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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.

Keywords: Fiscal federalism, Median voter, Bicameralism.
JEL Classification: H71; H77; H41.

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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. Given that today all federal countries have bicameral legislatures,[3] such an institutional feature should be considered when the process of formation of fiscal policies is analysed in federal countries. With bicameralism, local preferences on taxation and public expenditure are represented twice, i.e. by local governments, at a local level, and by a territorially-based upper chamber, at a national level, while the whole population preferences are represented only once by a lower chamber, still at a national level. Since local interests can be specific and distinct from those of the whole population, one interesting question to analyse is how the design of fiscal policies in federal countries is affected by the existence of a bicameral legislature creating a systems of checks and balances between requests coming from different constituencies.[4]

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 share the same financial 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, i.e. egalitarian bicameralism. In particular, both chambers have to decide a national tax rate on perfectly mobile capital income while regional governments have to decide regional capital tax rates. 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 draws on both political

[1]See, for example, Keen and Kotsogiannis (2002, 2003) 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 United Arab Emirates. Overall, about one-third of the world's countries have bicameral legislatures.

[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,

science and economics, and it 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 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. Wrede (1996), Keen and Kotsogiannis (2002, 2003), Flochel and Madies (2002), Janeba and Wilson (2005), Grazzini and Petretto (2007), Kelders and Köthenbürger (2010)) have not taken into account the possible role played by a constitutional feature such as bicameralism on shaping national fiscal policies.[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. Following Lockwood (2002), the assumption that citizens are homogenous within any region makes legislative elections straightfoward, and as it will be clearer below, it allows us to abstract from the role of

and also references on the empirical literature.

[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).

strategic voting for delegates to the legislature.[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. However, we suppose a different order of voting for the two chambers.

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.

We assume that both the House and the Senate delegates from region i must be drawn from the homogenous population in that region, i.e. each region elects citizen-candidates as its delegates at the House and at the Senate.[10] Delegates are assumed to be unable to commit to a particular platform, and thus they are only interested in maximising their utilities once in office. The Constitution fixes two different rules to elect the representatives and the senators. 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 instead a geographically-represented chamber and adopts unit representation: each region is assigned the same absolute representation independently of its population.[11] To simplify, we assume that each region is represented by a Senate delegate.[12] We also suppose symultaneous elections for delegates at the regional governments, the House, and the Senate.

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

[9] For papers on strategic voting see, among the others, Persson and Tabellini (1992), Chari et al. (1997), Lorz and Willmann (2005), and Harstad (2010).

[10] See Osborne and Slivinski (1996) and Besley and Coate (1997).

[11] 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)).

[12] Since all residents of a region are assumed to be identical, the House delegates coming from the same region are also identical, and the Senate delegate of each region is identical to the regional policy-maker. This latter feature may approximate the election of members of the *Bundesrat* in Germany where delegates are members of the government of the *Länder*. Notice, however, that notewithstanding Germany is considered a country with a bicameral legislation, the *Bundesrat* is not a proper second chamber of the German Parliament because it is a legislative body that represents the sixteen *Länder* at federal level.

to check whether the national tax rate, and the national lump-sum transfer chosen by the House is also optimal from its viewpoint. If it is (not) optimal, then the Senate will vote in favour of (against) it, and the process (does not) ends, i.e. the bill is (not) promulgated.[13] In other words, our model is as if the House makes a take-it-or-leave-it offer to the Senate.[14]

Both national and regional assemblies adopt majority-voting. At the regional level, 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. Instead, the Senate's decision reflects the preferences of the median senator who, *de facto*, represents the residents of the median region because of unit representation.[15]

The model proposed is an adptation 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, i.e. there is an inter-regional heterogeneity in the distribution of the initial endowment.[16] His/her preferences are described by the following utility function

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

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

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

[13] Our model does not analyse what happens when there is a disagreement between the two chambers. In this respect, notice that methods to resolve disagreements between chambers vary among countries, and usually also in the same country between nonfinancial and financial legislation. The most common method is the navette, or shuttle system: the bill shuttles back and forth between chambers until agreement is reached. Depending on the country, it can be different the number of rounds a bill can shuttle between the two chambers. Should the navette fail, the alternative methods to reach a final decision may differ. One method is a conference committee: Each chamber usually appoints an equal number of delegates who are asked to reach a compromise. Another method is a joint session: Both chambers meet in a common session to vote on the bill. Finally, in some cases, one chamber is decisive. Of course, another possibility is new elections.

[14] This is reminiscent of the fast-track authority that exists in US trade policy. US legislators can decide to grant fast-track authority to the President, giving up their power to amend trade agreements. Under fast-track procedures, the Congress can only approve or reject trade-policy deals that the President makes, with no possibility of amending them. For a paper analysing strategic delegation motives behind congressmen's voting behaviour on fast track, see Conconi et al. (2012).

[15] 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 strategically adjust the choice on the regional tax rate. The same type of assumption is also made for the Senate.

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

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.[17]

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 $K^i = n_i k_i^i + \sum_i n_j k_j^i$, $i, j = 1, ..., I$, $i \neq j$, 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:[18]

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

and thus the demand for capital:

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

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.[19] 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

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

[17] 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.

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

[19] 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).

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 $\Gamma(\rho) \equiv \sum_{i=1}^{I} n_i S_i$ 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

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

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

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

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. 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

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

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,[20] obtains as follows

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

All the terms in this expression have a familiar interpretation in the literature on fiscal federalim.[21] From (13), the first term describes how an infinitesimal rise in t^i negatively affects the net remuneration to individual savings. Notewithstanding, at equilibrium, all agents bear the same reduction in the net remuneration to savings, each regional government does not take into account the harm borne by citizens of the other regions due to an increase in its own tax rate, thus giving rise to a horizontal externality. 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. Since region i, when it increases its tax rate, does not take into account the capital flight which benefits other regions - a positive horizontal externality -, it perceives the above indirect effect in a negative way, i.e. as a deadweight loss creating disincentives to redistribution. Finally, the fourth term describes a vertical externality from the regional to the national level, i.e. how an infinitesimal rise in t^i affects the national tax revenue via a change in the national tax base (a tax base effect).

[20] An application of the envelope theorem is behind (19) and the following first order conditions (23) and (30).
[21] See, for example, Grazzini and Petretto (2007).

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.[22] Let us define $i = m$ the median representative. Then, the House chooses the tax rate T in order to maximise the welfare of the median representative. 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

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

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

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

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

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

Notice that α describes the effect of an infinitesimal increase of T on the net remuneration to savings (21) both *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

[22] In what follows, we suppose that agents' preferences are single-peaked on the whole range of the national tax rate.

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.[23] 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 $\Psi^{iH} < 0$.[24]

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. 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.[25] 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

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

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

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

[23] 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).

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

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

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 $i = M$ the median senator. Then, 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

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

where the reader must keep in mind that the net remuneration of capital is now given in (28).

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

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

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, β also 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 now into account the net remuneration to savings resulting at the end of the game given in (28). The sign of β, and its value with respect to α, are 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. $\frac{d(\rho+\tau^i)}{dT} = \beta + 1 + \frac{\partial t^i}{\partial T} > 0$. 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

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

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 an 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, and the timing of the game. Take, for example, the case when national and regional tax rates are strategic complements which implies that $1 + \frac{\partial t^i}{\partial T} > 0$. Then, because of horizontal externality, regional tax rates tend to be fixed at inefficiently low levels.[26] The national tax rate can thus be used to push regional tax rates up to counter the distortionary effect of the horizontal externality. However, since the Senate votes after the game is played, it has more information with respect to the House on the process through which regional tax rates can be manipulated

[26] From the proof of Proposition 1 in the Appendix, it can be checked that $1 + \frac{\partial t^i}{\partial T} \geqslant 0$ implies $\phi \leqslant 0$. A sufficient condition to guarantee $\phi < 0$ is that region $M = m$ is a capital importer, i.e. $S_M(\rho) - \frac{K^M}{n_M} < 0$, thus choosing an inefficiently too low regional tax rate.

by the choice on the national tax rate. 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 (see the difference between (28) and (21)). For this reason, from the viewpoint of the Senate, the national tax rate chosen by the House is inefficiently too low. The same type of reasoning applies to the overtaxation result.

4.3 House and Senate with different median voters

Consider now that the House and the Senate median voters are different. To simplify our set-up, let us suppose that it is negligible the difference in the sum of the indirect effects on regional and national tax revenue of the national tax rate from the viewpoint of the House and the Senate, i.e. $\Omega^H - \Omega^S = 0$. To concentrate our attention on the set-up that can be interpreted more straightforwardly, we consider the case where the two regions m and M are one capital importer and the other one capital exporter, i.e. $sign\left(S_m(\rho) - \frac{K^m}{n_m}\right) = -\left(S_M(\rho) - \frac{K^M}{n_M}\right)$.[27]

We can now state the following

Proposition 2 *There is undertaxation (overtaxation) from the viewpoint of the Senate if* $S_M(\rho) - \frac{K^M}{n_M} < (>) 0$ *and* $\frac{K^m}{n_m} \geqslant (\leqslant) \frac{K^M}{n_M}$.

Proof. See the Appendix.

This result depends on whether the regions where the Senate and the House median voter lives are capital exporter or importer, on the extent of fiscal competition among regions which drives the allocation of total savings in each region, and finally on population asymmetry between regions m and M. In particular, the result depends on the interplay between two effects. A first vertical effect describes how the median representative and senator choose the national tax rate in reaction to the regional tax rates: If the regional tax rate is chosen at an inefficiently too low (high) level, then the national legislator would couteract this by voting for a high (low) national tax rate. A second horizontal effect describes how the choice on the national tax rate also depends on the amount of per-capita capital invested in the region where the median representative and the median senator lives. This is because the national tax rate preferred by the House and the Senate reflects the preferences of the median representative and the median senator, respectively, and such preferences are affected by the amount of capital invested within their own region of residence.

To grasp the intuition behind the result in Proposition 2, consider, for example, the case when, at equilibrium, region M (m) is a capital importer (exporter), i.e. $S_M(\rho) - \frac{K^M}{n_M} < 0$, and the per-capita capital investment in region M is lower than in region m, i.e. $\frac{K^M}{n_M} < \frac{K^m}{n_m}$. Since region M (m) is a capital importer (exporter), then t^M (t^m) is fixed at an inefficiently too low (high) level. On the basis of the vertical effect, to counter this, the median representative m would tend to choose a low national tax rate T while the median senator M would prefer a high national tax rate.

[27] The result also holds when the two regions are both capital importer or capital exporter. The effects determining the result are also of the same type of the ones described in the text, that is why we have chosen only to present the simpler set-up.

On the basis of the horizontal effect, however, since the per-capita capital investment in region M is lower than that in region m, the median representative would tend to choose a higher national tax rate than the one preferred by the median senator. Overall, in this case, the vertical effect will offset the horizontal one, and the median representative will choose a national tax rate T which is inefficiently too low from the viewpoint of the median senator M who would, instead, prefer a higher national tax rate. The same kind of reasoning applies to obtain instead overtaxation 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.'[28] 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.[29,30]

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

Second, when the House and the Senate have different decisive legislators, the result on overtaxation (undertaxation) from the Senate viewpoint depends on the fact that the regions where the decisive senator and the decisive representative live are capital exporter or importer, and on whether the per-capita capital investment is higher or lower in the region where the median representative or the median senator lives. 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. In this sense,

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

[29] 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)).

[30] 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).

our result confirms that bicameralism allows changes to the status quo more difficult to reach with respect to unicameralism, even in the case when the two chambers are politically similar, i.e. share the same pivotal voter (Tsebelis and Money (1997)). Alternatively, bicameral legislatures where chambers have different assignments can make changes to the status quo easier to reach.

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 electoral rules. Our simple model can thus be considered as a first step. Extensions to broader set-ups which include strategic voting and/or the modeling of the game after a Senate's veto, 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

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

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

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

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 (35), (30) evaluated at T^H can be written as

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

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

Proof of Proposition 2. Under the assumption that $\Omega^H - \Omega^S = 0$, rewrite (23) as

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

and rewrite (30) as

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

By using (37), (38) evaluated at equilibrium can be rewritten as

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

Then, the proposition directly follows because $\alpha,\beta<0$.$\square$

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