FEDERALISM WITH BICAMERALISM

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Abstract

We analyse horizontal and vertical fiscal externalities in a federal country with a bicameral national system. We show under which conditions, at equilibrium, the two chambers agree or disagree on the choice of a national tax rate.

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1 Introduction

When countries have a federal architecture, fiscal policies are determined by the interaction between vertical and horizontal externalities which distort fiscal policies but in opposite directions.[1] A vertical externality tends to lead to inefficiently too high equilibrium tax rates, while a horizontal externality tends to lead to inefficiently too low equilibrium tax rates.[2] In order to try to understand the interaction between such externalities, the institutional structure of federal countries should be taken into account. Today, all federal countries have bicameral legislatures:[3] local preferences are represented not only by local governments, but also at a national level by a territorially-based upper chamber while the preferences of the whole population are represented by a lower chamber.[4] Thus, one interesting question to analyse is how fiscal policy is affected by both vertical and horizontal externalities in a federal country with a bicameral legislature.

To answer such a question, we propose a simple model describing a federal country with two tiers of government - central and regional governments- and a bicameral national legislature - a proportionally-represented chamber (House) and a geographically-represented chamber (Senate). Both chambers have the same legislative responsibilities so that each decision on taxation or public expenditure has to be approved by both of them in order to pass, i.e. each chamber has the power of veto (egalitarian bicameralism). Both the regional governments and the national government tax perfectly mobile capital income according to the source-based principle. Regional governments play a noncooperative game between them, with the government of the federal country acting as a Stackelberg leader with respect to its regional governments (i.e. a sequential game). Our main result shows under which conditions, at equilibrium, the two chambers agree or disagree on the choice of a national tax rate, depending on the fact that the pivotal voter in the two chambers is the same or not.

Notewithstanding bicameralism is common in many countries, few theoretical papers have examined its consequences on shaping fiscal policies.[5] The issue at stake has typically been a distributional one, namely a bargaining over the division of public expenditures in bicameral legislatures (Ansolabehere et al. (2003)). To analyse such point, and in particular coalition formation, most

[1] See, for example, Keen and Kotsogiannis (2002) and Grazzini and Petretto (2007) for papers analysing the interplay of such externalities.

[2] Because of a vertical externality, when different tiers of government tax the same base, neither of them takes into account the harm caused to the others from the shrinking of the common tax base. On the contrary, because of a horizonthal externality, when governments at the same level tax a mobile base, each of them strategically decreases the tax rate in order to attract more tax base within its borders without taking into account the loss suffered by the others in terms of tax base reduction.

[3] Tsebelis and Money (1997) report that two minor exceptions are the Federal States of Micronesia and the Unites Arab Emirates.

[4] 'In the *Federalist 51*, James Madison suggests that one purpose of dividing the legislature into different chambers is to achieve such separation that makes it more difficult for a collusive faction to control the whole legislature' (Diermeier and Myerson (1999) p. 1195).

[5] Tsebelis and Money (1997) and Cutrone and McCarty (2006) provide comprehensive surveys on bicameralism, and also references on the empirical literature.

papers use cooperative game theory models of voting power.[6] A noncooperative approach is instead used by Diermeier and Myerson (1999) and Ansolabehere et al. (2003). By using a noncooperative model of lobbying, the first paper analyses how bicameralism affects the internal organization of legislatures, namely it examines the incentives to delegate decision rights in a game between chambers. In particular, it shows that bicameralism can encourage a chamber to create internal veto players or supermajority rules. The second paper concentrates the attention on the effects of malapportionment, i.e. highly unequal representation of the population, in bicameral legislatures on the distribution of public expenditures. While there exists large empirical evidence showing a positive relationship between the share of public expenditures a district receives and its per-capita seats in the legislature, this paper shows that, contrary to unicameral settings, in a bicameral legislature, unequal representation is not sufficient to explain maldistribution of government spending. Other institutional rules, as for example supermajority rules or proposal power assigned to the malapportioned chamber, are required to explain such phenomenon.[7]

To the best of our knowledge, the novelty of this paper is to analyse how bicameralism can affect capital taxation in a federal country when both vertical and horizontal externalities interact. Previous analyses of such interaction between vertical and horizontal externalities (e.g. Keen and Kotsogiannis (2002), Grazzini and Petretto (2007), Kelders and Koethenbuerger (2010)) have not taken into account the possible role played by a constitutional feature such as bicameralism on shaping national capital tax rates, at equilibrium.[8]

The plan of the paper is the following. Section 2 presents the model. Section 3 analyses voting on regional tax policy by regional governments, while section 4 analyses voting on national tax policy by the national government. Section 5 examines whether the national tax policy chosen by the House is also optimal from the viewpoint of the Senate. Finally, section 6 contains some concluding remarks.

2 The model

We study a two-period model with a federal country where there is an odd number of asymmetric regions i, $i = 1, ..., I$, each populated by a different number n_i of identical individuals.[9] At the federal level, we suppose a bicameral national legislature made by two different chambers, the House and the Senate. The House legislators are the representatives, and the Senate legislators are the senators. Since we are only interested in analysing financial legislation, we suppose that for such issue there is an egalitarian bicameralism. In our simple model, this means that a national decision on tax policy can be taken only if both chambers vote in favour of it. As it will be clearer below, however, we suppose a different order of voting for the two chambers.

[6] See the discussion on the references cited in Ansolabehere et al. (2003).

[7] For other papers, see also Kalandrakis (2004), Muthoo and Shepsle (2008), and Crémer and Palfrey (1999).

[8] For empirical analyses on horizontal and vertical fiscal interaction in Canada, see Karkalakos and Kotsogiannis (2007) and Esteller-Moré and Solé-Ollé (2002).

[9] Following Lockwood (2002), we assume that the population within any region is homogenous in order to abstract the role of strategic-voting for the delegates (Besley and Coate (2003)).

We assume that the Constitution fixes the rules to represent regions' preferences at national level - the representation dimension (Crémer and Palfrey (1999)); the rules establishing the allocation of powers between political units at different levels, i.e. public goods' provision and taxing authority; and the rules governing the interaction between national and regional units. In particular, the Constitution fixes two different rules to elect the delegates to the House and to the Senate. The House is a proportionally-represented chamber which adopts *population-proportional representation*: each region is represented proportionally to its population, thus more populated regions are also more represented. The Senate is a geographically-represented chamber and adopts *unit representation*: each region is assigned the same absolute representation independently of its population.[10] To simplify, we assume that each region is represented by a Senate delegate. Both national and regional governments have the power to levy a per unit tax on capital income, which is taxed according to the source based principle. Capital is assumed perfectly mobile while agents are immobile. Tax revenues are used by national and regional governments to finance lump-sum transfers to their citizens. The interaction between national and regional units is modeled as a three-stage game. Events unfold as follows. First, at national level, the House chooses the national tax rate, and a national lump-sum transfer. Second, at the local level, each region i, $i = 1, ..., I$, chooses both the level of the regional tax, and the amount of a regional lump-sum transfer. Third, agents make their consumption and investment decisions. After the game is played, the Senate has to check whether the national tax rate, and the national lump-sum transfer chosen by the House is also optimal from its viewpoint.

Both national and regional assemblies adopt majority-voting. Since all the agents in a region are identical, each regional decision simply reflects the preferences of the residents (Lockwood (2002)). At the national level, under the assumption that the number of the House delegates is odd, the House's decision reflects the preferences of the median representative, who may represent any region, even if he or she will more probably represent a large region, because of the House's population-proportional representation.[11] Instead, the Senate's decision reflects the preferences of the median senator who, *de facto*, represents the residents of the median region.[12]

The model we propose is an adaptation of Keen and Kotsogiannis (2002), and Grazzini and Petretto (2007) to a federal country with a bicameral legislature. In a region $i = 1, ..., I$, all agents own a fixed initial endowment E_i, $i = 1, ..., I$, of first period income.[13] His/her preferences are described by the following utility function

[10] For example, in the U.S. Congress, the House of Representatives approximates population-proportional representation and the Senate adopts unit representation. Such rules imply a trade-off: population-proportional representation guarantees a greater retention of local sovereignty for more populated regions, while unit representation serves to moderate requests coming from such larger regions (Crémer and Palfrey (1999)).

[11] Since all residents of a region are assumed to be identical, the House delegates coming from the same region are also identical.

[12] Since all residents of a region are identical, the Senate delegate is identical to the regional policy-maker. This set-up may approximate the election of members of the *Bundesrat* in Germany where delegates are members of the government of the *Länder*. Notice, however, that the *Bundesrat* is not a second chamber of the German Parliament because it is a legislative body that represents the sixteen *Länder* at federal level.

[13] The subscript i is also used to denote an agent living in region $i = 1, ..., I$.

$$U_i = U(C_i^1) + C_i^2, \qquad i = 1, ..., I, \tag{1}$$

where $U(\cdot)$ is a well-behaved utility function, and C_i^1 and C_i^2 denote consumption in the first and second period, respectively. In the first period, each agent decides how much to save and where to save. His/her budget constraint is given by

$$E_i = C_i^1 + k_i^i + \sum_j k_i^j, \qquad i, j = 1, ..., I, \; i \neq j, \tag{2}$$

where k_i^j denotes individual savings, with the subscript referring to the region i where an agent lives, and the upperscript referring to the region j where he/she chooses to save. Accordingly, individual savings are given by $S_i \equiv E_i - C_i^1 = k_i^i + \sum_j k_i^j$, $i, j = 1, ..., I$, $i \neq j$. In the second period, each agent receives principal and interest on his/her savings, plus a lump-sum transfer from both the regional and the national government. Thus, the second period budget constraint for an agent i is given by

$$C_i^2 = [1 + (r^i - t^i - T)]k_i^i + \sum_j [1 + (r^j - t^j - T)]k_i^j + g^i + G, \qquad i, j = 1, ..., I, \; i \neq j, \tag{3}$$

where r^i, $i = 1, ..., I$, denotes the gross remuneration to savings in region i; t^i, T denote the regional and the national tax rate, respectively; g^i, G denote the regional and the national per capita lump-sum transfer, respectively.[14]

In all regions, the same consumption good is produced by using the same technology, which uses capital as the sole input. Specifically, in each region, the production function is defined as

$$f(K^i), \qquad i = 1, ..., I, \tag{4}$$

where $K^i = k_i^i + \sum_i k_j^i$, $i, j = 1, ..., I$, $i \neq j$, denotes total savings in each region, and f is increasing, strictly concave, and at least three times continuously differentiable. Furthermore, we suppose that the market is perfectly competitive, and accordingly firms' profit maximising behaviour implies the following familiar condition on marginal factor productivity:[15]

$$f'(K^i) = r^i, \qquad i = 1, ..., I, \tag{5}$$

and thus the demand for capital:

$$K^i = K(r^i) \qquad i = 1, ..., I. \tag{6}$$

[14] See, for example, Persson and Tabellini (1992) and Grazzini and Petretto (2007) for the same assumption on savings' taxation financing lump-sum transfers to citizens. This simplified framework corresponds to the case where national and regional public goods are perfect substitutes, and the marginal valuation of public spending is equal to unity.

[15] Derivatives are denoted by a prime for functions of one argument.

Rents arising in region i, $\Pi^i \equiv f(K^i) - f^{'}(K^i)K^i$, $i = 1, ..., I$, are assumed to be fully taxed at the regional level.[16] Accordingly, the regional budget constraints obtain as

$$t^i K^i(r^i) + \Pi^i(r^i) = g^i n_i, \qquad i = 1, ..., I, \tag{7}$$

while the national budget constraints obtain as

$$T \sum_i K^i(r^i) = G \sum_i n_i \qquad i = 1, ..., I. \tag{8}$$

In each region, consumer solves his/her optimization problem by maximising his/her utility function (1) subject to the first and second period budget constraint (2) and (3). It is easy to check that the first order conditions imply that:

$$MRS_{C_i^1, C_i^2} = 1 + \rho, \qquad i = 1, ..., I, \tag{9}$$

where ρ denotes the net return to savings, which is different from the cost of capital for firms because of the presence of savings taxation. Further, the assumption of perfect mobility of capital implies that arbitrage by capital investors insures that, in each region, an identical net return ρ will prevail:

$$\rho = r^i - \tau^i, \qquad i = 1, ..., I, \tag{10}$$

where $\tau^i = t^i + T$, $i = 1, ..., I$, is the consolidated tax rate. Perfect mobility of capital implies that investors share a common capital market, and thus the net returns to savings across regions is the same. From (9), the individual first and second period demand functions obtain as $C_i^1(\rho)$ and $C_i^2(\rho)$, $i = 1, ..., I$, respectively, while supply function obtains as $S_i(\rho)$, $i = 1, ..., I$. Assuming full employment of capital, the common rate of return ρ is determined by using the market clearing condition

$$\sum_i K^i(\rho + \tau^i) = \Gamma(\rho), \qquad i = 1, ..., I, \tag{11}$$

where $\Gamma(\rho) \equiv \sum_{i=1}^{I} S_i$ is total savings, i.e. total supply of capital, with $\Gamma'(\cdot) \geqslant 0$. The net return ρ is thus the solution to the above equation, which means that it is a function of t^i and T, i.e. $\rho = \rho(t^i, T)$. Differentiating (11) with respect to t^i, $i = 1, ..., I$, and ρ yields:

$$\frac{\partial \rho}{\partial t^i} = \frac{K^{i'}}{\Gamma' - \sum_{i=1}^{I} K^{i'}}, \qquad i = 1, ..., I, \tag{12}$$

which implies

$$-1 < \frac{\partial \rho}{\partial t^i} < 0, \qquad i = 1, ..., I. \tag{13}$$

[16] We also assume that rent taxation is not sufficient to entirely finance lump-sum transfers. Since rents are a component of second-period income for consumers, either directly because they are earned by consumers, or indirectly via a regional or a national lump-sum transfer, nothing would change if rents were not taxed, or they were taxed at a national level. For a discussion on the role of the allocation of rents between different tiers of governments with respect to production efficiency, see Kotsogiannis and Makris (2002).

Similarly, by differentiating (11) with respect to T and ρ yields:

$$\frac{\partial \rho}{\partial T}=\frac{\sum_i K^{i\prime}}{\Gamma'-\sum_i K^{i\prime}}=\sum_i \frac{\partial \rho}{\partial t^i}, \qquad i=1,...,I, \tag{14}$$

which implies

$$-1<\frac{\partial \rho}{\partial T}<0. \tag{15}$$

In region i, $i=1,...,I$, we also obtain that

$$\frac{\partial r^i}{\partial t^i}>0, \quad \frac{\partial r^i}{\partial t^j}<0, \quad \frac{\partial r^i}{\partial T}>0, \qquad i,j=1,...,I, \quad i\neq j, \tag{16}$$

and

$$\frac{\partial K^i}{\partial t^i}<0, \quad \frac{\partial K^i}{\partial t^j}>0, \quad \frac{\partial K^i}{\partial T}<0 \qquad i,j=1,...,I \quad i\neq j. \tag{17}$$

3 Voting on capital taxation

3.1 Regional capital tax rates voted by regional governments

In stage two of the game, each region i, $i=1,...,I$, has to decide the tax rate to levy on each unit of capital located in its jurisdiction by majority voting. Such a decision is made by behaving as a Nash player with respect to other regions, i.e. taking as given the other regional tax rates, and as a Stackelberg follower with respect to the national government, i.e. taking as given the level of the national tax rate T. Accordingly, regional fiscal choices are made without taking into account their effects on the federal government budget constraint.[17] By the solution to the consumer maximization problem in stage three and by the regional government budget constraint (7), as all agents in a region are identical, the indirect utility function of an agent i obtains as

$$\begin{aligned} V_i = U(E_i - S_i(\rho)) + (1+\rho)\, S_i(\rho) + \qquad\qquad\qquad\qquad\qquad\qquad (18)\\ +\frac{1}{n_i}\left(t^i K^i(\rho+\tau^i)+\Pi^i(\rho+\tau^i)\right)+T\frac{\sum_i K^i(\rho+\tau^i)}{\sum_i n_i}, \quad i=1,...,I, \end{aligned}$$

where the reader must keep in mind that ρ depends on t^i and T, i.e. $\rho=\rho(t^i,T)$. Since $\Pi^{i\prime}=-K^i$, the first order condition of (18) with respect to t^i, after some manipulations,[18] obtains as follows

$$\frac{\partial \rho}{\partial t^i}S_i(\rho)-\frac{K^i}{n_i}\left(1+\frac{\partial \rho}{\partial t^i}\right)+\frac{1}{n_i}\left(K^i+t^i\frac{\partial K^i}{\partial t^i}\right)+T\frac{\sum_i \frac{\partial K^i}{\partial t^i}}{\sum_i n_i}=0. \tag{19}$$

All the terms in this expression have a familiar interpretation in the literature on fiscal federalim. Following, for example, Grazzini and Petretto (2007), from (13), the first term describes the negative impact on the net remuneration to individual savings due to an infinitesimal rise in t^i. It describes

[17] We assume that, at stage two of the game, the residents of the region where the House median delegate lives do not know that the House median delegate comes from their region, otherwise they could anticipate that they will be decisive at the House, and thus could adjust the choice on ρ_j.

[18] An application of the envelope theorem is behind (19) and the following first order conditions (23) and (30).

a *horizontal externality*: The government of region i does not take into account the harm borne by citizens of the other regions when an increase in t^i leads to a decrease in the net remuneration to savings. The second term is also negative, and it describes how an increase in the regional tax rate, which determines an increase in the cost of capital, leads to a decrease in rent tax revenue. In terms of a *horizontal externality*, the government of region i does not take into account the benefits received by the citizens of the other regions when capital invested within their borders increases, and also rent tax revenue increases, because of an increase in t^i. The third term represents the sum of the direct and the indirect effect on regional tax revenue of the tax increase. As usual, the direct effect is positive while the indirect effect is negative, in the case of a positive tax. More precisely, the latter describes the positive *horizontal externality*, in terms of capital flight, which benefits other regions when region i increases its tax rate. Since region i, when it increases its tax rate, does not take into account such an externality, it perceives this indirect effect in a negative way, i.e. as a deadweight loss, that creates a disincentive to redistribution. Finally, the fourth term represents the impact on national tax revenue deriving from a change in the national tax base due to an infinitesimal rise in t^i, i.e. a *vertical externality* from the regional to the national level (a *tax base effect*). More precisely, an increase in t^i leads to a decrease in savings in region i while it leads to an increase in savings in other regions.

Condition (19) defines region i's reaction function:

$$t^i = t^i(t^1, ..., t^j, ..., t^I, T) \equiv t^i(t^{-i}, T), \qquad i, j = 1, ..., I, \qquad i \neq j, \tag{20}$$

and thus

$$\rho = \rho(t^1\left(t^{-1}, T\right), ..., t^I\left(t^{-I}, T\right), T). \tag{21}$$

A Nash equilibrium of the game played by the regions is given by the solution to the system of the above reaction functions.

3.2 The national capital tax rate voted by the House

In stage one of the game, the House votes on the national tax rate T. Since the House's choice on T automatically determines the level of the lump-sum transfer G, the policy problem faced by the House is one-dimensional, so that we can apply the median voter theorem. The House chooses the tax rate T in order to maximise the welfare of the median representative, $i = m$. Since he/she acts as a national legislator, his/her optimisation problem is subject both to the federal public budget constraint and the public budget constraint of his/her region, and thus his/her objective function obtains as

$$\begin{gathered} V_m = U(E_m - S_m(\rho)) + (1+\rho)\, S_m(\rho) + \\ + \frac{1}{n_m}\left(t^m K^m(\rho+\tau^m) + \Pi^m(\rho+\tau^m)\right) + T\frac{\sum_i K^i(\rho+\tau^i)}{\sum_i n_i}, \end{gathered} \tag{22}$$

where the reader must keep in mind that $t^m = t^m\left(t^{-m}, T\right)$, and the net remuneration of capital is given in (21), so that the House objective function differs with respect to the one of a regional government (18). The first order condition of (22) with respect to T is given by

$$\frac{dV_m}{dT} = \alpha S_m(\rho) - \frac{K^m}{n_m}\left(\alpha + 1 + \frac{\partial t^m}{\partial T}\right) + \tag{23}$$
$$+\frac{1}{n_m}\left(\frac{\partial t^m}{\partial T}K^m + t^m \Psi^{mH}\right) + \frac{1}{\sum_i n_i}\left(\sum_i K^i + T\sum_i \Psi^{iH}\right) = 0,$$

where

$$\alpha \equiv \frac{\partial \rho}{\partial T} + \sum_{i=1}^{I} \frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}, \tag{24}$$

and

$$\Psi^{iH} \equiv K^{i\prime}\left(\alpha + 1 + \frac{\partial t^i}{\partial T}\right), \tag{25}$$

and we have used $\frac{\partial \Pi^m}{\partial r^m} = -K^m(\rho + \tau^m)$. Notice that α describes the effect of an infinitesimal increase of T on the net remuneration to savings (21): *directly,* i.e. $\frac{\partial \rho}{\partial T}$, and *indirectly* via the change in the regional tax rates, i.e. $\frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}$, $i = 1, ..., I$. The sign of α is provided in the following

Lemma 1.
(i) If $\frac{\partial t^i}{\partial T} > 0 \Longrightarrow \alpha < 0$;
(ii) if $\frac{\partial t^i}{\partial T} < 0$ and $\left|\frac{\partial \rho}{\partial T}\right| \geqslant \left|\sum_i \frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}\right| \Longrightarrow \alpha < 0$;
(iii) if $\frac{\partial t^i}{\partial T} < 0$ and $\left|\frac{\partial \rho}{\partial T}\right| < \left|\sum_i \frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}\right| \Longrightarrow \alpha > 0$.

Proof. See the Appendix.

Notice that, in what follows, we restrict our attention to the economically meaningful cases (i) and (ii) when an infinitesimal change in the national tax rate negatively affects the net remuneration to savings, i.e. $\alpha < 0$. This corresponds to the case where either national and local tax rates are strategic complements or they are strategic substitutes, but the direct effect of the national tax rate on the net remuneration of savings is greater than the indirect one.[19] Further, Ψ^{iH} describes the effect of a change in T on the regional demand for capital, and it can be either positive or negative depending on the sign of the effect of the national tax rate T on the gross remuneration to savings, i.e. $\frac{d(\rho+\tau^i)}{dT} = \alpha + 1 + \frac{\partial t^i}{\partial T}$ with ρ given in (21). In what follows, it seems to us economically reasonable to assume that an increase in the national tax rate T has a positive effect on the cost of capital, i.e. $\alpha + 1 + \frac{\partial t^i}{\partial T} > 0$, so that $\Psi^{iH} < 0$.[20]

We are now in a position to discuss the terms in (23), which again have a familiar interpretation. The first term describes the negative impact of an infinitesimal increase in the national tax rate T on the net remuneration to individual savings, and it can be interpreted in terms of a *horizontal*

[19] Both the theoretical and the empirical literature on fiscal federalism has analysed whether national and local tax rates should be considered strategic substitutes or complements. For theoretical papers, see for example, Keen and Kotsogiannis (2002, 2003) and Kelders and Koethenbuerger (2010). The empirical results are mixed. For instance, strategic substitutabilty is found in a work by Goodspeed (2000), and strategic complementarity is instead found in a work by Besley and Rosen (1998).

[20] In a symmetric set-up, and under plausible assumptions, Grazzini and Petretto (2007) show that $\alpha + 1 + \frac{\partial t^i}{\partial T} > 0$.

externality (see discussion after (19)). The second negative term is analogous to the second term in (19), and it describes how rent tax revenue is affected by a change in the national tax rate through a change in the cost of capital. The third term describes a *vertical externality*, and it is given by the sum of the direct and the indirect effects on regional tax revenue of an increase in the national tax rate. The direct effect is positive (negative) when national and regional tax rates are strategic complements (substitutes), i.e. a *revenue effect*.[21] The indirect effect is negative because $\alpha + 1 + \frac{\partial t^i}{\partial T} > 0$, i.e. a *tax-base effect*. Finally, the forth term describes the sum of the direct and the indirect effects on national tax revenue of an increase in the national tax rate. The direct effect is always positive while the indirect effect is negative because $\alpha + 1 + \frac{\partial t^i}{\partial T} > 0$. As it will be useful below, let us define Ω^H the sum of the indirect effects on regional and national tax revenue of an increase in the national tax rate from the viewpoint of the House

$$\Omega^H \equiv t^m \frac{\Psi^{mH}}{n_m} + T \frac{\sum_i \Psi^{iH}}{\sum_i n_i} < 0, \tag{26}$$

because $K^{i\prime} < 0$, and $\alpha + 1 + \frac{\partial t^m}{\partial T} > 0$.

By solving (23), the optimal value of the national tax rate from the viewpoint of the House, T^H, obtains as follows

$$T^H = T(t^1\left(t^{-1}, T\right), ..., t^I\left(t^{-I}, T\right)), \tag{27}$$

so that the net remuneration on savings rewrites as

$$\rho = \rho\left(t^1\left(t^{-1}, T\right), ..., t^I\left(t^{-I}, T\right), T\left(t^1\left(t^{-1}, T\right), ..., t^I\left(t^{-I}, T\right)\right)\right). \tag{28}$$

4 Agreement or disagreement between the two chambers?

4.1 The national capital tax rate voted by the Senate

After the game is played, we check whether the national tax rate chosen by the House is also optimal from the viewpoint of the Senate. To investigate this point, consider the Senate objective function evaluated at the equilibrium of the game. Let us define M the median senator, and V_M the median Senator objective function. Accordingly, from the viewpoint of the Senate, the national tax rate is inefficiently too high (low), at equilibrium, i.e. there would be overtaxation (undertaxation), when $\left.\frac{\partial V_M}{\partial T}\right|_{T^H} < (>)0$.

Since the Senate decision reflects the preferences of the median senator, we assume that the Senate evaluates the choice on the national tax rate made by the House by taking into account both the public budget constraint of the region from which the median senator comes from and the federal public budget constraint. Thus, the median senator objective function obtains as

$$\begin{aligned} V_M = U(E_M - S_M(\rho)) + (1+\rho)\, S_M(\rho) + \\ + \frac{1}{n_M}\left(t^M K^M(\rho + \tau^M) + \Pi^M(\rho + \tau^M)\right) + T\frac{\sum_i K^i(\rho + \tau^i)}{\sum_i n_i}. \end{aligned} \tag{29}$$

[21] See, for example, Goodspeed (2000).

Accordingly, the first order condition with respect to T is given by

$$\frac{dV_M}{dT} = \beta S_M(\rho) - \frac{K^M}{n_M}\left(\beta + 1 + \frac{\partial t^M}{\partial T}\right) + \tag{30}$$
$$+\frac{1}{n_M}\left(\frac{\partial t^M}{\partial T}K^M + t^M \Psi^{MS}\right) + \frac{1}{\sum_i n_i}\left(\sum_i K^i + T\sum_i \Psi^{iS}\right) = 0,$$

where

$$\beta \equiv I\frac{\partial \rho}{\partial T} + \sum_i \frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}, \tag{31}$$

and

$$\Psi^{iS} \equiv K^{i\prime}\left(\beta + 1 + \frac{\partial t^i}{\partial T}\right), \tag{32}$$

with $\sum_{i=1}^{I} \frac{\partial T}{\partial t^i}\frac{\partial t^i}{\partial T} = I$. As α, also β describes the direct and the indirect effects of an infinitesimal increase of T on the net remuneration to savings, but contrary to α, β takes into account the net remuneration to savings resulting at the end of the game given in (28). The sign of β is provided in the following

Lemma 2.
(i) If $\frac{\partial t^i}{\partial T} > 0 \Longrightarrow \beta < 0$;
(ii) if $\frac{\partial t^i}{\partial T} < 0$ and $\left|\frac{\partial \rho}{\partial T}\right| \geqslant \left|\sum_i \frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}\right| \Longrightarrow \beta < 0$;
(iii) if $\frac{\partial t^i}{\partial T} < 0$ and $\left|\frac{\partial \rho}{\partial T}\right| < \left|\sum_i \frac{\partial \rho}{\partial t^i}\frac{\partial t^i}{\partial T}\right| \Longrightarrow \beta > 0$;
(iv) $\alpha > \beta$.

Proof. See the Appendix.

As for α, in what follows, we restrict our attention to the economically meaningful cases (i) and (ii) when an infinitesimal change in the national tax rate negatively affects the net remuneration to savings, i.e. $\beta < 0$. Further, as Ψ^{iH}, Ψ^{iS} also describes the effect of a change in T on the regional demand for capital. For the same reasons discussed above, we only consider the case when an increase in the national tax rate T has a positive effect on the gross remuneration to savings, i.e. $\frac{d(\rho+\tau^i)}{dT} = \beta + 1 + \frac{\partial t^i}{\partial T} > 0$, with ρ in (28). This implies that $\Psi^{iS} < 0$.

Each term in (30) can be given a simple interpretation equivalent to the ones already provided for the House with the only difference that now the viewpoint is that of the Senate, and the net remuneration of capital is (28). As it will be useful below, let us define Ω^S the sum of the indirect effects on regional and national tax revenue of an increase in the national tax rate from the viewpoint of the Senate

$$\Omega^S \equiv t^M\frac{\Psi^{MS}}{n_M} + T\frac{\sum_i \Psi^{iS}}{\sum_i n_i} < 0, \tag{33}$$

because $K^{i\prime} < 0$, and $\beta + 1 + \frac{\partial t^M}{\partial T} > 0$.

4.2 House and Senate with an identical median voter

Let us firstly concentrate our attention on a simplified framework. We suppose that the median voters of the two chambers coincide, i.e. $m = M$, and that such median voter represents the average agent over the whole population, i.e. $K^m/n_m = K^M/n_M = \sum_i K^i / \sum_i n_i$. It is easy to check that such a set-up corresponds to the one where both the House and the Senate maximise a utilitarian social welfare function.

We are now in a position to state the following

Proposition 1 *There is undertaxation (overtaxation) from the viewpoint of the Senate iff* $1+\frac{\partial t^i}{\partial T} > (<) 0$, $i = 1, ..., I$. *The Senate agree on the national tax rate chosen by the House iff* $1 + \frac{\partial t^i}{\partial T} = 0$.

Proof. See the Appendix.

The intuition behind this result is linked to the roles played by both horizontal and vertical externalities. Because of horizontal externality, regional tax rates tend to be fixed at inefficiently low levels. Take for example the case when national and regional tax rates are strategic complements. By voting after the game is played, the Senate has more informations with respect to the House, and realizes that an increase in the national tax rate can be used to push regional tax rates up, thus countering the distortionary effect of the horizontal externality. For this reason, from the viewpoint of the Senate, the national tax rate chosen by the House is inefficiently too low. At the first stage of the game, the House cannot take appropriately into account the fact that the national tax rate depends on the regional reaction functions to the national tax rate itself. The same type of reasoning applies to the overtaxation result.

4.3 House and Senate with different median voters

Let us now consider that the House and the Senate median voters are different. However, to be able to analyse such a case, let us suppose a symplified set-up where there are only two regions in the federation, namely m and M. This implies that $S_m(\rho) - \frac{K^m}{n_m} = -\left(S_M(\rho) - \frac{K^M}{n_M}\right)$, namely that the amount of capital imported (exported) by the region m has to be equal to the amount of capital exported (imported) by the region M. Let us also suppose that $K^m/n_m - \sum_i K^i / \sum_i n_i = -\left(K^M/n_M - \sum_i K^i / \sum_i n_i\right)$. This means that the per-capita capital investment in one region is lower than in the other region, and that the distance between the regional per-capita capital investment and the national average per-capita capital investment is the same for the two regions. We can now state the following

Proposition 2 *There is undertaxation (overtaxation) from the viewpoint of the Senate iff* $S_M(\rho) - \frac{K^M}{n_M} < (>) \frac{\Omega^H + \Omega^S}{\alpha - \beta}$. *The Senate agree on the national tax rate chosen by the House iff* $S_M(\rho) - \frac{K^M}{n_M} = \frac{\Omega^H + \Omega^S}{\alpha - \beta}$.

Proof. See the Appendix.

The intuition for this proposition depends on the fact that the region, where the Senate median voter lives, is a capital exporter (importer), i.e. $S_M(\rho) - \frac{K^M}{n_M} > (<) 0$. Indeed, $\frac{\Omega^H + \Omega^S}{\alpha - \beta} < 0$, and if $S_M(\rho) - \frac{K^M}{n_M} > 0$, then there will be overtaxation from the viewpoint of the Senate while if $S_M(\rho) - \frac{K^M}{n_M} < 0$, and it is sufficiently low, i.e. $S_M(\rho) - \frac{K^M}{n_M} < \frac{\Omega^H + \Omega^S}{\alpha - \beta}$, then there will be undertaxation from the viewpoint of the Senate. To grasp the intuition behind this result, notice that when the median representative lives in a region m which is a capital importer (exporter), the median senator lives in a region M which is a capital exporter (importer). In each region, the government tends to fix a regional tax rate which is inefficiently too low (high) when it is a capital importer (exporter). Consider, for example, the case when region m (M) is a capital importer (exporter), i.e. $S_M(\rho) - \frac{K^M}{n_M} > 0$. Then t^m (t^M) is fixed at an inefficiently too low (high) level. To counter this, the median representative will choose a national tax rate T which is inefficiently too high from the viewpoint of the median senator who would, instead, prefer a lower national tax rate to counter a too high t^M. The same kind of reasoning also applies to obtain undertaxation from the Senate viewpoint.

5 Concluding remarks

In this paper, we have analysed how bicameralism can affect national fiscal policy in a federal country where both vertical and horizontal externalities play a role. In particular, our simple model tries to take into account the sequential structure of the legislative process in a bicameral institutional setting where the two chambers can be considered as 'competitive organizations in a market for legislation.'[22] In the case of an egalitarian bicameralism, for at least financial legislation, national fiscal policy is voted in a chamber (the House, in our model), and may not be amended by the other chamber (the Senate). This corresponds to the case of a closed rule, so that any national fiscal policy must be approved by majority voting in both chambers. In this sequential set-up, the Senate cannot make proposals or amendments, but it can only votes in favour or rejects proposals that pass the House.[23,24]

Our two main results show under which conditions the two chambers disagree on the national fiscal policy. First, when the House and the Senate share the same majority, i.e. the House median legislator comes from the same region of the Senate median legislator, undertaxation (overtaxation) arises from the viewpoint of the median senator if and only if the regional and the national tax rates are strategic complements or moderately strategic substitutes (highly strategic substitutes). Thus, even if the majority in both chambers is determined by the same median legislator, the two chambers disagree on the national fiscal policy because when the Senate votes, it has an informational advantage on the working of the capital market, due to the sequential nature of the

[22] Diermeier and Myerson (1999) p. 1184.

[23] A closed rule is a special case, but it allows to avoid to model the resolution of differences between the chambers (Ansolabehere et al. (2003)).

[24] In this sense, the two chambers 'are more like monopolistic producers of complementary goods than like duopolistic producers of a common good.' (Diermeier and Myerson (1999) p. 1184).

game.[25]

Second, when the House and the Senate have different median legislators, and the federal country is only made of two regions, the result on overtaxation (undertaxation) from the Senate viewpoint depends on the fact that the region where the median senator lives is a capital exporter (importer) and the region where the median representative lives is a capital importer (exporter). Again, this results depends on the informational advantage of the Senate with respect to the House: The negative power to block legislation of the Senate makes an agreement on national fiscal policy very difficult to reach by the two chambers.

Finally, even if we have checked that the same type of qualitatively results can be obtained in an institutional framework where the regional governments and the national government play a Nash game instead of a Stackelberg one, we stress the fact that our results have been obtained in a particular model of strategic interaction between the two chambers. We think, however, that to try to shed some light on the mechanisms behind the choice of fiscal policies in federal countries, we need to take into account the institutional bicameral nature of such countries. This could help in understanding which are the consequences on national fiscal policies of separating legislators into two chambers which represent the same voters, but according to different rules. Our simple model can thus be considered as a first step, and extensions to broader set-ups are open fields for further research.

6 Appendix

Proof of Lemma 1. The sign of α directly follows from (15), and (13).□

Proof of Lemma 2. The sign of β directly follows from (15), and (13). By comparing (24) and (31), it is easy to check that it is always $\alpha > \beta$.□

Proof of Proposition 1. Using (25) and $m = M$, let us rewrite (23) as follows

$$\frac{\sum_i K^i(\rho+\tau^i)}{\sum_i n_i} = -\alpha S_M(\rho) - \frac{\partial t^M}{\partial T}\frac{K^M}{n_M} - t^M \frac{K^{M\prime}}{n_M}\left(\alpha + 1 + \frac{\partial t^M}{\partial T}\right) + \\ + \frac{K^M}{n_M}\left(\alpha + 1 + \frac{\partial t^M}{\partial T}\right) - T\frac{\sum_i K^{i\prime}}{\sum_i n_i}\left(\alpha + 1 + \frac{\partial t^i}{\partial T}\right). \tag{34}$$

By using $K^M/n_M = \sum_i K^i / \sum_i n_i$, (34) can then be rewritten as

$$\alpha\Phi = -\left[t^M \frac{K^{M\prime}}{n_M}\left(1 + \frac{\partial t^M}{\partial T}\right) + \frac{T}{\sum_i n_i}\sum_i K^{i\prime}\left(1 + \frac{\partial t^i}{\partial T}\right)\right], \tag{35}$$

where

$$\Phi \equiv S_M(\rho) + t^M \frac{K^{M\prime}}{n_M} - \frac{K^M}{n_M} + T\frac{\sum_i K^{i\prime}}{\sum_i n_i}.$$

[25] Only in the very special case when $\frac{\partial t^i}{\partial T} = -1$, $i = 1, ..., I$, the two chambers agree.

If $1+\frac{\partial t^i}{\partial T} \geqslant (<)0$, $i=1,...,I$, the R.H.S. of (35) is not negative (negative), and thus $\Phi \leqslant (>)0$ because $\alpha < 0$.

Then, by using (34), (30) can be rewritten as

$$\left.\frac{\partial V_M}{\partial T}\right|_{T^S} = (\beta-\alpha)\Phi. \tag{36}$$

Accordingly, $\left.\frac{\partial V_M}{\partial T}\right|_{T^S} \gtreqless 0$ iff $1+\frac{\partial t^i}{\partial T} \gtreqless 0$, $i=1,...,I$, because $\beta-\alpha<0$ by Lemma 2.□

Proof of Proposition 2. Rewrite (23) as

$$\alpha\left(S_m(\rho)-\frac{K^m}{n_m}\right)+\Omega^H = \frac{K^m}{n_m}-\frac{\sum_i K^i}{\sum_i n_i}, \tag{37}$$

and rewrite (30) as

$$\beta\left(S_M(\rho)-\frac{K^M}{n_M}\right)+\Omega^S = \frac{K^M}{n_M}-\frac{\sum_i K^i}{\sum_i n_i}. \tag{38}$$

By using $S_m(\rho)-\frac{K^m}{n_m} = -\left(S_M(\rho)-\frac{K^M}{n_M}\right)$, $K^m/n_m-\sum_i K^i/\sum_i n_i = -\left(K^M/n_M-\sum_i K^i/\sum_i n_i\right)$, (37), and (38), (30) evaluated at equilibrium can be rewritten as

$$\left.\frac{\partial V_M}{\partial T}\right|_{T^H} = (\beta-\alpha)\left(S_M(\rho)-\frac{K^M}{n_M}\right)+\Omega^H+\Omega^S. \tag{39}$$

Thus, in (39), it is easy to check that $S_M(\rho)-\frac{K^M}{n_M} \gtreqless \frac{\Omega^H+\Omega^S}{\alpha-\beta} \Longrightarrow \left.\frac{\partial V_M}{\partial T}\right|_{T^H} \lesseqgtr 0$ because $\beta-\alpha<0$ by Lemma 2, and $\Omega^H, \Omega^S < 0$ (see (26) and (33)).□

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