization parameter θ is not displayed. From (23), $\tilde{\eta}_j$ is itself normally distributed. Using this fact and making use of $E(\varepsilon) = E(\gamma) = 0$ and

$E(\eta_j) = E(\eta_i) = 1$, we find the expectation and variance of the distribution of $\tilde{\eta}_j$, given, respectively, by

$$\begin{aligned} \mu(r_j, r_i, \theta) &= a_1(r_j)E(\eta_j) + a_2(r_i)E(\eta_i) + a_3(r_j, r_i)E(\varepsilon) + a_4(r_j, r_i)E(\gamma) + a_o \\ &= a_1(r_j) + a_2(r_i) + a_0, \qquad (24) \\ \sigma^2(r_j, r_i, \theta) &= [a_1(r_j)]^2\mathrm{Var}(\eta_j) + [a_2(r_i)]^2\mathrm{Var}(\eta_i) + [a_3(r_j, r_i)]^2\mathrm{Var}(\varepsilon) + [a_4(r_j, r_i)]^2\mathrm{Var}(\gamma) \\ &= \{[a_1(r_j)]^2 + [a_2(r_i)]^2\}\sigma_\eta^2 + [a_3(r_j, r_i)]^2\sigma_\varepsilon^2 + [a_4(r_j, r_i)]^2\sigma_\gamma^2, \qquad (25) \end{aligned}$$

where a_0, a_1, a_2, a_3 and a_4 are defined in (A.6) in the Appendix. A similar expression holds for the estimate by the voter in jurisdiction i of the level of competence for the incumbent of that jurisdiction.

We are now in a position to solve the maximization problem of the incumbent in jurisdiction j. From (10) she chooses r_j to maximize r_j+Prob $\{\tilde{\eta}_j \geq 1\} \cdot \delta(R + \bar{r})$, with necessary condition given by

$$1 + \frac{\partial \text{ Prob}\{\tilde{\eta}_j \geq 1\}}{\partial r_j} \cdot \delta(R + \bar{r}) = 0. \qquad (26)$$

Using normality, the re-election probability is given by

$$\text{Prob}\{\tilde{\eta}_j \geq 1\} = 1 - F(1; \mu(r_j, r_i, \theta), \sigma^2(r_j, r_i, \theta)), \qquad (27)$$

where $F(\cdot; \mu, \sigma^2)$ is the normal distribution with mean μ and variance σ^2, and $\mu(r_j, r_i, \theta)$, $\sigma^2(r_j, r_i, \theta)$ are as defined in (24) and (25).

Using (27), the first order condition (26) becomes

$$1 - \left[\frac{\partial F(1; \mu, \sigma^2)}{\partial \mu} \cdot \frac{\partial \mu(r_j, r_i, \theta)}{\partial r_j} + \frac{\partial F(1; \mu, \sigma^2)}{\partial \sigma^2} \cdot \frac{\partial \sigma^2(r_j, r_i, \theta)}{\partial r_j}\right] \cdot \delta(R + \bar{r}) = 0. \qquad (28)$$

Notice that, for later use, differentiation of $F(1; \mu, \sigma^2)$ with respect to μ gives

$$\frac{\partial F(1; \mu, \sigma^2)}{\partial \mu} = -f(1; \mu, \sigma^2) = -\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{1-\mu}{\sigma}\right)^2}, \qquad (29)$$

where $f(\cdot)$ is the density of the (μ, σ^2)-normal distribution. Moreover, using

$$a_1(r_j) = \frac{\sigma_\eta^2(\sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\tilde{u}_i^2\sigma_\gamma^2)}{|\Sigma_{22}|} \cdot \frac{\bar{\tau} - r_j}{\bar{\tau} - \tilde{r}_j} \qquad (30)$$

as stated in (A.6), we have from (24) that

$$\frac{\partial \mu(r_j, r_i, \theta)}{\partial r_j} = \frac{\partial a_1(r_j)}{\partial r_j} = -\frac{\sigma_\eta^2(\sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\tilde{\rho}_i^2\sigma_\gamma^2)}{|\Sigma_{22}|(\bar{\tau} - \tilde{r}_j)}. \qquad (31)$$

We turn now to the characterization of the equilibrium.

3.3 Symmetric equilibrium

We confine attention to a symmetric equilibrium, an equilibrium that is in which in both jurisdictions incumbents take the same rent $r = r_j = \tilde{r}_j = r_i = \tilde{r}_i$. Then, following from (15) and (17), $\tilde{\rho}_j = \tilde{\rho}_i = 1$. Moreover, following from (24), the definition of the weights $a_1(r), a_2(r)$, and a_o given in (A.6), and (20), we have $\mu(r, r, \theta) = 1$. In a symmetric equilibrium the estimate of the incumbent's competence thus equals the ex ante expected competence μ_η. From the symmetry of the normal distribution, this implies that in a symmetric equilibrium the incumbent is re-elected with probability $1 - F(1; \mu(r, r, \theta), \sigma^2(r, r, \theta)) = 1/2$. Since irrespective of the variance, the normal distribution has half of the probability mass left to the mean, it is the case that

$$\frac{\partial F(1; \mu(r, r, \theta), \sigma^2(r, r, \theta))}{\partial \sigma^2} = 0. \tag{32}$$

In addition, $\mu(r, r, \theta) = 1$ also implies

$$f(1; \mu(r, r, \theta), \sigma^2(r, r, \theta)) = \frac{1}{\sigma(r, r, \theta)\sqrt{2\pi}}. \tag{33}$$

Substituting (29), (31), (32), and (33) into (28), and making use of $\tilde{\rho}_i = 1$ and $r_j = r$ we obtain

$$1 - \frac{1}{\sigma(r, r, \theta)\sqrt{2\pi}} \cdot \frac{\sigma_\eta^2(\sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\sigma_\gamma^2)}{|\Sigma_{22}|(\bar{\tau} - r)} \cdot \delta(R + \bar{r}) = 0. \tag{34}$$

It is shown in Appendix A.3 that, considering the dependence of $\sigma(r, r, \theta)$ on r according to (25), the necessary condition (34) can be solved to yield the rent taken in a symmetric equilibrium

$$r(\theta(t)) = \bar{\tau} - \left(\frac{\sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\sigma_\gamma^2}{(\sigma_\eta^2 + 2\sigma_\varepsilon^2) \cdot (\sigma_\eta^2 + 2\theta^2\sigma_\gamma^2) \cdot 2\pi} \right)^{\frac{1}{2}} \cdot \delta(R + \bar{r}). \tag{35}$$

Equation (35) is central to the paper. Close inspection of this equation reveals that the equilibrium level of rents taken by the incumbents in both jurisdictions critically depends on the variance of competence, σ_η^2, the variance of the federation wide economic shock, σ_ε^2, and on the variance of the measurement error to the equalization transfer, σ_γ^2. Central to our purpose, the equilibrium rent also depends on θ which itself is a function of the rate of equalization transfer, that is $r(\theta(t))$.

Focusing on the equalization transfer rate, t, one observes that, for given noises of competence, economic environment, and transfers, and as long as the equalization transfer is bounded away from zero, equalization transfers increase rent seeking behavior in a federal economy. More specifically:

Proposition 1 *With the rate of equalization bounded away from zero, an increase in the equalization rate increases rents taken by incumbents in a symmetric equilibrium.*

Proof of Proposition 1. See Appendix A.4. □

The result of Proposition 1 shows that fiscal equalization tilts the incumbent politician's trade-off between current rents and the probability of winning the elections towards more rent diversion. In this trade-off, the marginal cost of an additional unit of rent diversion, determined by the loss in the probability of winning the election as given by the second term in (28), is affected by the equalization rate. To see how, recall that the second term in the square brackets in (28) is zero in a symmetric equilibrium. Thus, only the two factors in the first term matter for the equilibrium. The first factor $\partial\mu/\partial r_j$ expresses the fact that an increase in rent taking worsens the signal S_j, and hence, on average, citizens will attribute a lower competence to the incumbent. The second factor shows that for each unit by which this average estimate is reduced, the probability of re-election is reduced according to the density $f = -\partial F/\partial\mu$.

If the equalization rate is increased, the first component of marginal cost, $\partial\mu/\partial r_j$, is reduced in absolute value. That is, with a higher equalization rate, citizens' estimate of the incumbent's competence decreases less steeply with an increase in the rent r_j. This occurs because the signal S_j is increasingly determined by the noise introduced by equalization, and consequently, any given change in observation produced by a given change in rent diversion is increasingly attributed by citizens to this noise rather than to competence. Essentially, equalization reduces the quality of the information available to citizens, and hence rent-taking by the incumbent is less likely to be interpreted as incompetence.

Turning to the second component, we note that with an increasing equalization rate, the statistics S_j and S_i vary more strongly with the noise in the equalization system, and hence they convey less information about the realization of the incumbent's competence η_j. Consequently, for given rent taking strategies, the citizens have less reason to update their estimate of the competence from the ex ante expectation μ_η, placing more mass of the probability distribution of $\tilde{\eta}_j$ close to the ex ante mean μ_η. This implies that the density f of the estimate $\tilde{\eta}_j$ increases if the equalization rate increases, such that from this effect, the marginal cost of rent diversion increases as equalization is intensified. Proposition 1 shows, however, that the first effect dominates and that, overall, the marginal cost of rent diversion is decreased by equalization.

The mistake in the assessment of fiscal capacity is crucial for the effect analyzed in Proposition 1. Thus, one should expect that if there is no such mistake, i.e., if $\sigma_\gamma^2 = 0$, the incumbent politicians cannot 'successfully' hide behind the noise that exists in the equalization system, and so choose to divert zero rents. To emphasize this, we state:

Corollary 1 *An increase in the equalization rate t has no effect on the rents taken by incumbents in a symmetric equilibrium if $\sigma_\gamma^2 = 0$.*

Proof of Corollary 1. The proof of the Corollary readily follows from equation (A.9) in the proof of Proposition 1. □

4 Concluding remarks

A lot of attention has been paid to the efficiency properties of equalization schemes. A rather neglected issue of equalization transfers is how they interact with the incentives of incumbent politicians to divert resources away from public good provision and for personal gain. This paper has explored this aspect. It was shown that an increase in the equalization rate, starting from a strictly positive rate of equalization, tilts the incentive of the incumbents towards more rent extraction.

The analysis presented here suggests a number of extensions, two of which we discuss briefly. First, the impact of equalization on the informational content of public goods supplies has been modelled in a rather specific way by assuming that fiscal capacities are imperfectly measured. It remains an open question at this point whether other forms of incomplete information about the equalization system, for example relating to the equalization rate rather than the base, will produce similar results. Second, the result of Proposition 1 appears to suggest that equalization transfers in a federal economy have an unambiguously negative impact on welfare since they may increase rent seeking behavior. This would be a premature conclusion, however, since equalization transfers, of course, equalize fiscal capacities which, in a richer model, might provide a beneficial insurance effect. The overall impact of an equalization system on welfare, therefore, should be judged on the basis of a genuine comparison between the negative political aspect of equalization entitlements and the insurance benefit arising from the equalization of jurisdiction-specific shocks. While this is left for future research, the result presented here shows that the interaction of fiscal equalization and political incentives is an issue which deserves further attention.

Appendix

A.1 Proof of equation (19)

The vector of random variables $(\varepsilon,\ \gamma,\ S_j,\ S_i) = (\varepsilon,\ \gamma,\ \eta_j + \varepsilon + \theta\tilde{\rho}_j\gamma,\ \eta_i + \varepsilon - \theta\tilde{\rho}_i\gamma)$ has an absolute continuous distribution and hence, following De Groot (1970, p. 55), its variance-covariance-matrix, denoted by Σ, is given by

$$\Sigma = \left(\begin{array}{c|c} \Sigma_{11} & \Sigma_{12} \\ \hline \Sigma_{21} & \Sigma_{22} \end{array}\right) = \left(\begin{array}{cc|cc} \sigma_\varepsilon^2 & 0 & \sigma_\varepsilon^2 & \sigma_\varepsilon^2 \\ 0 & \sigma_\gamma^2 & \theta\tilde{\rho}_j\sigma_\gamma^2 & -\theta\tilde{\rho}_i\sigma_\gamma^2 \\ \hline \sigma_\varepsilon^2 & \theta\tilde{\rho}_j\sigma_\gamma^2 & \sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\tilde{\rho}_j^2\sigma_\gamma^2 & \sigma_\varepsilon^2 - \theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2 \\ \sigma_\varepsilon^2 & -\theta\tilde{\rho}_i\sigma_\gamma^2 & \sigma_\varepsilon^2 - \theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2 & \sigma_\eta^2 + \sigma_\varepsilon^2 + \theta^2\tilde{\rho}_i^2\sigma_\gamma^2 \end{array}\right), \tag{A.1}$$

and its mean vector is

$$E\left(\begin{pmatrix} \varepsilon \\ \gamma \end{pmatrix} | S_j, S_i\right) = E\left(\begin{pmatrix} \varepsilon \\ \gamma \end{pmatrix}\right) + \Sigma_{12}\cdot\Sigma_{22}^{-1}\cdot\begin{pmatrix} S_j - 1 \\ S_i - 1 \end{pmatrix}. \tag{A.2}$$

Solving (A.2) with the help of (A.1), one finds

$$\begin{aligned} E(\varepsilon|S_j,\ S_i) &= \frac{\sigma_\varepsilon^2}{|\Sigma_{22}|}[\sigma_\eta^2 + \theta^2\tilde{\rho}_i(\tilde{\rho}_j + \tilde{\rho}_i)\sigma_\gamma^2]S_j + \frac{\sigma_\varepsilon^2}{|\Sigma_{22}|}[\sigma_\eta^2 + \theta^2\tilde{\rho}_j(\tilde{\rho}_j + \tilde{\rho}_i)\sigma_\gamma^2]S_i \\ &- \frac{\sigma_\varepsilon^2}{|\Sigma_{22}|}[2\sigma_\eta^2 + \theta^2(\tilde{\rho}_j + \tilde{\rho}_i)^2\sigma_\gamma^2], \end{aligned} \tag{A.3}$$

and

$$\begin{aligned} E(\gamma|S_j, S_i) &= \frac{\theta\sigma_\gamma^2}{|\Sigma_{22}|}[\tilde{\rho}_j\sigma_\eta^2 + (\tilde{\rho}_j + \tilde{\rho}_i)\sigma_\varepsilon^2]S_j - \frac{\theta\sigma_\gamma^2}{|\Sigma_{22}|}[\tilde{\rho}_i\sigma_\eta^2 + (\tilde{\rho}_j + \tilde{\rho}_i)\sigma_\varepsilon^2]S_i \\ &+ \frac{\theta\sigma_\gamma^2}{|\Sigma_{22}|}(\tilde{\rho}_i - \tilde{\rho}_j)\sigma_\eta^2, \end{aligned} \tag{A.4}$$

where $|\Sigma_{22}|$ is as in (20). Substituting (A.3) and (A.4) into (18), after some simplification, one obtains (19). □

A.2 Proof of equation (23)

Upon substitution of (21) and (22) into (19) we obtain

$$\begin{aligned}\tilde{\eta}_j &= \frac{\sigma_\eta^2(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\tilde{\rho}_i^2\sigma_\gamma^2)}{|\Sigma_{22}|}\cdot\underbrace{\left[\frac{\bar{\tau}-r_j}{\bar{\tau}-\tilde{r}_j}(\eta_j+\varepsilon)+\frac{(\bar{\tau}-r_j)+(\bar{\tau}-r_i)}{2(\bar{\tau}-\tilde{r}_j)}\theta\gamma\right]}_{S_j} \\ &\quad -\frac{\sigma_\eta^2(\sigma_\varepsilon^2-\theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2)}{|\Sigma_{22}|}\cdot\underbrace{\left[\frac{\bar{\tau}-r_i}{\bar{\tau}-\tilde{r}_i}(\eta_i+\varepsilon)-\frac{(\bar{\tau}-r_j)+(\bar{\tau}-r_i)}{2(\bar{\tau}-\tilde{r}_i)}\theta\gamma\right]}_{S_i} \\ &\quad +\frac{2\sigma_\eta^2\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2\left[\tilde{\rho}_j(\tilde{\rho}_j-\tilde{\rho}_i)\sigma_\eta^2+(\tilde{\rho}_j+\tilde{\rho}_i)^2\sigma_\varepsilon^2\right]}{|\Sigma_{22}|}. \qquad \text{(A.5)}\end{aligned}$$

Upon collecting terms, (A.5) simplifies to

$$\begin{aligned}\tilde{\eta}_j &= \underbrace{\frac{\sigma_\eta^2(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\tilde{\rho}_i^2\sigma_\gamma^2)}{|\Sigma_{22}|}\cdot\frac{\bar{\tau}-r_j}{\bar{\tau}-\tilde{r}_j}}_{a_1(r_j)}\cdot\eta_j-\underbrace{\frac{\sigma_\eta^2(\sigma_\varepsilon^2-\theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2)}{|\Sigma_{22}|}\cdot\frac{\bar{\tau}-r_i}{\bar{\tau}-\tilde{r}_i}}_{-a_2(r_i)}\cdot\eta_i \\ &\quad +\underbrace{\frac{\sigma_\eta^2(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\tilde{\rho}_i^2\sigma_\gamma^2)\cdot\frac{\bar{\tau}-r_j}{\bar{\tau}-\tilde{r}_j}-\sigma_\eta^2(\sigma_\varepsilon^2-\theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2)\cdot\frac{\bar{\tau}-r_i}{\bar{\tau}-\tilde{r}_i}}{|\Sigma_{22}|}}_{a_3(r_j,r_i)}\cdot\varepsilon \\ &\quad +\underbrace{\frac{\sigma_\eta^2(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\tilde{\rho}_i^2\sigma_\gamma^2)\cdot\theta\frac{(\bar{\tau}-r_j)+(\bar{\tau}-r_i)}{2(\bar{\tau}-\tilde{r}_j)}+\sigma_\eta^2(\sigma_\varepsilon^2-\theta^2\tilde{\rho}_j\tilde{\rho}_i\sigma_\gamma^2)\cdot\theta\frac{(\bar{\tau}-r_j)+(\bar{\tau}-r_i)}{2(\bar{\tau}-\tilde{r}_i)}}{|\Sigma_{22}|}}_{a_4(r_j,r_i)}\cdot\gamma \\ &\quad +\underbrace{\frac{2\sigma_\eta^2\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2\left[\tilde{\rho}_j(\tilde{\rho}_j-\tilde{\rho}_i)\sigma_\eta^2+(\tilde{\rho}_j+\tilde{\rho}_i)^2\sigma_\varepsilon^2\right]}{|\Sigma_{22}|}}_{a_o}. \qquad \text{(A.6)}\end{aligned}$$

With the weights defined as illustrated by the braces, (A.6) reduces to (23). □

A.3 Proof of equation (35)

We start by evaluating $\sigma^2(r,r,\theta)$ in (25) at $\tilde{\rho}_i = \tilde{\rho}_j = 1$ and $r_j = \tilde{r}_j = r_i = \tilde{r}_i = r$. Doing this gives

$$\begin{aligned}\sigma^2(r,r,\theta) &= \frac{\sigma_\eta^4(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2)^2}{|\Sigma_{22}|^2}\cdot\sigma_\eta^2+\frac{\sigma_\eta^4(\sigma_\varepsilon^2-\theta^2\sigma_\gamma^2)^2}{|\Sigma_{22}|^2}\cdot\sigma_\eta^2\\ &\quad+\frac{[(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2)-(\sigma_\varepsilon^2-\theta^2\sigma_\gamma^2)]^2\sigma_\eta^4}{|\Sigma_{22}|^2}\cdot\sigma_\varepsilon^2\\ &\quad+\frac{[(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2)+(\sigma_\varepsilon^2-\theta^2\sigma_\gamma^2)]^2\theta^2\sigma_\eta^4}{|\Sigma_{22}|^2}\cdot\sigma_\gamma^2\\ &= \frac{\sigma_\eta^4}{|\Sigma_{22}|^2}\cdot(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2)(\sigma_\eta^2+2\sigma_\varepsilon^2)(\sigma_\eta^2+2\theta^2\sigma_\gamma^2).\end{aligned}\tag{A.7}$$

Taking now the square root of (A.7) and substituting into (34) gives (35). □

A.4 Proof of Proposition 1

Differentiating (35) with respect to t gives

$$\begin{aligned}\frac{\partial r}{\partial\theta}\frac{\partial\theta}{\partial t} &= -\frac{1}{2}\left(\frac{\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2}{(\sigma_\eta^2+2\sigma_\varepsilon^2)(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)2\pi}\right)^{-\frac{1}{2}}\\ &\quad\cdot\frac{2\theta\sigma_\gamma^2(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)-4\theta\sigma_\gamma^2(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2)}{2\pi(\sigma_\eta^2+2\sigma_\varepsilon^2)(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)^2}\cdot\frac{\partial\theta}{\partial t}\cdot\delta(R+\bar{r}).\end{aligned}\tag{A.8}$$

Since $\left\{[\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2]/[(\sigma_\eta^2+2\sigma_\varepsilon^2)(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)2\pi]\right\}^{-1/2} = \delta(R+\bar{r})/(\bar{r}-r)$, equation (A.8) can be re-written as

$$\begin{aligned}\frac{\partial r}{\partial\theta}\frac{\partial\theta}{\partial t} &= -\frac{\delta^2(R+\bar{r})^2}{2(\bar{r}-r)}\cdot\frac{2\theta\sigma_\gamma^2[\sigma_\eta^2+2\theta^2\sigma_\gamma^2-2(\sigma_\eta^2+\sigma_\varepsilon^2+\theta^2\sigma_\gamma^2)]}{2\pi(\sigma_\eta^2+2\sigma_\varepsilon^2)(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)^2}\cdot\frac{\partial\theta}{\partial t}\\ &= \frac{\delta^2(R+\bar{r})^2}{2(\bar{r}-r)}\cdot\frac{\theta\sigma_\gamma^2(\sigma_\eta^2+2\sigma_\varepsilon^2)}{\pi(\sigma_\eta^2+2\sigma_\varepsilon^2)(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)^2}\cdot\frac{\partial\theta}{\partial t}\\ &= \frac{\theta\sigma_\gamma^2\cdot\delta^2(R+\bar{r})}{2\pi(\sigma_\eta^2+2\theta^2\sigma_\gamma^2)^2(\bar{r}-r)}\cdot\frac{\partial\theta}{\partial t}.\end{aligned}\tag{A.9}$$

For $\theta > 0$ and with, following (9), $\partial\theta/\partial t > 0$, (A.9) is strictly positive. □

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