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Essays on the Political Economy of Taxation

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ESSAYS ON THE POLITICAL ECONOMY OF TAXATION

BY

RAUL ALBERTO PONCE RODRIGUEZ

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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ABSTRACT

ESSAYS ON THE POLITICAL ECONOMY OF TAXATION

By

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December, 2006

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In this dissertation we analyze the role of parties' electoral competition in aggregating voters' preferences over policy and its impact on tax design. The representation of voters' interests is central for the analysis of public finance since the issue of aggregation is closely linked to the tradeoff between efficiency and redistribution, and the size and composition of public spending. Parties' aggregation of preferences is related to the mechanism in which policy makers (parties) weigh the relative merits of competing goals of the tax system (in our analysis, redistribution versus efficiency), and reveals the welfare calculus throughout parties identify groups of individuals who might be beneficiated (hurt) by policy changes.

In the first essay we analyze the influence of voters in modifying tax policy through tax initiatives. In this essay we argue that the process of aggregation of preferences between the competition for votes in a representative democracy and the majority rule are different. This, in turn, might lead to the approval of a tax rate limit (TRL) initiative. We argue that the rationale for a TRL proposal is to substitute feasible tax structures rather than to constrain the government's power to collect taxes and provide a model that predicts the tax structure that would arise as a result of a TRL

The second essay addresses the role of voters' partisan attitudes in the determination of fiscal policies. We argue that partisan attitudes and its distribution across the electorate influence the proportion of the expected votes that different coalitions deliver in the election. We identify conditions in which voters' partisan

attitudes affect the provision of a public good and the redistributive properties of the tax structure.

The third essay extends our previous analysis of the impact of voters' partisan attitudes on tax design by incorporating parties that are policy motivated. In this setting, the relative merits of efficiency versus redistribution in designing the tax system are determined by the process of aggregation of voters' preferences and parties' preferences over policy. The conflict between parties and the electorate's preferences over tax policy depends on voters' partisan attitudes. In particular, voters' party affiliation soft parties' electoral constraints, allowing parties to advance the interests of their constituents. Redistribution (efficiency) will play a more prominent role for a party that represents a coalition of low (high) income individuals with a high (low) taste for public goods.

ESSAY I: ELECTORAL EQUILIBRIUM AND TAX RATE LIMITS

According to a report in 1995 by the U.S Advisory Commission of Intergovernmental Relations (ACIR), by 1995 forty-six states in the U.S had approved some sort of tax and expenditure limitation (TEL), tax rate limits had been the predominant form of state restrictions, and local governments in 33 states had been affected by overall and/or specific tax rate limits.[1] The ACIR (1995) also reports that TELs did not affect the size of government but changed the composition of state and local spending.[2] Empirical evidence also suggests that TELs modified the structure of state and local tax systems (see ACIR, 1995; Mullings & Joyce, 1996; Fisher & Gade, 1991; Shadbegian, 1999; Preston & Ichniowski, 1991; Dye & McGuire, 1997; and Skidmore, 1999).[3] Finally, the evidence indicates that TELs are long lived tax amendments (ACIR, 1995; Shadbegian, 1999; NCSL, 2005). To sum up, TELs are a widespread phenomenon affecting state and local spending and tax structure, tax rate limits are the predominant form of tax restrictions, and TELs are long lived tax amendments.

The objective of this essay is to examine why a tax rate limit (TRL) initiative is placed on the ballot, and what explains the approval/rejection of the TRL. In addition, we seek to explain some empirical regularities, that is, why a majority of voters would approve a TEL even when survey analysis revealed that voters were, in general, satisfied with government spending, and we seek to provide a model that can predict the tax structure that would arise as a result of the approval of a tax rate amendment.[4]

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[1] U.S Advisory Commission of Intergovernmental Relations, 1995, "Tax and Expenditure Limitations on Local Governments," *Center for Urban Policy and the Environment*, Indiana University.

[2] Other studies analyzing the impact of TELs on different measures of government's size find mixed evidence. For instance Mullings and Joyce (1996) find that TELs did not affect government's size and Fisher and Gade (1991) reports no evidence that the property tax limitation in Arizona restrained the growth of property taxes. In contrast, Preston and Ichniowski (1991) conclude that the growth of the property tax revenues was lower in municipalities in which a TEL had been approved. Similar results are reported by Dye and McGuire (1997) for the case of limits on growth of property tax levies.

[3] The document of the ACIR also concludes that TELs over local authorities increased the dependence of local governments on state aid. This led to higher centralization and lower responsiveness of local authorities to individuals' demands.

[4] On the issue that voters revealed in survey analysis that in general they were satisfied with government's spending see Attiyeh and Engle (1979), Citrin (1979), and Courant, Gramlich and Rubinfeld (1980).

In this essay, we develop a probabilistic model of electoral competition (parties with incomplete information on voters' preferences over policies) to analyze the design of tax policy. We use this framework to argue that the electoral competition between parties determines the tax system at the status quo by aggregating voters' preferences for policy in a different way than the majority rule aggregates voters' interests. In our analysis, the electoral competition aggregates the preferences of the electorate over policy while the majority rule aggregates the preferences of the decisive voter of the tax initiatives.[5] The approval of the motion, however, does not necessarily imply that voters are unsatisfied with the size of the budget or that voters question the efficiency of the government to transform public revenues into services.[6]

We argue that the rationale for a TRL proposal is to substitute feasible tax structures rather than to constrain the government's power to collect taxes. Based on the tax substitution hypothesis, we characterize conditions that provide empirically verifiable tests on the likelihood that a TRL is approved. Finally, we provide a model that predicts the tax structure that would arise as a result of a TRL. Previous studies have ignored the information that the approval/rejection of a TRL transmits on voters' preferences to policy makers. We propose a model in which, conditional on observing the approval of a TRL, Downsian parties update their system of beliefs on voters' preferences for tax structures and accommodate the tax initiative of voters. This might explain why TRL initiatives are long lived tax amendments.

Literature Review on Tax and Expenditure Limitations

The literature on TELs has centered on explaining why the government does not provide the fiscal policies demanded by the median voter, see Shapiro, et al. (1979). In other words, the approval by majority of a TRL is incompatible with the hypothesis that the electoral competition induces parties to propose the fiscal policies demanded by the

[5] In this context, the tax system at the status quo is a policy that maximizes parties' expected plurality. Since, the tax structure at the status quo might be different to the ideal policy of the median voter of the tax initiatives, then the decisive voter might increase his utility by approving a TRL.

[6] As we discuss in our review of the literature (see below), these two arguments have dominated the discussion of the rationale for a tax rate limit.

median voter. Otherwise, how do we explain that a majority of voters approve a TRL? In fact, Densau, Mackay and Weaver (1979, 1980) depict a TEL as a mechanism to restore the median voter outcome (MVO). They argue that the MVO can be upset by a group of high demanders with the power to control the agenda.

The apparent inability of the median voter model to explain the approval of tax and expenditure initiatives persuaded Brennan and Buchannan (1978a, 1978b, 1980) to provide a model in which a dictator rules the government. In their framework, the dictator has incentives to maximize the public budget. If, in addition, the dictator is not constrained by electoral considerations then the obvious result is a big government.[7] In this case, dissatisfied citizens seek to limit the power of a government that maximizes the "Leviathan," by approving a proposal that effectively constrains the government's capacity to collect taxes.

Two observations are worthy of notice on the hypothesis that the objective of a TRL is to control government's spending or capacity to collect taxes. First, as Brennan and Buchanan (1978b) recognize, an isolated tax rate limitation is unlikely to constrain the government's capacity to raise public revenue. Thus, in the context of government's monopolistic power, what is the rationale for a single tax rate limit? Second, in the light of an important expansion of the public sector after the 1950s, the explanation of a big government as the rationale of a TEL seems appealing. However, Attiyeh and Engle (1979), Citrin (1979), Courant, Gramlich and Rubinfeld (1980), and Ladd and Wilson (1982) use survey techniques to reveal that voters were, in general, satisfied with government's expenditure. This finding led Ladd and Wilson (1982) to argue that the approval of a TEL initiative (Massachusetts' proposition 2 ½) was more an attempt to reduce tax burdens and obtain higher efficiency from the government rather than to reduce spending.

Courant and Rubinfeld (1981) provide a model in which the government's services are inefficient since public employees have monopolistic power in setting public wages. In this setting, a coalition of voters seeks to increase their well being by limiting the public budget. However, the voters' approval of a budget limit requires that voters

[7] For arguments along these lines see Denzau and Mackay (1980), Romer and Rosenthal (1979), Shapiro and Sonstelie (1982), among many others.

expect that public employees, in their self interest, reduce their wages after the budget limit is approved. In the model, however, the mechanisms that explain how public employees respond to a budget limit and the voters' system of beliefs on the response of public employees are exogenous. For this reason, it is not clear why voters would approve a budget limitation.

In summary, tax initiatives have been regarded as a mechanism of voters to impose a non electoral control over a big government, as an attempt to improve the efficiency of the government, and as a way to restore the median voter outcome that was initially upset by a group of high demanders with the power to control the agenda. Other explanations for TELs proposed in empirical analysis include: Tax initiatives might be explained as voters' attempt to change the composition of tax collections and reduce tax burdens.[8]

Although we have learned a great deal from the models surveyed above, several important elements that can explain the proposal-approval of TRLs have received little attention. First, tax rate limits have been analyzed under the assumption that policy is one-dimensional and hence the effects of a TRL on government's tax structure have been ignored. Nevertheless, empirical evidence suggests that a TRL modifies the tax systems of state and local governments. Furthermore, the analysis of the effects of a TRL on tax structure is relevant since voters will be concerned with the overall tax liability. Hence, the approval of a tax rate limit should be related with voters' system of beliefs on the response of the government to a TRL.[9] That is, from the point of view of rational voters, the approval/rejection of a tax motion requires the comparison of the ex-ante tax structure versus the tax system that would arise as a result of a TRL.

Second, in the context of uncertainty, the government's response to a TRL might be affected by the information that the approval of a TRL provides. To see the relevance of this point, note that a party could choose a policy that fails to represent the preferences of a majority if parties have imperfect information on the actual ideal policies of voters. If

[8] To the best of my knowledge, no formal argument has been provided to show that some of the claims in the empirical analysis surveyed above can be characterized through the existing bureaucratic and/or political models.

[9] That is, when faced with the decision of voting for a tax initiative, rational voters take into account that a TRL imposes a constraint only in one of the tax instruments available to the government. Therefore, tax authorities could increase the non-constrained tax instruments as a result of a tax initiative.

Downsian parties know with certainty that a policy is a Condorcet winner then parties' dominant strategy is to choose such a policy.[10] Still, a Condorcet winner might exist but such a policy could be unknown for parties. Therefore, in the context of parties' uncertainty on voters' preferences, the approval of a tax initiative can be thought of as a mechanism that transmits information between voters and representatives since the approval of the initiative points out a policy with the support of a majority of voters.

Thus, the objective of the essay is to incorporate the elements we have mentioned above to explain the selection, approval/rejection and the effects of a TRL on government's tax policies. That is, in our analysis we incorporate: (a) The fact that tax policy is multidimensional; (b) The notion that initiatives are an alternative form of representation of preferences for policy;[11] (c) The voters' system of beliefs on government's response to a TRL; (d) The information that the approval/rejection of initiatives provide on voters' preferences for policy; and (e) The government's response to a TRL. We proceed to present our model.

Structure of the Economy and the Game of Electoral Competition

Voters' Preferences and Choices

Assume the economy is constituted by voters indexed from $h = 1,2...H$. In this economy voters delegate the activities of making and implementing proposals for tax policies to candidates who are nominated by their parties. Voters are engaged in two types of activities: The first is to vote for a candidate/party, and the second is to select their most preferred feasible consumption bundle. Evidence suggests that the individuals' choice of the vote reflects a complex calculus of (among other things) candidates' policies, voters' preferences over candidates' attributes, and a retrospective evaluation of

[10] A Condorcet winner is a policy that provides a probability of winning the election that is no less than ½. Roemer (2001). Coughlin (1992), Roemer (2001), and many others, show that proposing a policy that is a Condorcet winner (if such a policy exists) is a dominant strategy for Downsian parties.

[11] In a representative democracy, the constitutional provision of an initiative can be justified as a way to maintain checks and balances on elected representatives, but also as an alternative mechanism for the representation of voters' preferences for policies. Thus, a group of voters could propose an initiative if they perceive that their preferences have been misrepresented by the electoral process.

candidates' performance, see Fiorina (1997). For simplicity, we assume the individuals' voting behavior depends on policy issues and on nonspatial attributes of candidates (as candidates' religion, ethnic identity, competence). We denote a voting choice set Cs^h $\forall h$ that records the party that receives the vote from individual h.Thus, voter h will vote for party k if:

$$k \in Cs^h \quad \Leftrightarrow \quad Cs^h = \left[\forall h \middle| \, \upsilon^{hk}\left(\mathbf{t}^k\right) - \upsilon^{h,-k}\left(\mathbf{t}^{-k}\right) \geq \Delta\varepsilon^h \right] \tag{1}$$

Where $\upsilon^{hk}\left(\mathbf{t}^k\right)$ and $\upsilon^{h,-k}\left(\mathbf{t}^{-k}\right)$ are the indirect utility functions when parties k and $-k$ propose tax policies $\mathbf{t}^k$, and $\mathbf{t}^{-k}$, and $\Delta\varepsilon^h = \varepsilon^{hk} - \varepsilon^{h,-k}$ where $\varepsilon^{hk}, \varepsilon^{h,-k}$ are preference parameters of voter h toward nonspatial attributes of candidates k and $-k$.[12] We assume $\varepsilon^{hk}, \varepsilon^{h,-k}$ are unknown for parties. More specifically, we follow Hinich and Ordeshook (1969) and Enelow and Hinich (1982) and assume that candidates k and $-k$ consider $\Delta\varepsilon^h$ as an independently distributed random variable with zero mean. By definition, the indirect utility of voter h under policies proposed by party k is:

$$\upsilon^{hk}\left(\mathbf{t}^k\right) = \left\{ \underset{\{\mathbf{x}^h\}}{Max} \; \mu^{hk}(\mathbf{x}^h) \text{ s.t: } \mathbf{q}^k \mathbf{x}^h \leq 0 \right\} \text{ for all } h = 1,2...H \tag{2}$$

The expression in (2) defines the preference ordering over feasible options characterized by a quasi-concave utility function $\mu^{hk}(\mathbf{x}^h)$ where $\mathbf{x}^h \in \Re^n$ is the vector of feasible commodities. The consumer's price vector is $\mathbf{q}^k = \mathbf{p} + \mathbf{t}^k$ where $\mathbf{p}$ is the vector of producers' prices and $\mathbf{t}^k$ is the vector of commodity taxes proposed by party k. We will assume that in this economy the supply of private commodity i is perfectly elastic at $p_i \; \forall \; i = 1, 2....n$. From the budget constraint we define the nummeraire $x_1^h = \left(\ell^h - L^h\right)$ as the net purchases of leisure where ℓ^h is leisure and L^h is the labor supply of the voter, and q_1^k is the after tax wage. From (2) we can define the total tax contributions for

---

[12] In (1), $\varepsilon^{hk}, \varepsilon^{h,-k}$ affects the choice of the vote since voters have a preference relation over non spatial attributes of candidates. The label nonspatial attributes means that candidates can not affect voters' perceptions on their attributes.

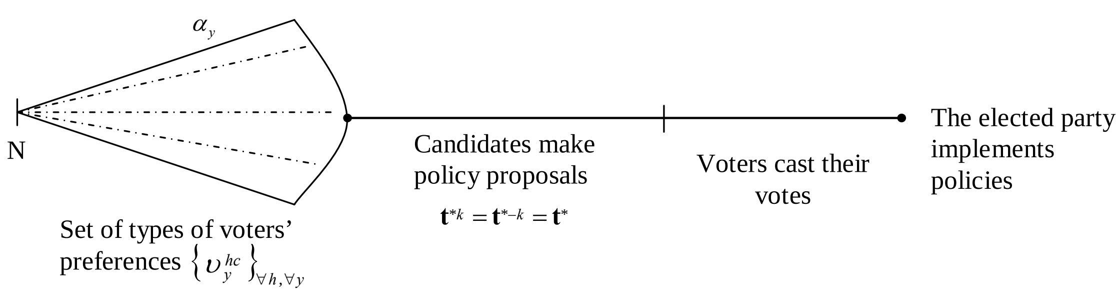
individual h as $c^h\left(\mathbf{t}^k\right)=\sum_{i=1}^{n} t_i^k x_i^h$ which represents the amount of private commodities that the voter has to forgone when participating in the collective action.

Electoral Competition

The problem to be considered in this section is how the political process, characterized by the competition of two parties for votes, determines the tax structure that provides to the party winning the election with public revenue $\bar{R}$. For the purpose of analyzing the formation of public policies we analyze a dynamic electoral game of incomplete information in which voters have perfect information on the alternatives they vote. Candidates, however, are uncertain on how the policies proposed by parties *k* and –*k* will be translated into votes. Following Harsanyi (1967) the dynamic game of incomplete information is transformed into a dynamic game of complete but imperfect information. Consider then, the three stage Downsian political process shown in Figure 1.

The stages of the game are as follows: In the first stage, nature (*N*) shows the different types and distribution of voters' preferences for policy. In the second stage, candidates announce simultaneously their tax policy proposals (a commodity tax system $\mathbf{t}^k, \mathbf{t}^{-k}$). In the third stage, after observing parties' positions, voters cast their votes according to (1) and the elected party proceeds to implement the tax platform in the fourth stage of the game.

Figure 1. Electoral Competition and the Design of Fiscal Policies



Candidates $c = \{k, -k\}$ select policies that maximize parties' expected plurality. The strategy set for parties *k* and –*k* is constituted by $S^k = \{\mathbf{t}^k\}$ and $S^{-k} = \{\mathbf{t}^{-k}\}$. Let the strategy space S^c be a convex, closed and bounded set representing the tax instruments that might raise the amount of public revenue $\bar{R}$ (assumed to be exogenously given). That is, $S^k, S^{-k} \in S^c = \left\{ \ \{t_i^c\}_{i=1}^n : \ \bar{R} = \sum_{i=1}^n t_i^c \left(\sum_{h=1}^H x_i^h \right) \right\}$ where x_i^h is the $i = 1....n$ Marshallian demand of the $h = 1, 2...H$ voters and $\{t_i^c\}_{i=1}^n$ is the sequence of tax instruments available for parties.

From the candidates' perspective their system of beliefs on the voting behavior corresponds to a common cumulative distribution function (cdf) over the set of voters' preferences and its distribution. That is, let nature shows $y = 1, 2....Y$ possible states and $\alpha_y \in [0,1]$ is the probability distribution function over y. Thus, for each state y, there is a complete specification of sequences $\{\upsilon_y^{hc}\}_{h=1,y}^H$ for $c = \{k, -k\}$ and $\Delta\varepsilon_y^h = \varepsilon_y^{hk} - \varepsilon_y^{h,-k}$. Nature's move is common knowledge but an individual voter knows his type (preferences). Parties' uncertainty on the voting behavior leads to a system of beliefs such that for given $\mathbf{t}^k, \mathbf{t}^{-k}$, $\Pr_y^{hk} \in [0,1] \ \forall y$, while $F^{hk}\big|\alpha_y = \sum_{y=1}^Y \alpha_y \Pr_y^{hk}$. We assume $\Pr_y^{hk} \in [0,1] \ \forall y$ is a continuous cumulative distribution over $\Delta\upsilon^h = \upsilon^{hk}(\mathbf{t}^k) - \upsilon^{h,-k}(\mathbf{t}^{-k})$. In other words, from the point of view of candidate *k* the probability that an individual $h \in \varphi^l$ votes for party *k* is:

$$\Pr^{hk}\left(\mathbf{t}^k, \mathbf{t}^{-k} \big| \alpha_y\right) = F^{hk}\left(\ \upsilon^h\left(\mathbf{t}^k\right) - \upsilon^h\left(\mathbf{t}^{-k}\right) \big| \alpha_y \right) \ \forall \ h \in \varphi^l \tag{3}$$

The function $F^{hk}\big|\alpha_y : \mathbf{t}^k \times \mathbf{t}^{-k} \to [0,1]$ is a continuous cdf relating the policy proposals $\mathbf{t}^k, \mathbf{t}^{-k}$ with the chance that a consumer *h* will vote in favor of party *k*. Parties partition the set of *H* voters into a finite number of groups indexed by φ^l for $l = 1, 2...M$ satisfying $\sum_l^M \varphi^l = 1$. Let φ^l be an element of the set of groups of voters Θ then φ^l

represents the fraction of voters h in group l. The expected proportion of the vote for party k is:

$$EV^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=\sum_{\forall\varphi^l\in\Theta}\sum_{\forall h\in\varphi^l}\Pr^{hk}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=\sum_{\forall\varphi^l\in\Theta}\varphi^l\Pr^{lk}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)\qquad(4)$$

Parties' plurality is $P\ell^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=EV^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)-EV^{-k}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)$.[13] We assume all voters in this economy vote then $EV^k+EV^{-k}=H$, therefore the objective of party k can be re-written as $P\ell^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=2EV^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)-H$. Under our assumptions, maximizing the expected proportion of the votes is equivalent to maximize parties' expected plurality. In other words parties' objective can be stated as:[14]

$$\begin{gathered}\underset{\{\mathbf{t}^k\}}{Max}\; EV^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=\sum_{\forall\varphi^l\in\Theta}\varphi^l\Pr^{lk}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=\sum_{\forall\varphi^l\in\Theta}\varphi^l F^{lk}\left(\upsilon^l\left(\mathbf{t}^k\right)-\upsilon^l\left(\mathbf{t}^{-k}\right)\right)\\ \text{s.t:}\quad \mathbf{t}^k,\mathbf{t}^{-k}\in S^c=\left\{\;\{t_i\}_{i=1}^n:\;\overline{R}=\sum_{i=1}^n t_i^c\left(\sum_{h=1}^H x_i^h\right)\right\}\end{gathered}\qquad(5)$$

Let the expected proportion of votes over the constrained policy space be concave on taxes. The electoral game is $\Gamma^{EC}=\left\{\{Cs^h\}_{\forall h}\in S^v,\mathbf{t}^{*k},\mathbf{t}^{*-k}\in S^c,F^{lc}\middle|\alpha_y,\alpha_y\geq 0,\varphi^l\in\Theta,\{V^{hc}\}_{\forall h},P\ell^c\right\}$ where the strategy set S^v contains voters' decisions with respect consumption and voting behavior $\{Cs^h\}_{h=1}^H$. The payoff for voters is the sequence of the preference relation $\{V^{hc}\}_{h=1}^H=\{\upsilon^{hc}+\varepsilon^{hc}\}_{h=1}^H$ and candidates' payoff is the expected plurality function $P\ell^c$ for $c=\{k,-k\}$. For a discussion of the conditions that guarantee the existence of the electoral equilibrium see Appendix A.

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[13] To define the proportion of the expected vote we assume $\forall h\in\varphi^l$, $\Pr^{hk}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)=\Pr^{lk}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\alpha_y\right)$.

[14] For simplicity of notation we will refer $F^{lk}\left(\upsilon^l\left(\mathbf{t}^k\right)-\upsilon^l\left(\mathbf{t}^{-k}\right)\middle|\alpha_y\right)=F^{lk}\left(\upsilon^l\left(\mathbf{t}^k\right)-\upsilon^l\left(\mathbf{t}^{-k}\right)\right)$.

We characterize an equilibrium for Γ^{EC} as follows: Let the perfect Bayesian equilibrium be constituted by strategies $\{Cs^{*h}\}_{h=1}^{H} \in S^{v}$, and $\mathbf{t}^{*k}, \mathbf{t}^{*-k} \in S^{c}$ along with the system of beliefs $F^{lc}\big|\alpha_y : \mathbf{t}^{k} \times \mathbf{t}^{-k} \rightarrow [0,1]$ $\forall\ h \in \varphi^{l}$ and $\forall \varphi^{l} \in \Theta$ such that:

$$
\begin{aligned}
&i)\ \ \mathbf{t}^{*c} \in \arg\max P\ell^{c}\left(\mathbf{t}^{*k}, \mathbf{t}^{*-k} \middle| \alpha_y\right) \text{ s.t } \mathbf{t}^{*k}, \mathbf{t}^{*-k} \in S^{c} \text{ for } c = \{k, -k\} \\
&ii)\ \ k \in Cs^{*h} \vee -k \in Cs^{*h} \quad \text{where } Cs^{*h} = \left[\forall h \middle| \ \upsilon^{hk}\left(\mathbf{t}^{k}\right) - \upsilon^{h,-k}\left(\mathbf{t}^{-k}\right) \geq \Delta\varepsilon^{h}\right] \qquad (6) \\
&iii)\ \ F^{lc}\Big|\ \alpha_y :\ \mathbf{t}^{*k} \times \mathbf{t}^{*-k} \rightarrow [0,1]\ \forall h \in \phi^{l} \in \Theta \text{ for } c = \{k, -k\}, \text{ if } E\left[\Delta\varepsilon^{h}\right] = 0
\end{aligned}
$$

In other words, the notion of the equilibrium derived in (6) implies that the process of electoral competition leads parties to propose and implement policies $\mathbf{t}^{*k} = \mathbf{t}^{*-k} = \mathbf{t}^{*}$ that maximize the expected proportion of the votes (see condition i), given candidates' system of beliefs on the voting behavior $F^{lc}\big|\alpha_y, \mathbf{t}^{*c}$ $\forall\ h \in \varphi^{l}, \forall \varphi^{l} \in \Theta$ and parties' knowledge of the continuation of the game. By assumption, the information set, the systems of beliefs of candidates over the choice of the vote, and the policy space are the same for both parties, therefore parties' platforms at equilibrium will converge.[15] By (ii) voters maximize their utility by voting for the party that delivers the highest utility. For $E[\Delta\varepsilon^{h}] = 0$ and $\mathbf{t}^{*k} = \mathbf{t}^{*-k} = \mathbf{t}^{*}$, voters vote for either party with probability $1/2$ and parties' proportion of the vote is $1/2$. In this case, parties' posterior system of beliefs are equivalent to the prior system of beliefs on the distribution of voters' types and their preferences over the policy space (see condition *iii*). Thus, the perfect Bayesian equilibrium in our model is equivalent to a pooling equilibrium in signaling games in which the strategies of players do not lead to an update of players' system of beliefs since the strategic behavior do not transmit additional information on players' type, see Vickers (1986). It is easy to see that the individuals' voting behavior in the third stage do not transmit information that leads to an update of parties' beliefs if parties converge in their

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[15] By solving the maximization problem in (5) it can be noticed the equivalence of the solution from the first order conditions for parties *k* and –*k* which imply $\mathbf{t}^{*k} = \mathbf{t}^{*-k} = \mathbf{t}^{*}$. For formal proofs on convergence see Coughlin (1992).

tax policies and $E[\Delta\varepsilon^h] = 0$. Thus the system of beliefs in *(iii)* supports the perfect Bayesian equilibrium.[16]

Voters' Preferences over Taxes and the Option of a Tax Rate Limit

The analysis in the last section acknowledges a political process in which the political participation of individuals is constrained to the vote. In this section we introduce the possibility of voters' initiatives. To do so, we assume several institutions including; a mechanism determining how a proposal for a TRL reaches the ballot, the type of tax amendments allowed, and the context in which a tax rate limit is voted.[17] We propose a dynamic game of imperfect information to analyze the proposal, approval and effects on government's behavior of TRL initiatives.

The dynamic game is shown in Figure 2. In the first stage of the game nature (*N*) moves to show several states $y=1,\ldots Y$ with probability $\alpha_y \geq 0 : \sum_{\forall y} \alpha_y = 1$, and different types of distributions of voters' preferences $\{\upsilon_y^{hc}\}_{h=1,y}^{H}$ for $c = \{k, -k\}$ and $\Delta\varepsilon_y^h = \varepsilon_y^{hk} - \varepsilon_y^{h,-k}$ for all $h = 1.....H$ in state of nature $y = 1, 2...Y$ and $E[\Delta\varepsilon^h] = 0$. Nature's move is common knowledge but an individual voter knows his type (preferences). Parties' uncertainty is reflected as parties' lack of knowledge of the state of nature that depicts the true distribution of voters' preferences.

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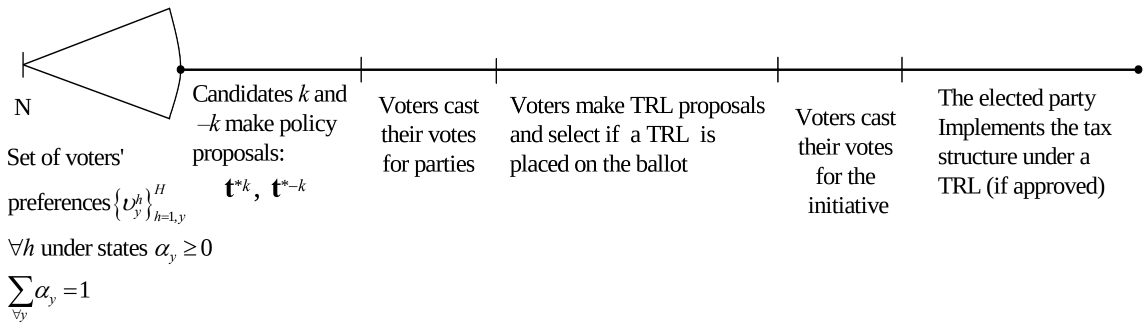
[16] Beliefs will be updated if $E[\Delta\varepsilon^h] \neq 0$. In this case, the proportion of the expected votes of some party *k* or –*k* will be higher or lower than $1/2$. Parties use this information to set $\alpha_y = 0$ for those states in y such that the sequences $\{\upsilon_y^{hc}\}_{h=1,y}^{H}$ for $c = \{k, -k\}$ and $\Delta\varepsilon_y^h = \varepsilon_y^{hk} - \varepsilon_y^{h,-k}$ do not produce the proportion of the votes that parties *k* and –*k* receive in the election.

[17] That is, we need to consider whether the tax amendment is voted alone or it is also voted in a general election in which parties' representatives are also on the ballot.

Figure 2. The Game of Voters' Initiatives



In the second stage, parties, *k* and *–k*, select simultaneously policies that maximize the expected proportion of parties' plurality. In the third stage, voters observe parties' proposals and vote for the party advancing the tax policy that leads to voters' highest utility. In the fourth stage of the game, voters propose tax initiatives simultaneously. In the essay we assume it is costless to propose tax amendments. For simplicity of the analysis we assume that individuals are allowed to propose tax rate limits *only* over an arbitrary tax instrument t_i. After observing the initiatives advanced by voters, the polity chooses by majority rule which initiative (if any) is placed on the ballot. We assume that the process of tax initiative selection is common knowledge.

In the fifth stage voters cast their votes for the tax amendment (if any is placed on the ballot). At the final stage, the elected government, within the context of the electoral competition and conditioned to a tax rate limit, if approved, will implement the tax structure $\overline{\mathbf{t}}^{*k}, \overline{\mathbf{t}}^{*-k}$ that satisfies party's objectives. If a tax rate limit is not approved to be placed on the ballot by a majority in the fourth stage then the game in Figure 2 is reduced to our previous game in Figure 1. In this case $\mathbf{t}^{*}$ is implemented in the last stage of the game.

The structure of the game in stages 4 and 5 is explained by our interest in analyzing the information on voters' preferences over tax policies that is revealed by the process of direct voting over tax amendments. Clearly, a TRL approved to be placed on the ballot in the fourth stage is a tax amendment approved in the fifth stage. The relevant is the information conveyed in the selection of the tax rate limit.[18] Let's consider the case in which tax structure is defined by two tax instruments. In the second stage parties propose $\mathbf{t}^{*k} = \mathbf{t}^{*-k} = \mathbf{t}^{*} = \left[t_i^*, t_j^*\right]$ given $\overline{R} = R\left(t_i^*, t_j^*\right)$, parties' beliefs, and the continuation of the game. Suppose a tax rate limitation is considered to be placed on the ballot with a proposal of fixing $t_i = \overline{t_i} < t_i^*$. First note that tax structure can be defined as a one dimensional function since $\forall t_i, t_j \in \overline{R} \quad \exists\, t_j : t_i \rightarrow t_j$ and thus $\overline{R} = R\left(t_i, t_j\left(t_i\right)\right) = R\left(t_i\right)$. We assume voters' preferences for tax policy are single peaked. In this case the most preferred feasible tax structure for voter *h* is denoted $\widehat{\mathbf{t}}^{h} = \left[\widehat{t}_i^{\,h}, \widehat{t}_j^{\,h}(\widehat{t}_i^{\,h})\right]$ where:

$$\widehat{\mathbf{t}}^{h} \in \arg\max\left\{ \upsilon^h\left(t_i, t_j\right) \text{ s.t } t_i, t_j\left(t_i\right) \in \overline{R} \right\} \;\; \forall\, h \tag{7}$$

In the fourth stage, the set of feasible tax amendments that are expected to receive the support of a majority is given by: [19]

$$d = \left\{ \begin{array}{c} \bar{t}_i^{\,h} \in \arg\max\left\{ \upsilon^h\left(t_i, t_j\left(t_i\right)\right) - \upsilon^h\left(t_i^*, t_j^*\right) \right\} \\ \text{s.t} \quad i)\;\; \forall t_i, \exists\, t_j\left(t_i\right) \in \overline{R} \\ ii)\;\; E\left\{ \upsilon^{MV}\left(\bar{t}_i^{\,h}, t_j\left(\bar{t}_i^{\,h}\right)\right) - \upsilon^{MV}\left(t_i^*, t_j^*\right) \right\} \geq 0 \end{array} \right\} \tag{8}$$

Condition (i) in set *d* reflects voter's expectation on parties' response to a TRL. Condition (ii) represents voter's beliefs that with probability $\alpha_y \geq 0$ the median voter in state *y* approves the tax motion.[20] Hence, voter's tax amendment $\bar{t}_i^{\,h}$ requires the approval of the expected median voter of the tax initiatives.

After observing the set of initiatives, voters vote for tax amendments. By construction, it is costless to propose a tax rate limit and voters' preferences over feasible

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[18] Note that our model is different to a signaling model in which players update their beliefs after they observe the set of signals. In our model, voters' initiatives signal their preferences, but parties update their beliefs based on how individuals votes over the set of initiatives proposed.

[19] Where $E\left\{ \upsilon^{MV}\left(\bar{t}_i^{\,h}, t_j\left(\bar{t}_i^{\,h}\right)\right) - \upsilon^{MV}\left(t_i^*, t_j^*\right) \right\} = \sum_{\forall y} \alpha_y \left[\upsilon_y^{MV}\left(\bar{t}_i^{\,h}, t_j\left(\bar{t}_i^{\,h}\right)\right) - \upsilon_y^{MV}\left(t_i^*, t_j^*\right) \right] \geq 0$.

[20] Note that the system of beliefs that support the set of tax initiatives is the one dictated by Nature's move in stage one. Beliefs, however, will be updated as voters observe the proportion of the votes received by the different tax initiatives.

tax systems are single peaked. Consequently, proposals for a TRL will be supplied competitively and a majoritarian equilibrium is guaranteed to exist for the mechanism dictating the selection of a tax rate limit. In this case the tax amendment selected to be placed on the ballot in the fourth stage (and approved in the fifth stage) will be dictated by the preferences of the median voter of the proposed tax initiatives (the decisive voter of set *d*). In this case, the median voter selects the feasible tax amendment that induces the maximum difference between the utility level set from the (ex-post) tax structure and the utility derived from taxes at the status quo. In other words, the median voter selects $t_i = \overline{t}_i \leq t_i^*$ such that:

$$\begin{aligned} &\underset{\{t_i=\overline{t}_i \leq t_i^*\}}{Max} \quad \chi^{MV} = \upsilon^{MV}\left(t_i, t_j\right) - \upsilon^{MV}\left(t_i^*, t_j^*\right) \\ &\text{s.t:} \quad t_i,\; t_j\left(t_i\right) \in \overline{R}:\; dt_j / dt_i\big|_{d\overline{R}=0} \leq 0 \end{aligned} \tag{9}$$

In equation (9) the median voter recognizes that the government will respond by changing the unconstrained tax instruments to satisfy the tax revenue objective $\overline{R}$. This restriction represents the expected reaction function of the government $t_j = t_j\left(t_i\right): dt_j / dt_i\big|_{d\overline{R}=0} \leq 0$. Clearly, a tax rate limit will be put on the ballot and approved if and only if:

$$\frac{d\chi^{MV}}{dt_i} = \frac{\partial \upsilon^{MV}}{\partial t_j}\left\{ \frac{dt_j}{dt_i}\bigg|_{d\overline{R}=0} - \frac{dt_j}{dt_i}\bigg|_{d\overline{\upsilon}^{MV}=0} \right\} \leq 0 \quad \text{for} \quad \gamma^M = \left\{ \frac{dt_j}{dt_i}\bigg|_{d\overline{R}=0} - \frac{dt_j}{dt_i}\bigg|_{d\overline{\upsilon}^{M}=0} \right\} \geq 0 \tag{10}$$

Which holds when $-dt_j / dt_i\big|_{d\upsilon^{MV}=0} \geq -dt_j / dt_i\big|_{d\overline{R}=0}$ where $-dt_j / dt_i\big|_{d\upsilon^{MV}=0}$ is a change in the tax structure that keeps the median voter in the same utility level set, and $-dt_j / dt_i\big|_{d\overline{R}=0}$ is a change in the tax rates of commodities *i* and *j* such that the revenue requirement $\overline{R}$ is satisfied.

In this economy, a proposal to limit a tax instrument t_i will be placed on the ballot and approved by the median voter of the tax initiatives when the tax structure at the status quo is not equivalent to the most preferred tax structure of the decisive voter. In other words, with costless proposals for tax amendments and $n = 2$, a difference between the tax structure in the status quo and the most preferred policy of the median voter is a sufficient condition for proposing and approving a tax rate amendment. The outcome is proved in Theorem 1.

Theorem 1. Let the tax structure derived by the process of electoral competition in the second stage be given by $\mathbf{t}^* = \left[t_i^*, t_j^*\right]$. Let $\upsilon^{MV}\left(\mathbf{t}^k\right) \neq \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^{lk}\left(\mathbf{t}^k\right) - \upsilon^{l-k}\left(\mathbf{t}^{-k}\right)\right)$, where $\upsilon^{MV}\left(\mathbf{t}^k\right)$ is the utility of the median voter of the tax initiatives while $\sum_{\forall \theta^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^{lk}\left(\mathbf{t}^k\right) - \upsilon^{l,-k}\left(\mathbf{t}^{-k}\right)\right)$ is a politically aggregated welfare function. Under costless tax amendments, a tax rate limit $t_i = \bar{t}_i \neq t_i^*$ will be proposed and approved.

Proof

In the second stage, $\mathbf{t}^* \in \operatorname{argmax}\left\{\sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^{lk}\left(\mathbf{t}^k\right) - \upsilon^{l-k}\left(\mathbf{t}^{-k}\right)\right) \text{ s.t: } \bar{R} = \sum_{i=1}^{n} t_i^k \left(\sum_{h=1}^{H} x_i^h\right)\right\}$.

Thus $MRTS_{t_j - t_i}^{PW}\Big|_{\mathbf{t}^*, dEV^k = 0} = -dt_j/dt_i\Big|_{d\bar{R}=0} \neq MRTS_{t_j - t_i}^{MV}\Big|_{\mathbf{t}^*, d\upsilon^{MV}=0}$ where $MRTS_{t_j - t_i}^{PW}\Big|_{\mathbf{t}^*, dEV^k = 0} = \sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_i^l \Big/ \sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_j^l$ and $MRTS_{t_j - t_i}^{MV}\Big|_{\mathbf{t}^*, d\upsilon^{\mathrm{MV}}=0} = \upsilon_i^{MV}/\upsilon_j^{MV}$ since by assumption $\upsilon^{MV}\left(\mathbf{t}^k\right) \neq \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^{lk}\left(\mathbf{t}^k\right) - \upsilon^{l-k}\left(\mathbf{t}^{-k}\right)\right)$.[21] Therefore it must be that either $-dt_j/dt_i\Big|_{\mathbf{t}^*, d\bar{\upsilon}^{MV}=0} > -dt_j/dt_i\Big|_{\mathbf{t}^*, d\bar{R}=0}$ or $-dt_j/dt_i\Big|_{\mathbf{t}^*, d\bar{\upsilon}^{MV}=0} < -dt_j/dt_i\Big|_{\mathbf{t}^*, d\bar{R}=0}$ where $-dt_j/dt_i\Big|_{\mathbf{t}^*, d\bar{R}=0}$ is the government's reaction to an exogenous change in t_i^*. Without loss

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[21] To see this, define parties' problem as $\underset{\{\mathbf{t}^k\}}{Max}\ \delta\left(\mathbf{t}^k, \mathbf{t}^{-k}\right) = \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^{lk}\left(\mathbf{t}^k\right) - \upsilon^{l-k}\left(\mathbf{t}^{-k}\right)\right) + \lambda\left[\bar{R} - \sum_{i=1}^{n} t_i^k \left(\sum_{h=1}^{H} x_i^h\right)\right]$ where λ is a Lagrange multiplier. The optimality conditions are $\sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_i^l + \lambda R_i = 0 \ \forall i = 1,2..n$ where $f^{lk} = \partial F^{lk}/\partial \upsilon^{lk}$, $\upsilon_i^l = \partial \upsilon^l/\partial t_i = -\alpha^l x_i^l$ and $R_i = \sum_{h=1}^{H} x_i^h + \sum_{z=1}^{n} t_z^k \left(\sum_{h=1}^{H} \partial x_z^h/\partial t_i^k\right)$ is the marginal tax revenue from t_i. The optimality conditions for tax rates i and j imply $\sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_i^l \Big/ \sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_j^l = R_i/R_j = 0 \ \forall i \neq j$. Define a level set of the expected proportion of parties' vote as $MRTS_{t_j - t_i}^{PW}\Big|_{\mathbf{t}^*, dEV^k = 0} = -dt_j/dt_i\Big|_{\mathbf{t}^*, dEV^k = 0} = \sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_i^l \Big/ \sum_{\forall \varphi^l \in \Theta} \varphi^l f^{lk} \upsilon_j^l$ and a tax revenue level set such that $t_i, t_j\left(t_i\right) \in \bar{R} : -dt_j/dt_i\Big|_{\mathbf{t}^*, d\bar{R}=0} = R_i/R_j$. Hence, $MRTS_{t_j - t_i}^{PW}\Big|_{\mathbf{t}^*, dEV^k = 0} = -dt_j/dt_i\Big|_{d\bar{R}=0} \neq MRTS_{t_j - t_i}^{MV}\Big|_{\mathbf{t}^*, d\upsilon^{MV}=0}$.

of generality assume $-dt_j/dt_i\big|_{\mathbf{t}^*,d\upsilon^{MV}=0} > -dt_j/dt_i\big|_{\mathbf{t}^*,d\bar{R}=0}$, therefore $d\upsilon^{MV}/dt_i(\mathbf{t}^*) \leq 0$. By the mechanism of the full pairwise comparisons among proposals for a tax structure amendment, a proposal $t_i = \bar{t}_i < t_i^*$ such that:

$$\bar{t}_i = \in \arg\max\left\{\upsilon^{MV}(t_i, t_j) - \upsilon^{MV}(t_i^*, t_j^*) \text{ s.t } t_i, t_j(t_i) \in \bar{R} : dt_j/dt_i\big|_{\mathbf{t}^*,d\bar{R}=0} \leq 0\right\}$$

Will not be beaten by any other alternative since $t_i = \bar{t}_i$ is a feasible policy satisfying $-dt_j/dt_i\big|_{\bar{t}_i,d\bar{R}=0} = MRTS^{MV}_{t_j-t_i}\big|_{\bar{t}_i,,d\upsilon^{MV}=0}$. Now suppose $-dt_j/dt_i\big|_{\mathbf{t}^*,d\bar{\upsilon}^{MV}=0} < -dt_j/dt_i\big|_{\mathbf{t}^*,d\bar{R}=0}$ is derived from the initial tax structure, then $d\upsilon^{MV}/dt_j(\mathbf{t}^*) \geq 0$ and therefore the median voter is strictly better off by proposing and approving $t_i = \bar{t}_i > t_i^*$ such that the optimal deviation from the status quo satisfies $-dt_j/dt_i\big|_{\bar{t}_i,d\bar{R}=0} = MRTS^{MV}_{t_j-t_i}\big|_{\bar{t}_i,d\upsilon^{MV}=0}$.

■

Theorem 1 says that a tax rate limit in this economy will be cast on the ballot by any voter that seeks to reduce the distance between the voter's most preferred policy position and the tax system at the status quo delivered by the electoral competition. However, a tax amendment will be approved only if there are gains to be exploited by the median voter of the proposed initiatives.

Note that the electoral competition leads parties to propose and implement a tax system that maximizes a politically aggregated welfare function. Thus there might be a difference between the most preferred tax structure of the median voter of the tax amendments and the tax system that maximizes parties' expected proportion of the votes. This explains why a tax rate limit reaches the ballot in the fourth stage. In the second stage, the electoral competition has aggregated the preferences of voters in a different way the majority rule does. To be more precise, the majority rule does not consider the intensity of voters' preferences over tax instruments (one man is one vote regardless of the intensity of preferences over alternatives) while parties' competition for votes in the electoral game does. This eventually leads to the proposal and approval of a tax rate limit in our economy.

From the construction of our model we can infer that if we assume costly tax amendments, a proposal for a tax rate limit would be explained, as before, by the voters' desire to obtain a policy outcome closer to his most preferred feasible tax structure. However the possible proposals for tax limits would correspond only to a subset of the set of initiatives *d*. To see this, let Υ is a fixed cost of proposing tax initiatives. The set of initiatives is $d = \{ \bar{t}_i^h \in \arg\max \{ \chi^h - \Upsilon \}$ s.t $i)\ \forall t_i, \exists t_j(t_i) \in \bar{R}$ $ii) E\{ \upsilon^{MV}(\bar{t}_i^h, t_j(\bar{t}_i^h)) - \upsilon^{MV}(t_i^*, t_j^*) \} \geq 0$ and $iii)\ \chi^h - \Upsilon \geq 0 \}$ where $\chi^h = \upsilon^h(t_i, t_j(t_i)) - \upsilon^h(t_i^*, t_j^*)$, condition (i) represents the voter's beliefs on parties' response to a TRL, *(ii)* is the constraint that an initiative requires the support of a majority, and condition $\chi^h - \Upsilon \geq 0$ is a participation constraint. Denote ρ^h as the Lagrangian for condition *(iii)* and re-define $\hat{\chi}^h = \{ \chi^h - \Upsilon \}$ to find the set TI_P of tax initiatives that could be placed on the ballot:

$$TI_p = \left\{ t_i = \bar{t}_i \leq t_i^* : \frac{d\hat{\chi}^h}{dt_i} = \frac{\partial \upsilon^h}{\partial t_i} (1 + \rho^h) \left\{ dt_j / dt_i \big|_{d\bar{R}=0} - dt_j / dt_i \big|_{d\upsilon^{MV}=0} \right\} \leq 0 \ \wedge \ \hat{\chi}^h \geq 0 \right\} \tag{11}$$

It is clear that the higher the costs of proposing tax initiatives the smaller is the set of permissible tax amendments TI_P. Higher costs of proposing tax initiatives also suggests that the set of TI_P will be composed by more stringent tax limits. The approval of a tax amendment requires that the marginal rate of tax substitution of the median voter be at least as high as the government's reaction, otherwise the median voter will be better off by rejecting the motion. Hence the set of the tax initiatives that could be approved is characterized by:

$$TI_A = \left\{ t_i = \bar{t}_i^h \leq t_i^* : \ \frac{d\chi^{MV}}{dt_i} = \frac{\partial \upsilon^{MV}}{\partial t_j} \left\{ dt_j / dt_i \big|_{d\bar{R}=0} - dt_j / dt_i \big|_{d\bar{\upsilon}^{MV}=0} \right\} \leq 0 \right\} \tag{12}$$

Hence, a proposal for a tax rate limit that is approved by majority requires:

$$TI_{p-A} = \left\{ t_i = \bar{t}_i \leq t_i^* \in \{ TI_p \cap TI_A \} : \frac{d\hat{\chi}^h}{dt_i} \leq 0 \ , \ \hat{\chi}^h \geq 0 \ \wedge \ \frac{d\hat{\chi}^{MV}}{dt_i} \leq 0 \right\} \tag{13}$$

There might be tax rate limits that fail to satisfy the former condition. For instance let $t_i = \bar{t}_i \leq t_i^* \in TI_p \wedge t_i = \bar{t}_i \notin TI_A$. Thus, $t_i = \bar{t}_i \leq t_i^*$ is proposed but the motion is rejected. Alternatively, let $t_i = \bar{t}_i \leq t_i^* \notin TI_p \wedge t_i = \bar{t}_i \in TI_A$ in this case the median voter would benefit from an initiative such that $t_i = \bar{t}_i \leq t_i^*$, however no such amendment is proposed.

To sum up, in our economy with electoral competition under uncertainty and with costless tax amendments a tax rate limit is proposed and approved as long as the tax structure offered by parties in the context of electoral competition is different to the ideal policy of the median voter of the tax initiatives. Our model also suggests that if we assume costly tax amendments a proposal for a tax rate limit would be explained by voters' desire to obtain a policy outcome closer to their most preferred feasible tax structure. However, under costly tax amendments the set of proposals for tax limits corresponds only to a subset of the full rounds of pair wise comparisons. It is easy to see that TI_P is a subset with more stringent tax rate limits. From this subset of tax amendments only those propositions in which the marginal rate of tax substitution of the median voter is actually higher than the government's reaction function could potentially be approved by majority.

Effects of a Tax Rate Limit on Government's Choices and Behavior

In this section we analyze the effects of a tax rate limit on government's behavior. In particular, we are interested in the process that delivers the expected tax structure $\bar{\mathbf{t}}$ induced by a TRL. We will focus our attention on how the TRL restricts the feasible set of tax instruments and how the tax constraint changes the way the electoral competition aggregates voters' preferences. If approved, the tax amendment reduces the strategy set since parties will not be able to use the tax instrument t_i. Thus, the new feasible and "*constrained,*" strategy set for parties k and $-k$ is given by $S'^k, S'^{-k} \in S'^c$:

$$S'^k, S'^{-k} \in S'^c = \left\{ \exists \ \bar{t}_i, t_j\left(\bar{t}_i\right) \in \bar{R} : dt_j / dt_i\left(\bar{t}_i\right)\Big|_{d\bar{R}=0} = -R_i / R_j\Big|_{\bar{t}_i} \leq 0 \right\} \qquad (14)$$

Where $R_i = \partial R/\partial t_i \geq 0$ and $R_j = \partial R/\partial t_j \geq 0$ are the marginal tax revenue of changes in t_i and t_j. In addition, in the fourth stage voters vote for the proposed tax initiatives and reveal the aggregate proportion of the vote $pv(\bar{\mathbf{t}}^h) \in [0,1]$ attached to all tax systems $\bar{\mathbf{t}}^h = \left[\bar{t}_i^h, t_j(\bar{t}_i^h)\right] \in d$. Thus, the process of voting shows that $pv(\bar{t}_i^h)$ is ½ for $\bar{t}_i^h = \bar{t}_i$ where $\bar{t}_i$ is the most profitable deviation of the decisive voter, $pv(\bar{t}_i^h) < ½ \;\; \forall \, \bar{t}_i^h < \bar{t}_i$ and $\forall \, \bar{t}_i^h > \bar{t}_i$. The information revealed by the approval of a tax rate limit modifies the system of beliefs of parties on how tax policies translate into aggregate votes. Parties set a probability $\alpha_y = \tilde{\alpha}_y \geq 0 : \sum_{\forall y} \tilde{\alpha}_y = 1$ to all states *y* in which the distribution of voters' preferences assign the proportion of the aggregate votes $pv(\bar{\mathbf{t}}^h) \in [0,1] \;\; \forall \, \bar{\mathbf{t}}^h \in d$ revealed by the pair wise comparison of tax initiatives, otherwise parties set $\alpha_y = 0$. Hence the probability a voter $h \in \varphi^l$ is now given by $\widetilde{\Pr}\left(\mathbf{t}^k, \mathbf{t}^{-k} \middle| \tilde{\alpha}_y\right) = \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}^{lk}\left(\upsilon^l(\mathbf{t}^k) - \upsilon^l(\mathbf{t}^{-k})\right)$ with $\tilde{F}^{hk} \middle| \tilde{\alpha}_y = \sum_{y=1}^{Y} \tilde{\alpha}_y \Pr_y^{hk}$. Therefore, parties' problem is to select the tax system that maximizes the candidate's new expected proportion of the votes conditioned to a tax rate limit $t_i \leq \bar{t}_i < t_i^*$ and the new system, as it is shown in (15):

$$\begin{aligned} \underset{\{\mathbf{t}^k\}}{Max} \;\; E\tilde{V}^k\left(\mathbf{t}^k, \mathbf{t}^{-k} \middle| \tilde{\alpha}_y\right) &= \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}^{lk}\left(\upsilon^l(\mathbf{t}^k) - \upsilon^l(\mathbf{t}^{-k})\right) \\ \text{s.t}: \;\; i) \quad \overline{R} &= \sum_{i=1}^{n} t_i^k \left(\sum_{h=1}^{H} x_i^h\right) \\ ii) \quad & t_i \leq \bar{t}_i < t_i^* \end{aligned} \tag{15}$$

Restricting our attention, as before, to an economy with two commodities we will show that the *constrained* electoral game in (15) is equivalent to maximize the utility of the median voter when the objective of the collective action is to obtain a tax structure such that $t_i, t_j \in \overline{R}$. In other words, an approved tax rate limit will be equivalent to a change in the weighing factors of the politically determined welfare function such that policy is determined by the decisive voter of the set *d*. This implies that the process of electoral competition in (15) will maximize the utility of the median voter of the tax initiatives. This result is shown formally in Theorem 2.

Theorem 2. Let parties' choice of tax policies be given by (15) for an economy with two tax instruments and under the presence of a tax rate limit $t_i \le \overline{t}_i < t_i^*$. Therefore, the electoral equilibrium delivers the tax structure $\overline{\mathbf{t}}$ which is equivalent to a policy that solves the next problem:

$$\underset{\{t_i,t_j\}}{Max} \quad \upsilon^{MV}\left(\mathbf{t}^k\right) \quad s.t:\ i)\ \overline{R} = \sum_{i=1}^{n} t_i^k \left(\sum_{h=1}^{H} x_i^h\right) \quad \text{where } \mathbf{t}^k = \left[t_i^k, t_j^k\right]$$

Proof

From the "constrained" policy set and the electoral competition problem it is clear that the solution to (15), denoted by $\overline{\mathbf{t}} = \left[\overline{t}_i, t_j\left(\overline{t}_i\right)\right]$, is $t_i^k\left(\ \overline{t}_i\right) \in S'^k$ for party *k.* Similarly, party $-k$ selects $t_j^{-k}\left(\ \overline{t}_i\right) \in S'^{-k}$. Since $S'^k, S'^{-k} \in S'^c$ are singleton sets the expected proportion of the votes for parties at $t_j\left(\ \overline{t}_i\right)$ is $E\tilde{V}^k\left(\overline{t}_i, t_j\left(\ \overline{t}_i\right)\right) = \sum_{\forall \varphi^l \in \Theta} \tilde{\varphi}^l \big/ 2 = E\tilde{V}^{-k}\left(\overline{t}_i, t_j\left(\ \overline{t}_i\right)\right)$ implying that parties' pluralities are $P\ell^k = P\ell^{-k} = 0$.[22]

Now consider the "*unconstrained"* and certain electoral competition problem:

$$\underset{\{t_i,t_j\}}{Max} \quad \upsilon^{MV}\left(\mathbf{t}\right) \quad s.t:\ i)\ \overline{R} = \sum_{i=1}^{n} t_i^k \left(\sum_{h=1}^{H} x_i^h\right) \quad \text{where } \mathbf{t}^k = \left[t_i^k, t_j^k\right]$$

Its solution is the ideal tax structure of the median voter $\widehat{\mathbf{t}}^* = \left[\widehat{t}_i^*, \widehat{t}_j^*\right]$. The optimality conditions imply $\upsilon_i^{MV} \big/ R_i = \upsilon_j^{MV} \big/ R_j$ hence $\left.\frac{\partial t_j}{\partial t_i}\right|_{d\overline{R}=0,\widehat{t}_i^*} = \left.\frac{\partial t_j}{\partial t_i}\right|_{d\upsilon^{MV}=0,\widehat{t}_i^*}$. From (9), $\widehat{t}_i^* = \overline{t}_i \in arg\max\left\{\ \upsilon^{MV}\left(t_i,t_j\right) - \upsilon^{MV}\left(t_i^*,t_j^*\right) \text{ s.t: } t_i, t_j\left(t_i\right) \in \overline{R} : dt_j / dt_i\big|_{d\overline{R}=0} \le 0\ \right\}$ then it is satisfied $\widehat{t}_j^* = t_j\left(\overline{t}_i\right) : \left.\frac{\partial t_j}{\partial t_i}\right|_{d\overline{R}=0,\overline{t}_i} = \left.\frac{\partial t_j}{\partial t_i}\right|_{d\upsilon^{MV}=0,\widehat{t}_i^*}$ .We conclude, $\overline{\mathbf{t}} = \widehat{\mathbf{t}}^*$. It follows that the problem of choosing t_j from the constrained strategy set for parties in (15) is equivalent

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[22] Note that the strategy sets $S'^k = S'^{-k} = S' = \left\{t_j = t_j\left(\overline{t}_i\right)\right\}$ have a single element that is mapped from the revenue function and therefore it, trivially, becomes in the parties' dominant strategy to a tax rate limit.

to the policy chosen by parties seeking to maximize the utility of the median voter over the level of public revenue $\overline{R}$. ■

The relevance of Theorem 2 is to show that a binding tax rate limit, effectively, modifies the feasible strategy set of the electoral game which, in turn, limits the policy outcomes at the equilibrium and regulates the electoral competition. For our two commodity economy, a tax rate limit in one tax instrument is equivalent to signal to parties that a majority of voters prefers $\overline{\mathbf{t}} = \left[\overline{t_i}, t_j\left(\overline{t_i}\right)\right]$ over $\mathbf{t}^* = \left[t_i^*, t_j^*\right]$. Moreover, the process of voting for tax initiatives reveals the aggregate proportion of the expected vote $pv\left(\overline{\mathbf{t}}^h\right) \in [0,1]$ attached to all tax systems $\overline{\mathbf{t}}^h = \left[\bar{t}_i^h, t_j\left(\bar{t}_i^h\right)\right] \in d$. Since in this economy there exists a unique Condorcet winner and $t_i = \overline{t_i}$ reflects the most preferred feasible deviation from the status quo under a competitive process of tax amendment proposals, then it must be that $t_i = \overline{t_i}$ is the Condorcet winner. The tax rate limit serves as a signal that eliminates the uncertainty in the two commodity economy and, consequently, the electoral competition seeking to maximize the expected proportion of the votes is reduced to a certainty problem in which there exists a Condorcet winner. The electoral competition has a unique and stable equilibrium, the policy that maximizes the utility of the median voter of the tax initiatives. This implies that the electoral competition problem under uncertainty in the "*constrained*" case, (see equation 15) can be reduced to an "*unconstrained*" maximization problem under certainty in which the objective is to maximize the utility of the median voter subject to the satisfaction of the revenue objective $\overline{R}$.

Now we proceed to characterize the perfect Bayesian equilibrium in which a tax rate limit is proposed and approved by a majority in the game with voters' initiatives.

Proposition 1. *Let* $\mathbf{t}^*$ *be parties' tax platform in the second stage of the game. Let* $\mathbf{t}^* \neq \widehat{\mathbf{t}}^*$ *where* $\widehat{\mathbf{t}}^*$ *is the ideal policy of the median voter of the tax initiatives. Then a tax rate limit* $t_i \leq \overline{t_i} < t_i^*$ *will be proposed and approved for the game of voters' initiatives. The perfect Bayesian equilibrium compatible with the approval of a tax amendment is constituted as follows:*

i. In the second stage parties select $\mathbf{t}^*$:

$$\mathbf{t}^* \in \arg\max \sum\nolimits_{\forall \varphi^l \in \Theta} \varphi^l F^{lc}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right) \middle| \alpha_y\right) \text{s.t}: \ \overline{R} = \sum_{i=1}^{n} t_i^c \left(\sum_{h=1}^{H} x_i^h\right) \forall c = \{k, -k\}$$

and

$$\forall h \in \varphi^l \wedge c = \{k, -k\}, \ F^{lc}(\bullet)\big|\alpha_y = \sum_{y=1}^{Y} \alpha_y \Pr_y^{lk} \ : \ \Pr_y^{lk} \in [0,1] \wedge \ \alpha_y \geq 0 : \sum\nolimits_{\forall y} \alpha_y = 1$$

ii. Voters propose initiatives $\bar{t}_i^h \ \forall h$:

$$\bar{t}_i^h \in \arg\max\left\{ \upsilon^h\left(t_i, t_j\left(\bar{t}_i^h\right)\right) - \upsilon^h\left(t_i^*, t_j^*\right)\right\} \ \forall h$$

$$\text{s.t}: \qquad \forall \bar{t}_i, \ \exists \ t_j\left(\bar{t}_i\right): \ \bar{t}_i, t_j\left(\bar{t}_i\right) \in \overline{R}, \qquad \text{and}$$

$$E\left\{\upsilon^{MV}\left(\bar{t}_i^h, t_j\left(\bar{t}_i^h\right)\right) - \upsilon^{MV}\left(t_i^*, t_j^*\right)\right\} = \sum\nolimits_{\forall y} \alpha_{\text{y}} \left[\upsilon_y^{MV}\left(\bar{t}_i^h, t_j\left(\bar{t}_i^h\right)\right) - \upsilon_y^{MV}\left(t_i^*, t_j^*\right)\right] \geq 0$$

iii. The median voter approves a tax rate limit $t_i \leq \overline{t_i} < t_i^*$ such that:

$$\bar{t}_i \in \arg\max\left\{\upsilon^{MV}\left(t_i, t_j\left(\bar{t}_i\right)\right) - \upsilon^{MV}\left(t_i^*, t_j^*\right)\right\} \quad \text{s.t} \quad i) \ \bar{t}_i, \ t_j\left(\bar{t}_i\right) \in \overline{R}$$

iv. Parties' new system of beliefs after observing $pv\left(\bar{\mathbf{t}}^h\right) \in [0,1] \ \forall \ \bar{\mathbf{t}}^h \in d$ are:

$$\forall h \in \varphi^l \wedge \forall c, \ \widetilde{F}^{lc}(\bullet)\big|\tilde{\alpha}_y = \sum_{y=1}^{Y} \widetilde{\alpha}_y \Pr_y^{lk} \ : \ \widetilde{F}^{lc}(\bullet)\big|\tilde{\alpha}_y \neq F^{lc}(\bullet)\big|\alpha_y \ \wedge \ \widetilde{\alpha}_y \geq 0 \ \wedge \ : \sum\nolimits_{\forall y} \widetilde{\alpha}_y = 1$$

v. Parties respond to a TRL by selecting $\bar{\mathbf{t}} = \left\lfloor \bar{t}_i, t_j\left(\bar{t}_i\right) \right\rfloor$:

$$t_j\left(\bar{t}_i\right) \in \arg\max \sum\nolimits_{\forall \varphi^l \in \Theta} \varphi^l \widetilde{F}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right) \middle| \tilde{\alpha}_y\right)$$

$$\text{s.t:} \ \ \bar{\mathbf{t}} \in S'^c = \left\{ \forall \ \ \bar{t}_i \ \ \exists \ t_j\left(\bar{t}_i\right) \in \overline{R}: \ dt_j / dt_i\left(\bar{t}_i\right)\Big|_{d\overline{R}=0} \leq 0 \right\}.$$

Proof

Let the Lagrangian $\delta^c(\hat{\mathbf{t}},\hat{\mathbf{t}})\ \forall c$ be parties' plurality under $\mathbf{t}^k = \mathbf{t}^{-k} = \hat{\mathbf{t}} = \left[\hat{t}_i, t_j\left(\hat{t}_i^h\right)\right]$ such that:

$$\hat{t}_j \in \arg\max \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lc}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right) \middle| \alpha_y\right)$$

$$\text{s.t} \qquad \hat{t}_i \in \arg\max\left\{ E\left\{ \upsilon^{MV}\left(\hat{t}_i, \hat{t}_j\left(\hat{t}_i\right)\right) - \upsilon^{MV}\left(t_i^*, t_j^*\right) \middle| \alpha_y \right\} \geq 0 \right\}$$

$$\forall\, \hat{t}_i,\ \exists\ \hat{t}_j\left(\hat{t}_i^h\right):\ \hat{t}_i, \hat{t}_j\left(\hat{t}_i^h\right) \in \overline{R}, \text{ where } \overline{R} = \sum_{i=1}^{n} t_i^c \left(\sum_{h=1}^{H} x_i^h\right) \forall c = \{k, -k\}$$

Now let $\mathbf{t}^* \in \arg\max \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lc}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right) \middle| \alpha_y\right) \text{s.t}:\ \overline{R} = \sum_{i=1}^{n} t_i^c \left(\sum_{h=1}^{H} x_i^h\right) \forall c = \{k, -k\}$

which leads to a plurality $\delta^c(\mathbf{t}^*,\mathbf{t}^*)\ \forall c$. Adding constraints to the policy space can not lead to higher plurality therefore $\delta^c(\mathbf{t}^*,\mathbf{t}^*) \geq \delta^c(\hat{\mathbf{t}},\hat{\mathbf{t}})\ \forall c$ which implies $\delta^c(\mathbf{t}^*,\hat{\mathbf{t}}) \geq \delta^c(\hat{\mathbf{t}},\hat{\mathbf{t}})\ \forall c$. This proves that $\hat{\mathbf{t}}$ can't belong to a perfect Bayesian equilibrium and that parties propose $\mathbf{t}^k = \mathbf{t}^{-k} = \mathbf{t}^*$ in the second stage of the game given parties' knowledge of the continuation of the game and their system of beliefs. Theorem 1 proves condition *(iii)* holds for an equilibrium in which a tax rate limit is approved. Theorem 2 also proves that the system of beliefs supporting the equilibrium corresponds to the beliefs shown in condition (iv). Condition (iii) and (iv) implies (v).

■

Proposition 1 says that parties can minimize the probability that a TRL is approved if parties select $\hat{\mathbf{t}}$. However, parties have no incentive to do so since parties' plurality over a constrained policy space can not be higher than parties' plurality over an unconstrained policy space. Since the election is held before a TRL is approved (rejected) then parties have no incentive to constrain their policy prospects to win the election. This doesn't mean that parties will propose any policy, parties maximize their chances to win the election if parties propose a policy that weighs voters' demands for tax structure according to voters' marginal proportion of the expected vote. Any deviation from this strategy hurts parties' chance to win the election in the third stage of the game

The hypothesis of tax substitution as the rationale for a TRL leads to the next conclusions: First a tax rate limit will be approved over a tax instrument t_i if it is satisfied:

$$\Rightarrow\ -\left.\frac{dt_j}{dt_i}\right|_{d\bar{U}^{MV}=0} \geq -\left.\frac{dt_j}{dt_i}\right|_{d\bar{R}=0} \qquad \Rightarrow \quad MRTS^{MV}_{t_j-t_i} \geq \sigma\left(\bar{R}\right)_{t_j-t_i} \tag{16}$$

In words, a proposal to limit a tax instrument t_i is set on the ballot and receives the majority support if the marginal rate of tax substitution of feasible taxes for the median voter $MRTS^{MV}_{t_j-t_i}$ (defined as different combinations of t_i, t_j that keep unchanged the utility of the voter), is at least as high as the elasticity of substitution of tax revenue $\sigma\left(\bar{R}\right)_{t_j-t_i}$ which is defined as the rate in which taxes t_i and t_j must change in order to collect the public revenue $\bar{R}$. To see this, note that the reaction function of a tax rate limit from the incumbent government is given by $-dt_j/dt_i\big|_{d\bar{R}=0} = R_i/R_j = \dfrac{R_i/\bar{R}}{R_j/\bar{R}} = \dfrac{dln\bar{R}(\mathbf{t})/dt_i}{dln\bar{R}(\mathbf{t})/dt_j} = \sigma\left(\bar{R}\right)_{t_j-t_i} \geq 0$ where $\bar{R}(\mathbf{t})$ is the tax revenue function that collects $\bar{R}$. Equation (16) is equivalent to:

$$MRTS^{MV}_{t_j-t_i} \geq \sigma\left(\bar{R}\right)_{t_j-t_i} \quad \Leftrightarrow \quad \gamma^{MV} = \left\{\frac{s_i^{MV}}{s_j^{MV}} - \frac{\varepsilon_{\bar{R}-t_i}}{\varepsilon_{\bar{R}-t_j}}\left(\frac{t_j^*}{t_i^*}\right)\right\} \geq 0 \tag{17}$$

Where $\varepsilon_{\bar{R}-t_i} = \partial R(\mathbf{t})/\partial t_i * \left(t_i/\bar{R}\right)$ and $\varepsilon_{\bar{R}-t_j} = \partial R(\mathbf{t})/\partial t_j * \left(t_j/\bar{R}\right)$ are the elasticities of tax public revenue with respect taxes t_i and t_j, the ratio t_j^*/t_i^* corresponds to the taxes prevailing at the status quo, and $s_z^h = x_z^h/I^h$ is the share of consumption of commodities $z = \{i, j\}$ over voter's budget. Equation (17) reflects the notion that in our economy the approval of a tax rate limit is explained by the effects of a TRL on voters' budget versus the effects of the initiative on tax revenue. The tax substitution hypothesis implies that a tax rate limit on t_i leads to an increase in t_j. There are higher incentives to impose a tax rate limit over an arbitrary tax instrument t_i:

(a) The higher is the relative share $s_i^{MV} \big/ s_j^{MV}$ of consumption of commodity *i* with respect commodity *j* for the median voter. This is so, since the higher is s_i^{MV} the more relevant are the voter's budget effects (gains) from substituting one tax rate (t_i) for the other (t_j).

(b) The lower is the relative ratio of the revenue elasticities of the tax instruments $\varepsilon_{\overline{R}-t_i} \big/ \varepsilon_{\overline{R}-t_j}$. A lower $\varepsilon_{\overline{R}-t_i} \big/ \varepsilon_{\overline{R}-t_j}$ might be related with a higher marginal tax revenue that can be collected from an increase in tax rate t_j compared with a similar change in tax rate t_i. Hence, the lower $\varepsilon_{\overline{R}-t_i} \big/ \varepsilon_{\overline{R}-t_j}$ the easier is to substitute tax revenue from commodity *i* to commodity *j*.

(c) The broader is the taxable base $X_j = \sum_{h=1}^{H} x_j^h$ of the tax rate t_j. In this case the broader the taxable base of the *unconstrained* tax instruments at the disposal of the government, the easier will be to accommodate the revenue loss from a tax rate limit over t_i.[23]

(d) The less broad (or more specific) is the tax base of the tax instrument to be subject to the limit (the lower $X_i = \sum_{h=1}^{H} x_i^h$) the higher the gain from the amendment. A possible interpretation is that the lower the tax base of a tax instrument the larger is the tax rate associated with each level of revenue to be collected and then the larger could be the marginal excess burden associated with the tax instrument.

[23] Formally, it can be shown that, *ceteris paribus*, the taxable base is positively related with the revenue elasticity.

Therefore there might be possible gains in reducing the inefficiency costs by diminishing the dependence in the revenue collection function from, presumably, a relatively more inefficient tax instrument.

An Economy with *n* Commodities

In our previous analysis of a two commodity economy, a tax rate amendment in one tax is binding since parties observe the aggregate share of the votes attached to the tax initiatives. This information allows parties to choose the tax system that is the Condorcet winner. A Condorcet winner exists in our economy with $n = 2$ because from the policy space there is a unique function (which is given by $\forall\, t_i,\ \exists\, t_j(t_i) \in \bar{R} : \bar{R} = R(t_i, t_j)$) that reduces the two dimensional policy space into an *ordered* policy space in one dimension. Thus the median policy in one space maps into the median policy of the other dimension and vice versa. Note that picking a Condorcet winner, when it exists, is a weakly dominant strategy for parties and the approval of a tax rate limit signaled such a policy.

However, in the case in which policy is multidimensional we should ask: What drives the response of parties to a tax rate limit? In this section we are interested in this question and in analyzing the conditions for the approval of a tax rate limit by a majority when policy is multidimensional. However, to keep calculations simple we assume $n = 3$. We proceed to evaluate the conditions in which a tax rate limit would be proposed and approved by a majority. Consider the electoral game with voters' initiatives in Figure 2. Let denote $\mathbf{t}^* = [t_1^*, t_2^*, t_3^*]$ as the tax structure proposed by parties in the second stage of the game.

As before, under the assumption that placing an initiative on the ballot is costless, a motion for a change in the tax structure will be proposed as long as there exists voters with their most preferred tax structure different to the status quo $\mathbf{t}^*$. Suppose that a tax rate limitation is placed to be voted with a proposal of fixing the tax rate of commodity *i* at $t_i = \overline{t_i} < t_i^*$. If approved, the tax rate limit reduces the tax price for voters by diminishing voters' tax liability from tax instrument i. However, parties will introduce some compensating modifications in the rest of tax instruments to satisfy the public revenue objective that increase the tax liability of the voter from the unconstrained taxes. Thus, the effect of a tax rate limit on the overall tax liability of voters is ambiguous. To evaluate more closely this tradeoff, let the ex-post tax structure after the approval of a tax initiative be $\bar{\mathbf{t}} = \left[\bar{t}_i, r_2\left(\bar{t}_i\right), \ldots r_n\left(\bar{t}_i\right)\right]$ where $r_j\left(\bar{t}_i\right)\ \forall i \neq j = 1 \ldots\ldots n-1$ are the government's response to a tax rate limit.

A sufficient condition for the approval of a tax rate limit is a majority of individuals such that $\forall h \in \varphi^l : \upsilon^l\left(\bar{\mathbf{t}}\right) - \upsilon^l\left(\mathbf{t}^*\right) \geq 0$. Now, let define $\Omega : P\left(\bar{\mathbf{t}}, \mathbf{t}^*\right) \to [0,1]$ where Ω is a continuous, strictly increasing cumulative distribution over the preference relation of voters on the policy space, and $P\left(\bar{\mathbf{t}}, \mathbf{t}^*\right) = \left\{\forall\ h \in \varphi^l : \upsilon^l\left(\bar{\mathbf{t}}\right) - \upsilon^l\left(\mathbf{t}^*\right) \geq 0\right\}$ is the set of voters who prefer $\bar{\mathbf{t}}$ over an alternative tax system $\mathbf{t}^*$.

Theorem 3. Let $\mathbf{t}^* \in \Re^n$ be the tax structure derived by the process of electoral competition in the second stage. Let the tax structure that would prevail if a tax rate limit $\bar{t}_i$ were approved be $\bar{\mathbf{t}} = \left[\bar{t}_i, r_2\left(\bar{t}_i\right), \ldots r_n\left(\bar{t}_i\right)\right]$ where $r_j = t_j\left(\bar{t}_i\right)$ for $j = 2, \ldots. n$ are the expected reaction functions derived by the process of electoral competition in the last stage of the game with voters' initiatives. Then, if $\Omega\left(\forall\ l : \sum_{j \neq i}^{n} \frac{r_j'\left(t_i\right)}{MRTS^l_{t_j - t_i}} \leq 1\right) = \frac{1}{2}$ a tax rate limit $t_i \leq \bar{t}_i < t_i^*$ will be approved.

Proof

Let the set of voters who prefer a tax structure $\bar{\mathbf{t}}$ over an alternative tax system $\mathbf{t}^*$ be given by $P\left(\bar{\mathbf{t}}, \mathbf{t}^*\right) = \left\{\forall\ h \in \varphi^l : \upsilon^l\left(\bar{\mathbf{t}}\right) - \upsilon^l\left(\mathbf{t}^*\right) \geq 0\right\}$. A tax rate limit is approved if the proportion of individual who are at least as well off under $\bar{\mathbf{t}}$ compared to $\mathbf{t}^*$ represents a majority. Therefore a sufficient condition for the approval of $t_i = \bar{t}_i < t_i^*$ is:

$$\Omega\left(P\left(\bar{\mathbf{t}}, \mathbf{t}^*\right)\right) = \Omega\left(\forall\ h \in \varphi^l : \upsilon^l\left(\bar{\mathbf{t}}\right) \geq \upsilon^l\left(\mathbf{t}^*\right)\right) = \frac{1}{2}$$

$$\Rightarrow \qquad \Omega\left(\forall h \in \varphi^{l}; \lim_{\Delta t_i \to 0} \frac{\upsilon^{l}(\bar{\mathbf{t}}) - \upsilon^{l}(\mathbf{t}^{*})}{\Delta t_i} = \left.\frac{d\chi^{l}}{dt_i}\right|_{\mathbf{t}^{*}} \right) = \frac{1}{2}$$

With $\Delta t_i = t_i - t_i^{*} < 0$ with $t_i = \bar{t}_i$, $\Delta\chi^{l} = \upsilon^{l}(\bar{\mathbf{t}}) - \upsilon^{l}(\mathbf{t}^{*})$. From

$\Omega\left(P\left(\bar{\mathbf{t}}, \mathbf{t}^{*}\right)\right) = \Omega\left(\forall\ h \in \varphi^{l} : \upsilon^{l}\left(\bar{\mathbf{t}}\right) \geq \upsilon^{l}\left(\mathbf{t}^{*}\right)\right) = \frac{1}{2}$ and $\bar{\mathbf{t}} = \left[\bar{t}_i, r_2\left(\bar{t}_i\right), \ldots r_n\left(\bar{t}_i\right)\right]$ where

$r_j' = dr_j / dt_i$, we obtain:

$$\Omega\left(\forall\ l : \frac{d\chi^{l}}{dt_i} = \frac{\partial \upsilon^{l}}{\partial t_1} + \frac{\partial \upsilon^{l}}{\partial t_2}\frac{dr_2}{dt_1} + \ldots.. \frac{\partial \upsilon^{l}}{\partial t_n}\frac{dr_n}{dt_1} \leq 0 \right) = \frac{1}{2}$$

$$\Rightarrow \quad \Omega\left(\forall\ h \in \varphi^{l} : \frac{d\chi^{l}}{dt_i} = \frac{\partial \upsilon^{l}}{\partial t_i}\left[1 - \frac{r_2'(t_i)}{MRTS^{l}_{t_2 - t_i}} - \ldots\ldots. - \frac{r_n'(t_i)}{MRTS^{l}_{t_n - t_i}}\right] \leq 0 \right) = \frac{1}{2}$$

Where $MRTS^{l}_{t_j - t_i} = -\upsilon_i^{l} / \upsilon_j^{l}$. Note $\partial\chi^{l} / \partial t_i \leq 0$, since $\upsilon_i^{l} = \partial\upsilon^{l} / \partial t_t \leq 0\ \ \forall\, i = 1..n$

then $\sum_{j \neq i}^{n} \frac{r_j'(t_i)}{MRTS^{l}_{t_j - t_i}} \leq 1 \ \Leftrightarrow\ \partial\chi^{l} / \partial t_i \leq 0$. Therefore:

$$\Omega\left(\forall\ h \in \varphi^{l} :\ \sum_{j \neq i}^{n} \frac{r_j'(t_i)}{MRTS^{l}_{t_j - t_i}} \leq 1 \right) = \frac{1}{2}$$

It is left to prove that the condition above identifies a Condorcet winner for the process of tax amendments and that the motion is approved by a strict majority. We proceed by letting condition $\Omega\left(\forall\ h \in \varphi^{l} :\ \sum_{j \neq i}^{n} \frac{r_j'(t_i)}{MRTS^{l}_{t_j - t_i}} \leq 1 \right) = \frac{1}{2}$ to hold. Now, let parties propose $\mathbf{t}^{*}$ in the first stage of the game. A voter $h \in \varphi^{l}$ will propose a tax amendment such that $\bar{t}_i^{\,l} \in \arg\max\left\{\upsilon^{l}\left(\bar{t}_i, r_2\left(\bar{t}_i\right), ..r_n\left(\bar{t}_i\right)\right) - \upsilon^{l}\left(\mathbf{t}^{*}\right)\right\}$ subject to $\Omega\left(P\left(\bar{\mathbf{t}}, \mathbf{t}^{*}\right| \alpha_y\right) = 1/2$ where $\upsilon^{l}\left(\mathbf{t}^{*}\right)$ is given and $\bar{\mathbf{t}}^{l} = \left[\bar{t}_i^{\,l}, r_2\left(\bar{t}_i^{\,l}\right), \ldots r_n\left(\bar{t}_i^{\,l}\right)\right]$ is the most profitable deviation from the status quo that receives the support of a majority given the system of beliefs of voter type l. As before, voters propose simultaneously their tax initiatives.

Let $\bar{t}_i^{\min} = Min\{\bar{t}_i^{\,l}\}_{l=1}^{M}$ and $\bar{t}_i^{\max} = Max\{\bar{t}_i^{\,l}\}_{l=1}^{M}$ then define d as an ordered set representing the ideal deviations from the status quo that will be voted in the fourth stage of the game. That is,

$d = \left\{ \forall h \in \varphi^l \subset \Theta, \exists \bar{t}_i^{\,l} \in \left[\bar{t}_i^{\min}, \bar{t}_i^{\max}\right] : \bar{t}_i^{\,l} \in \arg\max \left\{ \upsilon^l\left(\bar{\mathbf{t}}^l\right) - \upsilon^l\left(\mathbf{t}^*\right) \right\} \text{ s.t } \Omega\left(P\left(\bar{\mathbf{t}}, \mathbf{t}^*\right) \middle| \alpha_y\right) = 1/2 \right\}$.

Let $T\left(\bar{t}_i^{\,l}\right)$ be the set of voters with their most preferred tax policy amendment less than $\bar{t}_i^{\,l} \in d$, that is $T\left(\bar{t}_i^{\,l}\right) \subseteq d$. Let $\Omega\left(T\left(\bar{t}_i^{\min}\right)\right) \approx 0$, $\Omega\left(T\left(\bar{t}_i^{\max}\right)\right) = 1$, and

$\Omega\left(P\left(\bar{\mathbf{t}}, \mathbf{t}^*\right)\right) = \Omega\left(\forall\ h \in \varphi^l : \upsilon^l\left(\bar{\mathbf{t}}\right) \geq \upsilon^l\left(\mathbf{t}^*\right)\right) = \frac{1}{2}$ implies, $\Omega\left(T\left(\bar{\mathbf{t}}\right)\right) = 1/2$. Now let there exists any two alternatives $\bar{\mathbf{t}}^{l\prime}, \bar{\mathbf{t}} \in d$ to be confronted such that

$\bar{t}_i \in \bar{\mathbf{t}} \ \wedge \ \bar{t}_i^{\,l\prime} \in \bar{\mathbf{t}}^{l\prime} : \bar{t}_i^{\,l\prime} < \bar{t}_i$. Since Ω is a continuous and a strictly increasing function then $\Omega\left(T\left(\bar{\mathbf{t}}^{l\prime}\right)\right) < \Omega\left(T\left(\bar{\mathbf{t}}\right)\right) = 1/2$ hence the proportion of voters who prefer $\bar{\mathbf{t}}$ to $\bar{\mathbf{t}}^{l\prime}$ is

$\Omega\left(P\left(\bar{\mathbf{t}}, \bar{\mathbf{t}}^{l}\right)\right) = \Omega\left(T\left(\bar{t}_i^{\max}\right)\right) - \Omega\left(T\left(\bar{\mathbf{t}}\right)\right) + \frac{1}{2}\left[\Omega\left(T\left(\frac{\bar{\mathbf{t}} + \bar{\mathbf{t}}^{l\prime}}{2}\right)\right)\right]$ similarly the proportion of voters who prefer $\bar{\mathbf{t}}^{l\prime}$ to $\bar{\mathbf{t}}$ is $\Omega\left(P\left(\bar{\mathbf{t}}^{l\prime}, \bar{\mathbf{t}}\right)\right) = \Omega\left(T\left(\bar{\mathbf{t}}^{l\prime}\right)\right) - \Omega\left(T\left(\bar{t}_i^{\min}\right)\right) + \frac{1}{2}\left[\Omega\left(T\left(\frac{\bar{\mathbf{t}} + \bar{\mathbf{t}}^{l\prime}}{2}\right)\right)\right]$. Hence,

$\Omega\left(P\left(\bar{\mathbf{t}}, \bar{\mathbf{t}}^{l\prime}\right)\right) - \Omega\left(P\left(\bar{\mathbf{t}}^{l\prime}, \bar{\mathbf{t}}\right)\right) = 1 - \Omega\left(T\left(\bar{\mathbf{t}}\right)\right) - \Omega\left(T\left(\bar{\mathbf{t}}^{l\prime}\right)\right) = \frac{1}{2} - \Omega\left(T\left(\bar{\mathbf{t}}^{l\prime}\right)\right) > 0$ and

$\Omega\left(P\left(\bar{\mathbf{t}}, \bar{\mathbf{t}}^{l\prime}\right)\right) > \Omega\left(P\left(\bar{\mathbf{t}}^{l\prime}, \bar{\mathbf{t}}\right)\right)$ therefore the proposal $\bar{\mathbf{t}}$ wins over any proposal $\bar{\mathbf{t}}^{l\prime} < \bar{\mathbf{t}}$. Thus, if $\mathbf{t}^* = \mathbf{t}^{l\prime} \leq \bar{\mathbf{t}}$ then $\bar{\mathbf{t}}$ wins over $\mathbf{t}^*$ by majority.

Now let proposals $\bar{\mathbf{t}}^{l\prime} \in d$ and $\bar{\mathbf{t}}$ be confronted where $\bar{\mathbf{t}}^{l\prime} > \bar{\mathbf{t}}$ means $\Omega\left(T\left(\bar{\mathbf{t}}^{l\prime}\right)\right) > \Omega\left(T\left(\bar{\mathbf{t}}\right)\right) = 1/2$ since Ω is strictly increasing. Now the proportion of voters who prefer $\overline{\mathbf{t}}$ to $\overline{\mathbf{t}}^{l\prime}$ are $\Omega\left(P\left(\overline{\mathbf{t}},\overline{\mathbf{t}}^{l\prime}\right)\right)=\Omega\left(T\left(\overline{\mathbf{t}}\right)\right)-\Omega\left(T\left(\overline{t}_i^{\min}\right)\right)+\frac{1}{2}\left[\Omega\left(T\left(\frac{\overline{\mathbf{t}}+\overline{\mathbf{t}}^{l\prime}}{2}\right)\right)\right]$

and those who prefer $\overline{\mathbf{t}}^{l\prime}$ to $\overline{\mathbf{t}}$ are $\Omega\left(P\left(\overline{\mathbf{t}}^{l\prime},\overline{\mathbf{t}}\right)\right)=\Omega\left(T\left(\overline{t}_i^{\max}\right)\right)-\Omega\left(T\left(\overline{\mathbf{t}}^{l\prime}\right)\right)+\frac{1}{2}\left[\Omega\left(T\left(\frac{\overline{\mathbf{t}}+\overline{\mathbf{t}}^{l\prime}}{2}\right)\right)\right]$

thus:

$$\Omega\left(P\left(\overline{\mathbf{t}},\overline{\mathbf{t}}^{l\prime}\right)\right)-\Omega\left(P\left(\overline{\mathbf{t}}^{l\prime},\overline{\mathbf{t}}\right)\right)=\Omega\left(T\left(\overline{\mathbf{t}}\right)\right)-\Omega\left(T\left(\overline{t}_i^{\min}\right)\right)+\Omega\left(T\left(\overline{\mathbf{t}}^{l\prime}\right)\right)=\Omega\left(T\left(\overline{\mathbf{t}}^{l\prime}\right)\right)-1/2>0$$

Therefore $\Omega\left(P\left(\overline{\mathbf{t}},\overline{\mathbf{t}}^{l\prime}\right)\right)>\Omega\left(P\left(\overline{\mathbf{t}}^{l\prime},\overline{\mathbf{t}}\right)\right)$ and the alternative $\overline{\mathbf{t}}$ wins over any other proposal $\overline{\mathbf{t}}^{l\prime}>\overline{\mathbf{t}}$. Thus, if $\mathbf{t}^*\geq\overline{\mathbf{t}}^{l\prime}$ is confronted with $\overline{\mathbf{t}}$, then policy $\overline{\mathbf{t}}$ wins by majority.

We conclude $\overline{\mathbf{t}}$ wins the pairwise voting rounds for tax initiatives and hence it is the Condorcet winner *for the process of finding tax amendments* that provides profitable deviations from the status quo. ■

Condition $\sum_{j\neq i}^{n}\frac{r_j'(t_i)}{MRTS_{t_j-t_i}^l}\leq 1$ in Theorem 3 is the general statement for $n>2$ of our conclusion in the previous section that a proposal for a tax rate limit will receive voters' support if and only if the marginal rate of tax substitution $MRTS_{t_j-t_i}^l$ for a voter h in group l is at least as high as the expected government's reaction dr_j/dt_i . Condition (T.3.2) generalizes our previous finding and implies that the sum of the ratios between the reaction functions dr_j/dt_i over the $MRTS_{t_j-t_i}^l$ $\forall\ i\neq j$ must be less than one in order a voter prefers the tax structure $\overline{\mathbf{t}}=\left[\overline{t}_i,r_2\left(\overline{t}_i\right),...r_n\left(\overline{t}_i\right)\right]$ with $t_i=\overline{t}_i<t_i^*$ to the status quo.[24] Condition (T.3.2) also says that the approval of $t_i=t_1=\overline{t}_1$ by majority reflects the most preferred feasible deviation from the status quo under a competitive process of tax amendment proposals. Therefore it must be that $t_i=\overline{t}_i$ is the Condorcet winner of the feasible deviations from the status quo.

[24] Note that the condition (T.3.2) for $n=2$ reduces to equation (10).

Now we proceed to characterize the reaction functions of the government $r_2(\overline{t}_i),...r_n(\overline{t}_i)$ that are derived as a result of the approval of a tax rate limitation in the last stage of the game. We start with the effects of the tax motion on the policy strategy set. By definition the unconstrained policy space is $\overline{R} = R(t_1, t_2, t_3) \in \Re^3$, the approval of a tax rate limit on a tax instrument implies that the policy space is reduced to $\overline{R} = R(r_2(\overline{t}_1), r_3(\overline{t}_1) | t_1 = \overline{t}_1)$. The expression means that, conditional to $t_i = t_1 = \overline{t}_1$, taxes $t_2 = r_2 \wedge t_3 = r_3$ must satisfy the public revenue objective $\overline{R}$. The "*constrained*" strategy set for parties k and $-k$, when $\overline{t}_i = \overline{t}_1$, is given by $S'^k, S'^{-k} \in S'^c$:

$$S'^k, S'^{-k} \in S'^c = \left\{ \forall \overline{t}_1, r_2, r_3 : \overline{R} = R\left(r_2(\overline{t}_1), r_3(\overline{t}_1) \middle| t_1 = \overline{t}_1\right) \right\} \qquad (18)$$

If the tax rate limit is approved for $n = 3$, the parties' problem is:

$$\begin{aligned} &\underset{\{t_2^k, t_3^k\}}{Max}\ E\tilde{V}^k\left(\mathbf{t}^k, \mathbf{t}^{-k} \middle| \tilde{\alpha}_y\right) = \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}^{lk}\left(\upsilon^l(\mathbf{t}^k) - \upsilon^l(\mathbf{t}^{-k})\right) \\ &\text{s.t}: \ i) \quad \overline{R} = \sum_{i=1}^{n} t_i^k \left(\sum_{h=1}^{H} x_i^h \right) \text{ for } n = 2, \quad ii) \quad t_i \le \overline{t}_i < t_i^* \end{aligned} \qquad (19)$$

In (19) we write $E\tilde{V}^k\left(\mathbf{t}^k, \mathbf{t}^{-k} \middle| \tilde{\alpha}_y\right) = \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}^{lk}\left(\upsilon^l(\mathbf{t}^k) - \upsilon^l(\mathbf{t}^{-k})\right)$ to distinguish the candidate's new system of beliefs with respect the voting behavior. The optimality conditions for (19) are given by:[25]

$$\begin{aligned} \tilde{\delta}_2 = 0 \quad &\Rightarrow \quad \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}'^{lk} \upsilon_2^l + \tilde{\lambda} R_2 = 0 \quad \Rightarrow \quad r_2(\overline{t}_1) \\ \tilde{\delta}_3 = 0 \quad &\Rightarrow \quad \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}'^{lk} \upsilon_3^l + \tilde{\lambda} R_3 = 0 \quad \Rightarrow \quad r_3(\overline{t}_1) \\ \tilde{\delta}_{\tilde{\lambda}} = 0 \quad &\Rightarrow \quad \sum_{i=1}^{n} t_i \left(\sum_{h=1}^{H} x_i^h \right) - \overline{R} = 0 \quad \Rightarrow \quad \tilde{\lambda}(\overline{t}_1) \end{aligned} \qquad (20)$$

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[25] Where $\tilde{\delta}(r_2, r_3, \lambda | \overline{t}_i)$ is the constrained objective function in (19) and $\tilde{\delta}_j = \partial\tilde{\delta} / \partial t_j$ for $j = 2, 3$.

Where $R_j = \frac{\partial R}{\partial t_j} = \sum_h^H x_j^h + \sum_{z=1}^n t_z \left(\sum_h^H \frac{\partial x_z^h}{\partial t_j} \right)$ is the marginal revenue from tax on commodities $j = 2,3$, $\sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}'^{lk} \upsilon_j^l$ for $j = 2,3$ is the marginal expected votes, $\tilde{\lambda}$ is the marginal political cost of relating for one unit the public budget constraint, and $r_2(\overline{t_1})$ and $r_3(\overline{t_1})$ are the reaction functions to a tax rate limit. Let $\overline{t_i} = \overline{t_1}$ and use implicit differentiation to obtain the reaction functions $dr_2/d\overline{t_1}$ and $dr_3/d\overline{t_1}$:[26]

$$\begin{aligned} \frac{dr_2}{d\overline{t_1}} &= \frac{(R_3)^2 \tilde{\delta}_{21} - R_1 R_3 \tilde{\delta}_{23} - (R_2)^2 \tilde{\delta}_{31} + R_2 R_1 \tilde{\delta}_{33}}{\tilde{\Delta}} \\ \frac{dr_3}{d\overline{t_1}} &= \frac{(R_2)^2 \tilde{\delta}_{31} - R_2 R_1 \tilde{\delta}_{32} + R_2 R_3 \tilde{\delta}_{21} + R_3 R_1 \tilde{\delta}_{22}}{\tilde{\Delta}} \end{aligned} \tag{21}$$

In (21) the sign of the reaction function will depend of the nature of the relationship between commodities x_1^l, x_2^l and x_3^l (that is on the sign of $\tilde{\delta}_{ji} = \partial^2 \tilde{\delta} / \partial t_j \, \partial t_i$). To evaluate the sign of the reaction functions we follow Feldstein (1972a, 1972b), Atkinson and Stiglitz (1976, 1980) and assume that the demand of commodities are price independent (cross price effects are zero). Hence we obtain:

$$\begin{aligned} \frac{dr_2}{d\overline{t_1}} &= \frac{R_2 R_1 \tilde{\delta}_{33}}{\tilde{\Delta}} = \frac{R_2 R_1 \left(\partial^2 E\tilde{V}^k / \partial^2 t_3 + \tilde{\lambda} R_{33} \right)}{\tilde{\Delta}} \leq 0 \qquad \text{for } \tilde{\delta}_{33} \leq 0 \\ \frac{dr_3}{d\overline{t_1}} &= \frac{R_3 R_1 \tilde{\delta}_{22}}{\tilde{\Delta}} = \frac{R_3 R_1 \left(\partial^2 E\tilde{V}^k / \partial^2 t_2 + \tilde{\lambda} R_{22} \right)}{\tilde{\Delta}} \leq 0 \qquad \text{for } \tilde{\delta}_{22} \leq 0 \end{aligned} \tag{22}$$

Since the expected votes function on the constrained policy space is strictly concave then it follows $\tilde{\Delta} = -(R_2)^2 \tilde{\delta}_{33} - (R_3)^2 \tilde{\delta}_{22} > 0$, $\tilde{\delta}_{33} = \partial^2 E\tilde{V}^k / \partial^2 t_3 + \tilde{\lambda} R_{33}$ and $\tilde{\delta}_{22} = \partial^2 E\tilde{V}^k / \partial^2 t_2 + \tilde{\lambda} R_{22}$ which means that $sign(\tilde{\delta}_{33})$ and $sign(\tilde{\delta}_{22})$ imply, respectively, $sign(dr_2/d\overline{t_1})$ and $sign(dr_3/d\overline{t_1})$. Equations (22) say that provided that the change in the marginal expected proportion of the votes is non increasing as we increase tax rates

[26] For the details of the calculation see Appendix B.

$r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$ (in other words provided that $\tilde{\delta}_{33} \leq 0$ and $\tilde{\delta}_{22} \leq 0$), a government seeking to maximize the expected votes will respond to a tax rate limit by increasing the tax rates at their disposal, namely $r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$, to satisfy the aimed public revenue collection $\bar{R}$.

Not surprisingly, the reaction function of parties $r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$ weigh the public revenue effects of increases of tax rates $r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$ with its political costs (measured by $\partial^2 E\tilde{V}^k / \partial^2 t_3$, and $\partial^2 E\tilde{V}^k / \partial^2 t_2$ in equation 22). From the discussion above the reaction functions can lead in a more intensive use of tax r_2 compared with r_3 (or $|r_2(\bar{t}_1)| \geq |r_3(\bar{t}_1)|$), as a result of the approval of a tax amendment if: $R_2 \geq R_3$ and/or if the relative marginal expected votes lost, as we increase tax rates $r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$, is smaller for $\tilde{\delta}_{22}$ relative to $\tilde{\delta}_{33}$.[27] In both cases, a more intense increase in r_2 compared with r_3 would reflect that marginal political costs per revenue collected over the unconstrained taxes are equalized.

The discussion above formalizes the tradeoffs of the response of parties to a tax initiative. Now we are interested in the effect of a tax rate limit on the aggregation of preferences from voters. As mentioned before, a tax rate limit reduces the electoral competition to the problem depicted in equation (19). The objective function $E\tilde{V}^k$ reflects the new expected proportion of votes (or candidates' updated beliefs on the voting behavior) over the constrained policy space $\bar{R} = R\left(r_2(\bar{t}_1), r_3(\bar{t}_1) | t_1 = \bar{t}_1\right) \in \Re^2$. As it is shown by Theorem 3, the process of voting for tax amendments reveals the aggregate proportion of the votes attached to the set of tax initiatives *d*. Parties update their system of beliefs by setting $\tilde{\alpha}_y \geq 0 : \sum_{\forall y} \tilde{\alpha}_y = 1$ to all states of nature in which the distribution of voters' preferences assign the proportion of the aggregate votes revealed by the pair wise comparison of tax initiatives, otherwise parties set $\alpha_y = 0$. The new system of beliefs leads to a probability a voter $h \in \varphi^l$ votes for party k (for $\mathbf{t}^k$ and $\mathbf{t}^{-k}$) given by

[27] The smaller is δ_{22} relative to δ_{33} implies that the lower is the rate of change in the marginal expected proportion of the votes as there are changes in the tax instrument $r_2(\bar{t}_1)$ compared with $r_3(\bar{t}_1)$.

$\widetilde{\Pr}^{lk}\left(\mathbf{t}^{k},\mathbf{t}^{-k}\middle|\tilde{\alpha}_{y}\right)=\tilde{F}^{lk}\left(\upsilon^{l}\left(\mathbf{t}^{k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)$. This implies that in the new politically aggregated welfare function $E\tilde{V}^{k}$ parties assign a higher weight to the preferences of those individuals in the majoritarian coalition approving the tax rate limit (compared with the weight assigned to those voters in the expected votes function EV^{k}). The outcome is proved in Theorem 4.

Theorem 4. A tax rate limit regulates government's behavior by designating a higher weight in the politically aggregated welfare function to those voters expected to belong to the majoritarian coalition approving the tax limit. Let $\omega^{l}=\varphi^{l}f^{lk}$ be the weight assigned to the preferences of voter type *l* in the second stage of the game, and $\tilde{\omega}^{l}=\varphi^{l}\tilde{f}^{l}$ is the new weight assigned to voter type *l* after a TRL is approved. Therefore $\forall h\in\varphi^{l}:h\in P\left(\bar{\mathbf{t}},\mathbf{t}^{*}\right),\ \ \tilde{\omega}^{l}\geq\omega^{l}$.

Proof

In the first stage, the optimality conditions of party's problem imply $\sum_{\forall\varphi^{l}\in\Theta}\varphi^{l}f^{lk}\upsilon_{j}^{l}+\lambda R_{j}=0\ \forall t_{j}^{*}$ where $F'^{lk}=f^{lk}$. The weight assigned to the voter type *l* in determining party's tax policies is given by $\omega^{l}=\varphi^{l}f^{lk}$.[28] In the third stage, parties observe the aggregate proportion of the votes attached to all policies $\forall\,\bar{\mathbf{t}}^{l}\in d:\Omega\left(P\left(\bar{\mathbf{t}},\bar{\mathbf{t}}^{l}\right)\right)$ where $\bar{\mathbf{t}}$ is the initiative winning the full round of pair wise comparisons. The approval of the tax rate limit $t_{i}=\bar{t}_{i}<t_{i}^{*}\Rightarrow\exists\,\Omega\left(P\left(\bar{\mathbf{t}},\mathbf{t}^{*}\right)\right)=\frac{1}{2}$.

Therefore:

$$\exists\,h\in\varphi^{l};\ h\in P\left(\bar{\mathbf{t}},\mathbf{t}^{*}\right):\left\{\forall\,l:\varphi^{l}\upsilon^{l}\left(\bar{\mathbf{t}}\right)\geq\varphi^{l}\upsilon^{l}\left(\mathbf{t}^{*}\right)\right\}\ \Rightarrow\forall\,l\in P\left(\bar{\mathbf{t}},\mathbf{t}^{*}\right):\upsilon^{l}\left(\bar{\mathbf{t}}^{k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\geq\upsilon^{l}\left(\mathbf{t}^{*k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)$$

Let the new system of beliefs of parties $\tilde{\alpha}_{y}\geq0:\sum_{\forall y}\tilde{\alpha}_{y}=1$ leads to a non decreasing cumulative distribution function given by $\tilde{F}(\bullet)\middle|\tilde{\alpha}_{y}$. Hence,

$\forall h\in\varphi^{l};h\in P\left(\bar{\mathbf{t}},\mathbf{t}^{*}\right):\ \tilde{F}\left(\upsilon^{l}\left(\bar{\mathbf{t}}^{k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)\geq\tilde{F}\left(\upsilon^{l}\left(\mathbf{t}^{*k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)\ \forall\mathbf{t}^{-k}\in S'^{-k}$. Since

[28] By definition, $\omega^{l}=\varphi^{l}f^{lk}$ is the marginal proportion of the expected vote from voters type l. The higher ω^{l} the more effective voters type l are to influence parties. Hence, the higher ω^{l}, the closer is the policy position taken by parties to the ideal policy position of voter *l*.

$\tilde{F}\left(\upsilon^{l}\left(\mathbf{t}^{*k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)=F\left(\upsilon^{l}\left(\mathbf{t}^{*k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)$, $\exists\ h\in\varphi^{l}$, $h\in P\left(\overline{\mathbf{t}},\mathbf{t}^{*}\right)$ and $\tilde{F}^{lk}\in E\tilde{V}\ \wedge$ $F^{lk}\in EV$ such that $\tilde{F}^{lk}\left(\upsilon^{l}\left(\overline{\mathbf{t}}^{k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)\geq F^{lk}\left(\upsilon^{l}\left(\mathbf{t}^{*k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)$. Hence it is satisfied $\forall h\in\varphi^{l}$, $l\in P\left(\overline{\mathbf{t}},\mathbf{t}^{*}\right)$: $\tilde{f}^{lk}\left(\upsilon^{l}\left(\overline{\mathbf{t}}^{k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)\geq f^{lk}\left(\upsilon^{l}\left(\mathbf{t}^{*k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\right)$ $\forall\mathbf{t}^{-k}\in S'^{-k}$ which implies $\tilde{\omega}^{l}\geq\omega^{l}$.

■

We conclude that a tax rate limit also affects the objective function of the electoral competition game by modifying candidates' beliefs on the voting behavior which is the mechanism that regulates the electoral competition. Thus a tax rate limit "regulates" the government's behavior by changing the process in which the electoral competition aggregates voters' preferences. In particular, voters approving the tax rate limit will be assigned a higher weight in the politically aggregated welfare function. This suggests that a government with election concerns will be more responsive to those individuals who are expected to have supported the tax amendment.

Now we will proceed to characterize the perfect Bayesian equilibrium in which a tax rate limit is proposed and approved by a majority.

Proposition 2. *Let* $\mathbf{t}^{*c}\in\Re^{n}$ *for n>2, be the tax structure derived by the process of electoral competition in the second stage. In the game of voters' initiative, a tax rate limit* $t_i\leq\bar{t}_i<t_i^*$ *is approved and leads to* $\overline{\mathbf{t}}=\left[\bar{t}_i,r_2\left(\bar{t}_i\right),\dots r_n\left(\bar{t}_i\right)\right]$ *if the following is satisfied:*

i. Parties propose $\mathbf{t}^{*k}=\mathbf{t}^{*-k}=\mathbf{t}^{*}$ in the second stage of the game, where:

$$\mathbf{t}^{*}\in\arg\max\sum_{\forall\varphi^{l}\in\Theta}\varphi^{l}F^{lc}\left(\upsilon^{l}\left(\mathbf{t}^{k}\right)-\upsilon^{l}\left(\mathbf{t}^{-k}\right)\middle|\alpha_{y}\right)\text{s.t}:\ \overline{R}=\sum_{i=1}^{n}t_i^{c}\left(\sum_{h=1}^{H}x_i^{h}\right)\forall c=\{k,-k\}\ \text{ and}$$

$$\forall h\in\varphi^{l}\wedge c=\{k,-k\},\ F^{lc}\left(\bullet\right)\big|\alpha_{y}=\sum_{y=1}^{Y}\alpha_{y}\Pr_{y}^{lk}\ :\ \Pr_{y}^{lk}\in[0,1]\wedge\ \alpha_{y}\geq 0:\sum_{\forall y}\alpha_{y}=1$$

ii. Voters propose initiatives $\bar{t}_i^{h}\ \forall\ h$:

$$\bar{t}_i^{h}\in\arg\max\left\{\upsilon^{h}\left(t_i,\dots\dots t_n\right)-\upsilon^{h}\left(t_i^{*},t_j^{*}\right)\right\}\ \forall h$$

$$\text{s.t}:\ \left\{r_j=r_j\left(\bar{t}_i\right)\right\}_{j\neq i}\ \text{ and }\ \Omega\left(P\left(\bar{\mathbf{t}},\mathbf{t}^{*}\right)\middle|\alpha_{y}\right)=1/2$$

where $r_j = r_j\left(\bar{t}_i\right)\ \forall j \neq i$ are the expected best responses of parties to a tax rate limit.

iii. $\exists\ h \in \varphi^l : \Omega\left(P\left(\bar{\mathbf{t}},\mathbf{t}^*\right)\right) = \frac{1}{2}$ where $P\left(\bar{\mathbf{t}},\mathbf{t}^*\right) = \left\{\ l:\ \upsilon^l\left(\bar{\mathbf{t}}\right) \geq \upsilon^l\left(\mathbf{t}^*\right)\ \right\}$

iv. Parties' new system of beliefs are: $\exists h \in \varphi^l\ ; h \in P\left(\bar{\mathbf{t}},\mathbf{t}^*\right) \wedge c = \{k,-k\},\ \tilde{\alpha}_y \geq 0 \wedge \sum_{\forall Y} \tilde{\alpha}_y = 1$:

$$\tilde{F}^{lc}\left(\bullet \middle| \tilde{\alpha}_y\right) = \sum_{y=1}^{Y} \tilde{\alpha}_y \Pr{}_y^{lk} \quad \text{implying} \quad \tilde{\omega}^l \geq \omega^l$$

v. In the final stage, parties respond to a TRL by selecting $\left\{ r_j = r_j\left(\bar{t}_i\right) \right\}_{j \neq i}$ where:

$$r_j\left(\bar{t}_i\right) \in \arg\max \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right) \middle| \tilde{\alpha}_y\right)$$

$$\text{s.t:}\ \ \bar{t}_i, \left\{ r_j = r_j\left(\bar{t}_i\right) \right\}_{j \neq i} \in \bar{R} : \bar{R} = \sum_{j=1}^{n} t_j^c \left(\sum_{h=1}^{H} x_j^h \right) \ \text{for}\ n > 2,\ \forall c\ \text{and}\ \ t_i \leq \bar{t}_i < t_i^*$$

Proof

Condition (i) follows from the proof in proposition 1. Theorem 3 proves conditions (ii) and (iii). Theorem (4) shows condition (iv) holds for an equilibrium in which a tax amendment is approved. Condition (iv) implies (v).

■

We summarize our findings. We have extended the analysis made in Theorems 1 and 2. Theorem 3 provides a sufficient condition for the approval of a tax rate limitation when tax initiatives are costless and policy is multidimensional. We have concluded that a proposal for a tax rate limit will receive the support from a majority if the sum of the ratios between the reaction functions dr_j / dt_i over the $MRTS^l_{t_j - t_i}\ \ \forall\ i \neq j = 2.....n$ is less than one for a majority. The result is the equivalent statement to our previous finding that, in order a voter *h* supports a tax rate limit, the marginal rate of tax substitution $MRTS^l_{t_j - t_i}$ for voter h in group l must be at least as high as the government's reaction function dr_j / dt_i .

Theorem 1 is extended when policy is multidimensional. The approval of a tax rate limit by a majority reflects the most preferred feasible deviation from the status quo under a competitive process of tax amendments. Theorem 3 shows that $t_i = \bar{t}_i$ (if approved) is the Condorcet winner of the feasible alternatives to deviate from the status quo. Also, we argue that Theorem 2 does not carry out for an economy with $n > 2$. In other words, the conclusion that a tax rate limit regulates the electoral competition as to aggregate the votes as if one man equals one vote regardless of the intensity of his preferences (which follows from the outcome that the median voter determines the design of public policy) does not hold for $n > 2$. It must be clear that as we increase the dimensions of the policy space (as n becomes larger) a tax rate limit becomes less influential in constraining the policy space and in regulating the process of aggregation of voters' preferences for tax policy. In short, as n becomes larger the tax rate limit might not be binding. Finally we have shown that under the assumption that the demand of commodities is independent, the expected reaction function of parties to a tax rate limit is to increase tax rates $r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$. By so doing, parties weigh the extra tax revenue collected from increases in $r_2(\bar{t}_1)$ and $r_3(\bar{t}_1)$ with their political cost derived in a fall in the expected proportion of the votes.

Concluding Remarks

This essay incorporates into the analysis of tax design the constitutional provision that allows voters to propose tax initiatives. In particular, we focus our analysis on initiatives known as tax rate limits. The objective of the essay is to study why tax rate limits are placed on the ballot, what explains the approval/rejection of the initiatives and which are the effects of tax amendments on the behavior of the government.

We argue that a tax rate limit is likely to arise as a result of two institutions with different mechanisms to aggregate voters' preferences. We develop a probabilistic model of electoral competition that determines the tax system by aggregating the preferences of all voters in the electorate. That is, the tax system at the status quo is the result of parties weighing the conflicting demands of individuals over policy according to voters' marginal propensity of the vote. However, the majority rule (in our model, the institution that dictates if a TRL is approved/rejected) aggregates the preferences of the decisive voter of the process of tax initiatives. Thus, the tax system at the status quo might be different to the ideal policy of the median voter of the tax initiatives. A TRL is approved if the decisive voter prefers the tax system that would arise as a result of the tax rate limit compared with the tax structure at the status quo. The approval of the motion, however, does not necessarily imply that voters are unsatisfied with the size of the budget or that voters question the efficiency of the government to transform public revenues into services.[29]

Empirical evidence suggests that voters' initiatives did not affect the size of the government but changed the tax structure of state and local governments. Assuming one single unit of government, we provide a model that explains the change of tax structure due to the approval of a TRL. In our model, the size of the government remains unchanged even when parties react in a countercyclical manner to a tax amendment. The approval of a tax rate limit induces parties to increase the reliance of the tax system on the unconstrained taxes to maintain unchanged tax revenue collection. The model suggests that parties change unconstrained taxes as to equalize the expected marginal proportion of the votes per dollar collected by the unconstrained tax instruments.

In our analysis, a proposal for a TRL is placed on the ballot by a coalition of voters who seek to obtain a tax structure that is closer to their most preferred feasible policy. A TRL will be approved if the marginal rate of tax substitution of the decisive voter (defined as the rate at which a voter changes tax structure while keeping his utility constant) is at least as high as parties' reaction functions (or changes in the unconstrained tax instruments as a result of the approval of a TRL). The hypothesis of tax substitution suggests that a tax rate limit is more likely to be approved when the government can easily substitute public revenue from the tax instrument subject to the tax limit.[30] The theory also suggests that individuals with a higher share of consumption of the commodity subject to the tax rate limit are more likely to approve the motion.

In previous works a tax rate limit has been regarded as a constraint on the budget set for the government. We show that a tax rate limit also modifies the way parties aggregate voters' preferences for policy since a tax rate limit changes parties' beliefs on how tax policy proposals translate into votes. The approval of a tax rate limit signals to parties that a majority of voters is expected to be better off under a tax structure that is

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[29] These two arguments have dominated the discussion of the rationale for a tax rate limit.

[30] Assume t_i is subject to a TRL. The degree of substitution of tax revenue is higher when the ratio of the revenue elasticities of tax instruments t_i and t_j is lower, the broader is the taxable base for t_j, and the less broad is the taxable base for t_i.

different to the status quo. After observing a tax rate limit is approved, parties update their beliefs on how tax policies might translate into votes. This, in turn, affects the way parties aggregate voters' preferences for tax policies. The change in the way parties aggregates voters' interests tends to accommodate the approval of the tax initiative. Hence, the model suggests that governments with electoral constraints will not go against the sentiment expressed by voters on the ballot. This may help to explain why tax initiatives might be long lived.

We distinguish between binding and non binding tax rate limits. A binding tax rate limit will restore the equilibrium of the median voter when policy is one-dimensional. In this case, the equilibrium of the median voter was initially disturbed by parties' imperfect information on voters' preferences. A binding tax rate limit serves as a signal to eliminate the uncertainty related with voters' preferences therefore parties accommodate unconstrained tax revenue to deliver the ideal policy of the median voter of the tax initiatives. A non binding tax rate limit is related with the dimensions of the tax structure. It should be clear that as we increase the dimensions of tax policy, a tax rate limit becomes less influential in constraining the policy space and in regulating the process of aggregation of voters' preferences. In short, as the dimensions of policy increase, a tax rate limit will not be binding.

Our framework leads to some policy implications on tax and expenditure limitations. Our model suggests that the success of a tax and expenditure limitation rely heavily on the differences of the processes determining the tax structure at the status quo and the one determining the approval/rejection of a tax amendment. The lower the cost of placing initiatives on the ballot the higher the likelihood of a tax rate limit. This might explain why tax amendments are so prevalent across state and local governments.

ESSAY II: PUBLIC GOODS AND TAX STRUCTURE UNDER VOTERS' PARTISAN ATTITUDES AND DOWNSIAN ELECTORAL COMPETITION

In the theory of elections, public policy is the outcome of the strategic interaction between policy makers (parties) and the electorate. The leading paradigm advanced by Downs (1957) assumes, among other things, that parties are teams selecting policy to win the election, parties have perfect information on voters' preferences, voters vote for the party advancing the platform that is closer to voters' ideal policy, and policy has one dimension.[31] Romer (1975, 1977), Roberts (1977), and Meltzer and Richards (1981, 1983) apply the Downs model to the analysis of tax design. They predict that parties converge in their fiscal policies, and the tradeoff between political redistribution and efficiency is determined by the tastes of the median voter and the deadweight costs of taxation.

The hypothesis of convergence of parties' policies is under debate. Reed (2006), Alt and Lowry (2001), Caplan (2001) and Rogers and Rogers (2000) find evidence that state taxes increase when Democrats have significant control of the legislative bodies of state governments. Fletcher and Murray (2006) find that party control is positively associated with higher top income tax rates, higher income threshold for the first bracket of the income tax, and Democrat administrations lead to higher earned income tax credits. Chernick (2005) finds that party control by Republicans is associated with more regressive state tax structures. Caplan (2001) finds that corporate and income taxes tend to rise under Democrat control of state legislatures and fall with larger Republican

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[31] Other assumptions include: voters' preferences are singled peaked, all voters vote, Parties are free to choose platforms at any point along the preference distribution, parties choose platforms simultaneously, and barriers of entry for new parties are infinite. For a discussion of the models' set up see Riker and Ordeshook (1973).

majorities. Blomberg and Hess (2003) find evidence that productive federal spending (spending net of transfers) and federal taxes increase in the second and third years of Democrat administrations. Alesina, Roubini and Cohen (1997) find that federal budget deficits are higher under Republican governments although they also find that parties converge in their federal spending on personal transfers.

In the Downs model, the formation of public policy is analyzed under the assumption that citizens vote for the party proposing the policy platform that is closer to voters' views. In contrast to the Downsian assumption that voting is policy oriented, the literature on voting behavior suggests that the choice of the vote is explained (among other things) by policy issues and partisan attitudes (see Downs, 1957; Campbell et al., 1960; Miller & Shanks, 1996; Fiorina, 1997).[32] The evidence on voting behavior also indicates that voters' partisan attitudes are the best predictor of the choice of the vote (Republican voters tend to vote for the Republican party), see Campbell et al. (1960), Miller and Shanks (1996), Niemi and Weisberg (2001), Bartels (2000). Finally, the evidence from the American national election studies (ANES) shows that the vast majority of the American electorate has a partisan preference.[33] Therefore, if the distribution of votes is also explained by voters' attitudes and parties design policies to win elections then what is the impact of voters' loyalties on tax design?

In addition, the prediction that parties select the ideal policy of the median voter does not hold when we relax the assumption of parties' perfect information on voters' preferences. In the probabilistic voting theory (PVM), parties have imperfect information

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[32] Voters' partisan attitudes are defined as voters' self identification (or lack of it) with some party.
[33] Data from the ANES suggests that, for the period 1952-2004, the average proportion of voters identified as Democrats is 52%, 35% regard themselves as Republicans, 11% as independents and the rest as apoliticals.

and select the policy that maximizes the preferences of all voters in the electorate. In this setting, the aggregation of the conflicting preferences of all voters is central to explain the design of public policies.[34] The emphasis of ongoing research under the PVM is on identifying coalitions of voters (and pressure groups) that can, systematically, influence spending and tax policies, see Hettich and Winer (1997, 1999), Hotte and Winer (2001), Coughlin, et al. (1990a, 1990b). Moreover, in the PVM, to the best of my knowledge, there is an open question on the roles that redistributive politics and efficiency play on guiding the design of tax rules for an economy with electoral constraints when policy is multidimensional and there is political-economic heterogeneity.[35]

To sum up, the stylized facts suggest that parties' policies do not converge and the individuals' choice of the vote is explained by policy issues and voters' partisan attitudes. Moreover, many researchers have emphasized that the heterogeneity of voters' preferences helps to explain the design of spending and tax policies. The objective of this essay is to provide a model of electoral competition that explains tax policy and incorporates that the choice of the vote is explained by voters' loyalties and policy issues. Furthermore, we provide a characterization of the tradeoff between redistributive politics and efficiency for an economy with electoral constraints when policy is multidimensional and there is political-economic heterogeneity.

The argument put forward in this essay is that voters' partisan preferences influence the design of tax policy through two different channels. First, voters' attitudes

[34] Empirical analysis by Bergstrom and Goodman (1973), Gramlich and Rubinfeld (1982), Borcherding and Holsey (1997), Dickson and Yu (2000), Reed (2006), among many others, find evidence that variables reflecting the composition of the electorate (such as the distribution of voters' age, gender, education, ethnic and religious background) explain the demand for public services and tax revenue. In other words, evidence suggests that heterogeneity of voters' preferences is an important determinant of fiscal policies.

[35] By political heterogeneity we mean voters with different propensities to vote for the Democrat/Republican party. By economic heterogeneity we mean voters with different preferences over policies and/or endowments.

affect the way parties aggregate the demands of voters over policy. That is, if a party designs fiscal policies to maximize the expected votes in an election then the party has incentives to weigh (aggregate) voters' preferences over policy according to voters' propensity to vote for the party. Since the partisan attitude is highly correlated with the individuals' choice of the vote, then the party identification of voters will affect the aggregation of voters' preferences and the design of public policy. Second, the distribution of the partisan identification in the electorate affects the relative political influence of voters by changing the expected votes that different coalitions of voters (Democrats, Republicans, Independents) can deliver in the election.

In our probabilistic voting model, the preferences of voters in the electorate explain the roles that redistributive politics and efficiency play on tax design.[36] Our Downsian model suggests that, even if parties are only concerned with winning the election, each party will weigh differently the demands of the same electorate (due to voters' partisan attitudes) and therefore the fiscal platforms of parties will, in general, diverge.[37] Thus, our model is different from other studies of electoral competition in which parties' lack of convergence is explained by assuming that parties have preferences over policy outcomes (see Roemer, 1997, 1999, 2001).

If parties believe that voters with partisan loyalties deliver the highest marginal proportion of the expected votes then the Democrat (Republican) party weighs more heavily the demands of, correspondingly, Democrat (Republican) voters. Data from the American National Election Studies suggests that Democrat voters prefer higher public spending compared with the ideal spending of Republican voters. Moreover, individuals

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[36] In other words, our analysis is different from other Downsian applications of tax design since in our setting there is no decisive voter but policy is the outcome of the preferences of the whole electorate.
[37] Still, we characterize some sufficient conditions that guarantee the convergence of parties' policies.

in the lowest ranks of the distribution of income are identified as Democrats. In this case, Democrat voters prefer high spending and a progressive commodity tax system while Republican voters prefer low spending and a regressive commodity tax structure.

Empirical evidence suggests that Democrat administrations increase taxes and spending and modify provisions towards a more progressive tax system. Our model can rationalize these stylized facts. In particular our analysis identifies conditions in which the Democrat party proposes higher public spending and redistribution compared with the policies proposed by the Republican party. That is, under Democrat administrations taxes on income elastic goods increase while taxes on income inelastic commodities fall implying that the Democrat party has an electoral incentive to propose a commodity tax system in which redistribution plays a more prominent role than efficiency on tax design. In contrast, the Republican party weighs less heavily redistribution (vis-à-vis efficiency) as a guiding principle of tax design.

Theory of Elections and Tax Design

In this section we review the predictions of the theory of elections on tax design.[38] The leading paradigm of the theory of elections, the Downs model, suggests that public policy reflects the preferences of the median voter. In their analysis of a linear income tax system, Romer (1975, 1977), Roberts (1977), and Meltzer and Richard (1981, 1983) indicate that redistribution depends on whether the income of the median voter is lower or higher than the mean income. In this setting, the extent of political redistribution is

[38] In our review we ignore the analysis of the theory of committees (or direct voting) and the role of other Democrat institutions (as the role of electoral systems). The interested reader can consult the surveys of Hettich and Winer (1997, 2004).

limited by the deadweight costs of taxation and the preferences over policy of the decisive voter. In spite of the simplicity of the median voter model, the lack of an electoral equilibrium in the multidimensional space when there is heterogeneity of preferences and endowment of voters, the prediction that policy outcomes reflect voting cycles, and the inability of the model to rationalize the divergence of parties' platforms, have limited the applicability of the Downs model.

The perceived limitations of the median voter model persuaded researchers to relax the Downsian assumptions. For instance, the probabilistic theory of elections (PTE), assumes that parties have imperfect information on voters' preferences. In the PTE, there exists an electoral equilibrium when policy is multidimensional and voters' preferences are heterogeneous. In this setting, parties aggregate voters' preferences by turning the conflicting interests of different groups into some form of policy platform. Hettich and Winer (1997, 1999) offer the first application of the PTE to the analysis of tax design, and argue that the government will set the tax structure to minimize the political opposition per dollar of tax revenue across taxable units. Hettich and Winer (1988, 1997, 1999) analyze a tradeoff between administrations' costs and parties' ability to implement a tax discrimination policy. They, however, do not analyze to what extent redistributive politics and efficiency guide the design of tax structure and in their model parties' policies convergence.

Nevertheless, evidence suggests that parties' policies do not converge. Reed (2006), Alt and Lowry (2001), Caplan (2001) and Rogers and Rogers (2000) find evidence that states' taxes increase when Democrats have significant control of the legislative bodies of state governments. Blomberg and Hess (2003) find evidence that productive spending (spending net of transfers) and taxes increase in the second and third years of Democrat administrations; Alesina, Roubini and Cohen (1997) find that budget deficits are higher under Republican administrations, although they reject the hypothesis that parties differ in their spending on welfare. Alesina and Rosenthal (1995) rationalize divergence on parties' policies through a model in which parties have preferences over policies and parties have imperfect information on voters' preferences.[39]

Roemer (1999, 2001) seeks to endogeneize parties' preferences for policy by assuming that parties are composed by factions of activists with different interests. Roemer applies the model of factions to explain why both parties, at the left and at the right of the political spectrum, have supported progressive taxation in the U.S. Roemer (1999) concludes that even when there might exist groups inside parties trying to deviate parties' proposals towards factions' most preferred positions, the incentives of the electoral competition lead both parties to propose a progressive tax structure if the majority of voters have an income lower than the mean income. Hence, the electoral constraints are still binding and policy oriented parties cannot advance their own agenda on policies.

The political economy of public finance has also contributed to the analysis of design of public policies by studying the role of political influence in determining policies. Becker (1983, 1985) contends that pressure groups advance their economic interests by exerting political pressure over policy makers. In Becker (1983), competition among pressure groups favors efficient methods of taxation. In the analysis of Hettich and Winer (1999, 2001), individuals with higher propensity to vote for a party can exert a

[39] Hinich, Ledyard and Ordeshook (1973) provide conditions in which parties might diverge from the median position if voters abstain. To the best of my knowledge, the model has not been applied to the analysis of tax design.

more effective influence on the party. Coughlin, et al. (1990a) provide a model in which the demands of pressure groups are weighed according to their ideological beliefs. The focus of the model is to show the existence of an electoral equilibrium while the implication of ideological interest groups on the design of public spending is explored in Coughlin, et al. (1990b). Rutherford and Winer (1990, 1999), and Hotte and Winer (2001) incorporate interest groups to study the role of political influence on tax design. Rutherford and Winer (1990, 1999) use a computable general equilibrium model to reject the hypothesis that the systematic reductions in capital and personal income taxes over the decade after 1973 are explained by changes in the relative political influence of some special interest groups.[40]

Another area that remains relatively unexplored is the analysis of tax design under a richer set of conditions determining the individuals' choice of the vote. As we mentioned before, in the context of a representative democracy the voting behavior is central for the aggregation of preferences and the observed policy outcomes. In the Downs model, the formation of public policy is assumed that citizens vote for the party proposing the policy platform that is closer to voters' views over policy. In contrast to the Downsian assumption that voting is policy oriented, the literature on the voting behavior suggests that the individuals' choice of the vote is explained by policy issues (Downs, 1957; Niemi & Weisberg, 2001), by partisan attitudes (see Campbell et al., 1960; Miller & Shanks, 1996; and Fiorina 1997), and by a prospective-retrospective evaluation of parties' performance (see Barro, 1973; Fiorina 1981).[41] Furthermore, the evidence of the voting behavior indicates that party identification (or voters' partisan attitude) is the best

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[40] Although Rutherford and Winer (1999) conclude that the relative influence of lower income voters kept taxes on capital and high income from falling and taxes on labor from rising.

[41] For a survey on the determinants of the voting behavior see Fiorina (1997).

predictor of the choice of the vote, see Campbell et al. (1960), Miller and Shanks (1996), and more recently Bartels (2000). Finally, the evidence from the American national election studies (ANES) shows that the vast majority of the American electorate has a partisan preference.[42] Therefore, it is relevant to ask: What is the effect of voters' partisan attitudes on tax design? Moreover, voters' preferences will be aggregated in a different manner under alternative distributions of voters' attitudes. In this case we are interested to analyze the provision of a public good and tax structure under different distributions of voters' attitudes. In the next section we present a model that seeks to answer these questions.

Voters' Preferences for Tax Structure

Consider an economy in which individuals decide their consumption vector on the opportunity set and participate politically by voting for a representative of a party. We consider two candidates-parties denoted by *D* and *R* (with obvious references) competing to form the government. Preferences and the opportunity set for individuals are characterized as follows:

$$U^{hk} = \beta\mu^h\left(\mathbf{x}^h, G_s^k\right) + \left(1-\beta\right)\varepsilon^{hk} \text{ and } \mathbf{q}^k\mathbf{x}^h = \mathbf{p}\mathbf{x}^h + \mathbf{c}^h\left(\mathbf{t}^k\right) \leq w^h L^h \quad \forall h \tag{23}$$

Where U^{hk} is the overall utility of consumer *h* if party $k = \{D, R\}$ forms the government. $\mu^h\left(\mathbf{x}^h, G_s^k\right)$ represents the preferences over private consumption $\mathbf{x}^h \in \Re^n$ and the public good G_s^k. The parameter ε^{hk} measures the partisan preference of

42 For the period 1952-2004, on average, the proportion of voters with a party identification represented 88% of the electorate, around 11% regard themselves as independents and the rest as apoliticals.

consumer h for party k and β^h is a weighing parameter such that $\beta^h = \beta \in [0,1] \;\; \forall h$. Equation (23) implies that the overall utility of individuals depend not only on the policies that each party might enact but also individuals have a preference relation over the party that rules the government. We consider the view of the Michigan school on the partisan preference. Consequently, we assume that party identification (or preference) is learned in childhood, and it is largely exogenous (not based on policy views), see Campbell et al. (1960), Miller and Shanks (1996), among others.[43]

The opportunity set is defined by consumers' price $\mathbf{q}^k = \mathbf{p} + \mathbf{t}^k$. We will assume that in this economy the supply of private commodity i is perfectly elastic at p_i $\forall\; i = 1, 2....n$. The producers' value is $\mathbf{px}^h$, $\mathbf{c}^h\left(\mathbf{t}^k\right) = \mathbf{t}^k\mathbf{x}^h$ is the tax liability of individual h under tax policies $\mathbf{t}^k \in \Re^n$ proposed by parties $k = \{D, R\}$, and $w^h L^h$ is labor income. From (23) we can derive the indirect utility function V^{hk} in (23'):[44]

$$V^{hk} = \beta\upsilon^h\left(\mathbf{t}^k, G_s^k, y^h\right) + (1-\beta)\varepsilon^{hk} = Max\left\{\beta\mu^h\left(\mathbf{x}^{*h}, G_s^k\right) + (1-\beta)\varepsilon^{hk}\text{s.t: } \mathbf{q}^k\mathbf{x}^{*h} \le w^h L^{*h}\right\} \qquad (23')$$

From equation (23') we can obtain the ideal policy of voter h (denoted as $\mathbf{t}^{*h}, G_s^{*h}$) by maximizing the indirect utility V^{hk} subject to the constraint that the public good is financed by taxation. That is, we consider the preference relation over the policy space given by the public budget condition $G_s^h = R(\mathbf{t})$ where the right hand side of the constraint is the tax revenue function $R(\mathbf{t}) = \sum_{i=1}^{n} t_i^h \int_h x_i^h\left(\mathbf{t}^h, y\right)dh$, $x_i^h\left(\mathbf{t}^h, y\right)$ is the

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[43] This explains why we introduce the partisan preference as an additive parameter in (23).

[44] Eqn. (23') is obtained by finding $\mathbf{x}^{*h} \in \text{argmax } U^{hk} = \beta\mu^h\left(\mathbf{x}^h, G_s^k\right) + (1-\beta)\varepsilon^{hk}\text{s.t: } \mathbf{q}^k\mathbf{x}^h = \mathbf{px}^h + \mathbf{c}^h\left(\mathbf{t}^k\right) \le w^h L^h$.

Marshallian demand which depends on full income y and the ideal tax structure of voter h. Hence, the ideal fiscal policies $\mathbf{t}^{*h}, G_s^{*h}$ for voter h are found by:[45]

$$\underset{\{\mathbf{t}^h, G_s^h\}}{Max} \ \delta^h\left(\mathbf{t}^h, G_s^h, y^h\right) = V^h\left(\mathbf{t}^h, G_s^h, y^h\right) / \beta = \upsilon^h\left(\mathbf{t}^h, \sum_{i=1}^{n} t_i^h \int_h x_i\left(\mathbf{t}, y\right) dh\right) + \left(1-\beta\right) / \beta \varepsilon^{hk} \qquad (24)$$

The indirect utility function that recognizes the opportunity budget set of the individual and the public budget constraint (that is $\delta^h\left(\mathbf{t}^h, G_s^h, y^h\right)$) is our primitive preference relation over the policy space and it is assumed to be a concave function of taxes.[46] By finding $t_i^{*h} : \partial\delta^h / \partial t_i = 0 \ \forall \ t_i^*, \ i = 1, \ldots n$ we obtain the optimal tax structure for voter h denoted as $\mathbf{t}^{*h} = \left[t_1^{*h}, t_2^{*h}, \ldots\ldots t_n^{*h}\right]$, while the most preferred level of the public good is obtained by using $\mathbf{t}^{*h} = \left[t_1^{*h}, t_2^{*h}, \ldots\ldots t_n^{*h}\right]$ into $G_s^{*h} = \sum_{i=1}^{n} t_i^{*h} \int_h x_i^h\left(\mathbf{t}^{*h}, y^h\right) dh$. Finally the utility level attained to the individual's ideal policy position is given by $\delta^{*h}\left(\mathbf{t}^{*h}, G_s^{*h}\left(\mathbf{t}^{*h}\right), \varepsilon^{*h}\right)$.

We conclude this section by characterizing some stylized facts on preferences over policy and partisan attitudes. The surveys from the ANES measure the preferences of voters for government services and spending. Individuals are asked to evaluate whether public spending should be cut or increased. The survey reveals that for the

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[45] For convenience we normalize (23') as shown.

[46] Note that $\partial\delta^h / \partial t_i^k = \partial\upsilon^h / \partial t_i^k + \partial\upsilon^h / \partial G_s^k \{R_i\}$ reflects the fiscal exchange of changes in taxes. A concave $\delta\left(\mathbf{t}^h, G_s^h, \varepsilon^{hk}\right)$ would suggest that at low taxes the fiscal exchange for voter h is positive due to the cost of the public good is shared among the electorate. However, successive increases in taxes lead to decreasing changes in the fiscal exchange, that is, $\partial^2\delta^h / \partial^2 t_i^k = \partial^2\upsilon^h / \partial^2 t_i^k + \partial^2\upsilon^h / \partial^2 G_s^k \{R_i\}^2 + \partial\upsilon^h / \partial G_s^k \{R_{ii}\} \leq 0$ where $\partial^2\upsilon^h / \partial^2 t_i^k \geq 0$, decreasing marginal utility on public goods implies $\partial^2\upsilon^h / \partial^2 G_s^k \{R_i\}^2 \leq 0$ while $\partial\upsilon^h / \partial G_s^k \{R_{ii}\} \leq 0$ if the marginal tax revenue is decreasing in taxes, that is if $R_{ii} = \partial^2 R / \partial^2 t_i^k \leq 0$.

period 1982-2004, from the group of voters who prefer an *increase* in government services, 43% were identified as Democrats and 21% as Republicans. Furthermore, from the group of voters who prefer a *reduction* in government services, 16% were identified as Democrats and 42% as Republicans. In other words, a higher proportion of Democrats along the period from 1982 to 2004 have consistently being associated with preferences which support an increase in public spending and services in relation to Republicans. The surveys from the ANES also provide information that relates the distribution of income and the partisan identification of respondents. As shown in Table 1 of Appendix C, voters at the low/high ranks of income have a party identification with the Democrat/Republican party. We formalize these stylized findings as follows: Let $\theta^h = \Delta\varepsilon(1-\beta)/\beta = \{\varepsilon^{hR} - \varepsilon^{hD}\}(1-\beta)/\beta$, $\Delta\varepsilon = \{\varepsilon^{hR} - \varepsilon^{hD}\}$ represents the partisan bias, and θ^h is the partisan bias normalized by a factor related with the weigh in which the partisan preference explains the individuals' choice of the vote. Let $\theta^h < 0$ be a Democrat and $\theta^h > 0$ a Republican voter. The finding that Democrats' ideal spending is higher than that of Republicans is denoted as follows: $\forall \theta^0, \theta^1 \in [\underline{\theta}, \overline{\theta}] : \theta^0 < 0 \wedge \theta^1 > 0$, $G_s^{*\theta^0} \geq G_s^{*\theta^1}$, where $G_s^{*\theta^0}$ and $G_s^{*\theta^1}$ are the ideal spending for Democrat and Republican voters.[47] The positive association of income and Republican identification is denoted by covariance$[\theta, y] \geq 0$.

[47] An alternative way to represent that Democrats' ideal spending is higher than that of Republicans will be denoted as follows: $\forall \theta^0, \theta^1 \in [\underline{\theta}, \overline{\theta}] : \theta^0 < 0 \wedge \theta^1 > 0$, $MRS_{G-x_0}(\theta^0) \geq MRS_{G-x_0}(\theta^1)$. That is, Democrats' marginal valuation of the public good in terms of the nummeraire private good x_0 is higher than that of Republicans.

Electoral Competition and the Design of Fiscal Policy

In this section we characterize the electoral competition between parties. Parties *D* and *R* propose policy positions on tax structure and the level of the public good, the voter observes parties' policies and vote. The objective of candidates is to maximize their probability to win the election denoted by $\pi^k\left(\mathbf{P}^k\right)\ k=\{D,R\}$, the vector $\mathbf{P}^k \in \Re^{n+1} : \mathbf{P}^k = \left[\mathbf{t}^k, G_s^k\right]$ reflects public policies proposed by parties $k=\{D,R\}$ and $\mathbf{t}^k$ is a commodity tax vector.

We assume candidates do not know with certainty the determinants of the individuals' choice of the vote.[48] Thus, from candidates' point of view, policies $\mathbf{P}^D, \mathbf{P}^R$ and voters' bias θ^h lead to a probability $\Pr^{hD}$ that a voter *h* votes for party *D*. For convenience of the analysis, let partition the electorate such that each voter belongs to the domain $\theta^h \in \left[\underline{\theta}, \overline{\theta}\right]$, where $\underline{\theta} = Min\left\{\theta^h\right\}_{\forall h}$ and $\overline{\theta} = Max\left\{\theta^h\right\}_{\forall h}$ with $\underline{\theta} < 0 \wedge \overline{\theta} > 0$. Let there is a fraction such that $\forall\ h \neq h' \in\ g\left(\theta\right),\ \theta^h = \theta^{h'} = \theta$ and $\Pr^{hD} = \Pr^{h'D} = \Pr^{\theta D}\left(\Psi\left(-\theta\right)\right)$ where $\Psi(-\theta) = \upsilon^D\left(\mathbf{t}^D, G_s^D, y\right) - \upsilon^R\left(\mathbf{t}^R, G_s^R, y\right) - \theta$ is the net utility from policy and partisan issues of voter type θ if party *D* is elected. $\upsilon^D\left(\mathbf{t}^D, G_s^D, y\right)$ is the utility for voter *h* when party *D* selects policies $\mathbf{t}^D, G_s^D$, and a similar interpretation is given to $\upsilon^R\left(\mathbf{t}^R, G_s^R, y\right)$. Define $f^D\left(\bullet\right)$ as the probability distribution function (pdf) over $\Psi(-\theta)$. Thus, the probability that an individual type θ votes for party *D* is:

[48] The choice of the vote can be influenced, among other things, by policy issues, partisan attitudes, voters' perceptions over candidates (as candidates' competence), and a retrospective view of parties' performance, see Fiorina (1997). Therefore, it is compelling to assume that parties do not have perfect information on the determinants of the vote.

$$\Pr^{\theta D}\left(\theta\ voting\ D\right)=\int_{-\infty}^{\Psi(-\theta)} f^{D}\left(\psi\right)d\psi = F^{D}\left(\Psi\left(-\theta\right)\right) \tag{25}$$

The expression $F^D : \theta \times \mathbf{P}^D \times \mathbf{P}^R \rightarrow [0,1]$ is the cumulative distribution function evaluated at $\Psi(-\theta)$ for all partisan bias $\theta \in \left[\underline{\theta}, \overline{\theta}\right]$ and pair of fiscal policies $\mathbf{P}^D, \mathbf{P}^R$. F^D is a common, continuous, non decreasing function of $\Psi(-\theta)$. The properties of the function of the probability, F^D, reflect parties' prior beliefs on the distribution of net utility of voters $\Psi(-\theta)$ when party *D* holds office. If party *D* believes the probability of the vote is marginally increasing over $\Psi = \Psi(-\theta)$ then $F^D\left(\Psi(-\theta)\right)$ is convex. The probability of the vote is concave if the density over the net utility is concentrated around low values of $\Psi = \Psi(-\theta)$ and decreases monotonically afterwards.

The proportion of the expected votes for party *D* aggregates the probabilities of voting for a candidate across voters' partisan types $\forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$. That is:[49]

$$\phi^{D}\left(\mathrm{P}^{D},\mathrm{P}^{R}\right)=\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)F^{D}\left(\Psi\left(-\theta\right)\right)d\theta \tag{26}$$

The probability to win the election is denoted as the cumulative distribution over the plurality of parties. Let $W : \phi^D \times \phi^R \rightarrow [0,1]$ be a continuous, non decreasing, and concave cumulative distribution function and $W' = w\left(\rho^D\right) \geq 0$ is the corresponding pdf. Therefore, the probability of winning the election for party *D* is

[49] Similarly, the proportion of the expected votes for party *R* is:

$$\phi^{R}\left(\mathrm{P}^{D},\mathrm{P}^{R}\right)=\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)F^{R}\left(-\Psi\left(-\theta\right)\right)d\theta \tag{26'}$$

$\pi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)=\pi^D\left(\phi^D-\phi^R\right)$ where $\rho^D=\phi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)-\phi^R\left(\mathbf{P}^D,\mathbf{P}^R\right)$ is the proportion of the expected plurality for party *D*. Hence the probability of winning the election is characterized as:[50]

$$\pi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)=\int_{-\infty}^{\rho^D} w\left(\rho^D\right)d\rho=W\left[\phi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)-\phi^R\left(\mathbf{P}^D,\mathbf{P}^R\right)\right] \tag{27}$$

The problem of candidate *D* is to select the commodity tax vector and the public good subject to the public budget constraint that leads to the highest political support to the party. Formally, the party's problem is:

$$\begin{aligned}
&\underset{\{\mathbf{t}^D,G_s^D\}}{Max}\quad \pi^{\mathrm{D}}=\int_{-\infty}^{\rho^D} w\left(\rho^D\right)d\rho\\
&s.t:\ \ i)\quad \rho^D=\phi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)-\phi^R\left(\mathbf{P}^D,\mathbf{P}^R\right)\\
&ii)\ \ \phi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)\text{ and }\ \phi^R\left(\mathbf{P}^D,\mathbf{P}^R\right)\text{are defined in (26) and (26')}\\
&iii)\ \ \Psi=\Delta\upsilon-\theta=\upsilon^D\left(\mathbf{t}^D,G_s^D\right)-\upsilon^R\left(\mathbf{t}^R,G_s^R\right)-\theta\ \ \forall\theta\in\left[\underline{\theta},\overline{\theta}\right]\\
&iv)\ \ G_s^D=\sum_{i=1}^{\mathrm{n}} t_i^D\int_{\underline{\theta}}^{\overline{\theta}} g(\theta)x_i\left(\mathbf{t}^D,y\right)d\theta
\end{aligned} \tag{28}$$

A similar characterization is defined for party *R*.[51] The optimality conditions for parties *D* and *R* define two platforms for a commodity tax system given by: [52,53]

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[50] In the expression in (27) we use $\underset{\rho^k\to -1}{lim}\ \pi^k\left(\rho^k\right)=0$.

[51] The equation is derived as follows: The net utility from policy and partisan issues for voter type θ if candidate –*k* wins the election is $-\Psi(-\theta)$. The probability that a voter type θ votes for candidate *R* is $\mathrm{Pr}^{\theta R}\left(\theta\text{ voting }R\right)=\int_{-\infty}^{-\Psi(-\theta)} f^R\left(\psi\right)d\psi=F^R\left(-\Psi\left(-\theta\right)\right)$. The proportion of the expected vote for party R is $\phi^R\left(\mathrm{P}^D,\mathrm{P}^R\right)=\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)F^R\left(-\Psi\left(-\theta\right)\right)d\theta$ and the probability of wining the election is:

$$\pi^R\left(\mathbf{P}^D,\mathbf{P}^R\right)=\int_{-\infty}^{\rho^R} w\left(\rho^R\right)d\rho \tag{27'}$$

$$
\begin{aligned}
D: \quad & \frac{\partial \pi^D}{\partial t_i^D} = \Upsilon^D \frac{\partial \phi^D}{\partial t_i^D} = \Upsilon^D \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D\left(\Psi(-\theta)\right) \frac{\partial \Psi}{\partial t_i^D} d\theta = 0 \quad t_i^{*D} \ \forall i \\
R: \quad & \frac{\partial \pi^R}{\partial t_i^R} = \Upsilon^R \frac{\partial \phi^R}{\partial t_i^R} = \Upsilon^R \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^R\left(-\Psi(-\theta)\right) \frac{\partial \Psi}{\partial t_i^R} d\theta = 0 \quad t_i^{*R} \ \forall i
\end{aligned} \tag{29}
$$

From (29) $\Upsilon^k = 2w^k\left(\rho^k\right) \geq 0$ for $k = \{D, R\}$, the term $g(\theta) f^k(\bullet)$ inside the integral is the marginal proportion of the expected vote due to a change in the well being of voter type θ. The term determines the weight parties assign to the preferences over policy outcomes of voter type θ, while $\partial \Psi / \partial t_i^k \gtreqless 0$ provides the directional mobility of candidate *k*.[54] Equation (29) says that parties will select tax rates t_i^{*D}, t_i^{*R} at the point in which the marginal proportion of the expected vote is maximized by exhausting the gains of the fiscal exchange across the electorate. For the case of party *D*, equation (29) can be arranged as follows:

$$
\left\{-\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D\left(\Psi(-\theta)\right) \frac{\partial \upsilon}{\partial t_i^D} d\theta\right\} = \left\{\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D\left(\Psi(-\theta)\right) \frac{\partial \upsilon}{\partial G_s^D} d\theta\right\} R_i \quad \forall\, t_i^{*D} \tag{29'}
$$

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[52] The optimality condition is $\partial \pi^D / \partial t_i^D = 0 \Rightarrow w\left(\rho^D\right)\left\{\partial \phi^D / \partial t_i^D - \partial \phi^R / \partial t_i^D\right\} = 0 \ \forall\, t_i^{*D}$. Since $\phi^D + \phi^R = 1$ then $\partial \phi^D / \partial t_i^D = -\partial \phi^R / \partial t_i^D$ therefore $\partial \pi^D / \partial t_i^D = \Upsilon^D \partial \phi^D / \partial t_i^D$ where $\Upsilon^D = 2w\left(\rho^D\right)$. From (26) we obtain $\partial \phi^D / \partial t_i^D = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D\left(\Psi(-\theta)\right) \partial \Psi / \partial t_i^D \, d\theta$. A similar procedure is derived to obtain $\partial \pi^R / \partial t_i^R = 0$

[53] So far we have not discussed the conditions that guarantee the existence of the electoral equilibrium. For a more detailed characterization of the sufficient conditions for the existence of an equilibrium see Appendix D.

[54] Suppose $\partial \Psi / \partial t_i^k = \partial \upsilon / \partial t_i^k \geq 0$, then at the margin if candidate *k* increases tax rate *i* the candidate changes his expected proportion of the votes by $g(\theta) f^k(\bullet)$.

The left hand side of (29') represents the marginal lost of the proportion of expected votes because a tax on commodity *i* reduces voters' utility by $\partial \upsilon / \partial t_i^D = -\alpha x_i \leq 0$.[55] A tax on commodity *i*, also raises a marginal tax revenue (R_i) which produces an equivalent amount on public services. Hence, the right hand side is the marginal expected vote gain from the delivery of the public good. Rearranging terms we express condition (29') as follows:

$$-\frac{\sum_{j=1}^{n} t_j^D \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) S_{ij} d\theta}{X_i} = \frac{\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D(\Psi(-\theta)) \lambda^D d\theta}{\overline{f^D}(\Psi(-\theta)) \bar{\upsilon}_G^D} - \left\{ \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) \frac{\partial c}{\partial y} T^D(i) d\theta \right\} \qquad (30)$$

The left hand side of (30) is the percentage change along the compensated demand of commodity i as a result of the tax system, and $S_{ij} = \partial x_i^c / \partial t_j^D$ is the change in the compensated demand to a change in prices. In the right hand side $\lambda^D = \alpha \left\{ MRS_{G-x_0} - T^D(i) \right\}$ is the marginal utility of the net fiscal exchange for voter type θ . λ^D is characterized by the product of the marginal utility of income (α) and the difference between voter's marginal valuation of the public good in terms of the nummeraire private good x_0 (that is MRS_{G-x_0}), and voter's tax share from tax instrument *i*, that is, $T^D(i) = t_i^D x_i / t_i^D X_i$ where $X_i = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) x_i d\theta$. Hence, $\int g(\theta) f^D(\Psi(-\theta)) \lambda^D d\theta$ is the marginal proportion of the expected vote from the net fiscal exchange. By the mean value Theorem $\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D(\Psi(-\theta)) \frac{\partial \upsilon}{\partial G_s^D} d\theta = \bar{\upsilon}_G^D \overline{f^D}(\Psi(-\theta))$,

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[55] From the expression $\partial \upsilon / \partial t_i^D \leq 0$, $x_i \geq 0$ is the Marshallian demand of good *i* and α is voters' marginal utility of income.

$\overline{f^D}(\Psi(-\theta)) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D(\Psi(-\theta))\, d\theta$ is a weighted marginal probability of the vote while $\overline{\upsilon}_G^D = \overline{\partial \upsilon} / \partial G_s^D$ is, a politically weighted, marginal utility of the public good. The last expression in (30), $\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) \frac{\partial c}{\partial y} T^D(i)\, d\theta$, is a weighted measure of the change in tax revenue if parties redistribute one dollar to the electorate through the tax system.

We re-write condition (30) as:

$$-\frac{\sum_{j=1}^{n} t_j^D \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) S_{ij}\, d\theta}{X_i} = \frac{\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right] + \overline{f^D}\left(\Psi(-\theta)\right) E\left[\lambda^D\right]}{\overline{f^D}\left(\Psi(-\theta)\right) \overline{\upsilon}_G^D} - E\left[\frac{\partial c}{\partial y} T^D(i)\right]$$

In the equation above, $\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right]$ is the covariance between the marginal probability that a voter type θ votes for party D ($f^D\left(\Psi(-\theta)\right)$) and the net fiscal exchange λ^D. $E\left[\lambda^D\right] = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) \lambda^D\, d\theta$ is the expected net fiscal exchange across individuals, and $\bar{\lambda}^D = \overline{f^D}\left(\Psi(-\theta)\right) E\left[\lambda^D\right]$ is the proportion of votes from the gains derived by the expected net fiscal exchange. Dividing the term by $\overline{f^D}\left(\Psi(-\theta)\right) \overline{\upsilon}_G^D$, we obtain a normalized ratio of the net benefits from the net fiscal exchange over the politically aggregated marginal utility of the public good given by $\bar{\lambda}^D / \overline{\upsilon}_G^D$. Finally the tax rule becomes:

$$-\frac{\sum_{j=1}^{n} t_j^D \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) S_{ij}\, d\theta}{X_i} = \frac{\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right]}{\overline{f^D}\left(\Psi(-\theta)\right) \overline{\upsilon}_G^D} + \frac{\bar{\lambda}^D}{\overline{\upsilon}_G^D} - E\left[\frac{\partial c}{\partial y} T^D(i)\right] \quad \forall\, t_i^{*D} \qquad (31)$$

According to (31), the pattern of redistributive taxation is explained by the covariance between voters' marginal probability of voting for candidate *D* and the net fiscal exchange denoted as $\sigma^{D}\left[f^{D}\left(\Psi(-\theta)\right),\lambda^{D}\right]$. Hence, if party *D* forms the government the party will implement a tax system with a higher tax rate t_i^{*D} for the case it is observed a distribution of voters' preferences for fiscal policies such that voters with higher than average marginal probabilities of voting for party *D* are associated with higher than average marginal net fiscal exchange gains.[56]

To highlight the role of the partisan preference consider two different types of voters with a partisan bias given by $\forall\theta^0,\theta^1\in\left[\underline{\theta},\overline{\theta}\right]:\theta^0<0\wedge\theta^1>0$ and ideal policies $t_i^{*\theta^0}\geq t_i^{*\theta^1}$ leading to $\Psi\left(\theta^0\right)\geq\Psi\left(\theta^1\right)\;\forall t_i^{*D},t_i^{*R}$. Assume the function of the probability of the vote F^D is convex then $\Psi\left(\theta^0\right)\geq\Psi\left(\theta^1\right)$ implies $f^D\left(\Psi\left(\theta^0\right)\right)\geq f^D\left(\Psi\left(\theta^1\right)\right)$. If in addition, $g\left(\theta^0\right)\geq g\left(\theta^1\right)$ then, unambiguously, a Downsian candidate *D* will weigh more heavily the preferences over fiscal policies of individuals who have a partisan bias for party *D* (that is, Democrat voters or individuals type θ^0). As a result, party *D* provides a level of public good (G_s^D) that is closer to the ideal spending on public good of citizens with a partisan bias towards party *D* (that is $G_s^D\rightarrow G_s^{*\theta^0}$).[57] Conversely, if F^k is a concave cumulative function of $\Psi(-\theta)$, $t_i^{*\theta^0}\geq t_i^{*\theta^1}$ and voters' attitudes lead to $\Psi\left(\theta^0\right)\geq\Psi\left(\theta^1\right)\;\forall t_i^{*D},t_i^{*R}$ and $g\left(\theta^0\right)f^D\left(\Psi\left(\theta^0\right)\right)\leq g\left(\theta^1\right)f^D\left(\Psi\left(\theta^1\right)\right)$ for $\theta^0<\theta^1$, then party *D* will weigh less heavily the preferences over fiscal policies from voters type θ^0.

[56] In this case $\sigma^{D}\left[f^{D}\left(\Psi(-\theta)\right),\lambda^{D}\right]\geq 0$. Thus the higher the covariance the higher t_i^{*D}.

[57] Since parties will select policies in the region in which marginal tax revenues are positive (see Hettich & Winer 1997, 1999) then $t_i^{*\theta^0}\geq t_i^{*\theta^1}\Rightarrow G_s^{*\theta^0}\geq G_s^{*\theta^1}$ if $t_i^{*\theta^0},t_i^{*\theta^1}\in\Re^1$.

In this case, the provision of the public good will be lower compared with our previous example (since $G_s^D \rightarrow G_s^{*\theta^1} \wedge G_s^{*\theta^1} \leq G_s^{*\theta^0}$).

In addition, party *D* has the incentive to tax more heavily income elastic commodities and less prominently income inelastic and inferior goods. To see this, note that $MRS_{G-x_0}\left(\theta^0\right) \geq MRS_{G-x_0}\left(\theta^1\right)$, Democrat voters prefer a higher level of spending compared to the ideal expenditures of Republican voters and an income elastic commodity implies $T^D\left(i, y^1\right) \geq T^D\left(i, y^0\right)$ for individuals with $y^1 \geq y^0$ (the share of tax liability in good i is higher for voters with higher levels of income). Data from ANES suggests that $\text{covariance}\left[\theta, y\right] \geq 0$, therefore Democrat voters will be associated with lower than average shares of the tax price and therefore with higher than average values of the net fiscal exchange gains $\lambda^D\left(i, y^0\right) \geq \lambda^D\left(i, y^1\right)$. Furthermore, for a convex F^D, $t_i^{*\theta^0} \geq t_i^{*\theta^1}$ leading to $\Psi\left(\theta^0\right) \geq \Psi\left(\theta^1\right)$ $\forall t_i^{*k}, t_i^{*-k}$ implies $f^D\left(\Psi\left(\theta^0\right)\right) \geq f^D\left(\Psi\left(\theta^1\right)\right)$ for $\theta^0 < \theta^1$. Therefore, higher than average $f^D\left(\Psi\left(-\theta\right)\right)$ will be associated with higher than average λ^D and hence $\sigma^D\left[f^D\left(\Psi\left(-\theta\right)\right), \lambda^D\right] \geq 0$. Consequently, the higher the covariance σ^D the higher the tax rate t_i^{*D} on the tax system proposed by party *D*.

It should be clear that the covariance σ^D is higher under an income elastic commodity *i* compared with that of an income inelastic commodity *z* since the net fiscal exchange gains for Democrat voters are higher under good *i*. Consequently, party *D* will propose a higher tax rate on income elastic goods compared with that of income inelastic goods. A similar analysis can be made for an inferior commodity. Party *D* will not tax heavily an inferior commodity *j* if $T^D\left(j, y^0\right) \geq T^D\left(j, y^1\right)$ leads to $\lambda^D\left(j, y^0\right) \leq \lambda^D\left(j, y^1\right)$ for

$y^1 \geq y^0$. Since a convex function $F^D\left(\Psi(\theta)\right)$ and $\Psi(\theta^0) \geq \Psi(\theta^1)$, implies $f^D\left(\Psi(\theta^0)\right) \geq f^D\left(\Psi(\theta^1)\right)$ for $\theta^0 < \theta^1$ and higher than average $f^D\left(\Psi(-\theta)\right)$ will be associated with lower than average λ^D which means $\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right] \leq 0$. Clearly, the tax rate t_j^{*D} on the tax system proposed by party *D* will be lower the more negative is $\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right] \leq 0$.

Assuming the demand of commodities are independent (cross price effects are zero), the expression (31) is reduced to $\frac{t_j^D}{1+t_j^D} = \frac{1}{\varepsilon_{x_i - q_i}}\left\{\frac{\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right]}{\overline{f^D}\left(\Psi(-\theta)\right)\overline{\upsilon}_G^D} + \frac{\overline{\lambda}^D}{\overline{\upsilon}_G^D} - E\left[\frac{\partial c}{\partial y} T^D(i)\right]\right\}$

where $\varepsilon_{x_i - q_i} = -\int_{\underline{\theta}}^{\overline{\theta}}\left\{S_{ij}\, q_i / x_i^c\right\} T(i)\, g(\theta)\, d\theta$ is a weighted compensated price elasticity of commodity *i*.[58] The last expression reflects more clearly the tradeoff between political redistribution and efficiency. An income elastic commodity implies $\sigma^D\left[f^D\left(\Psi(-\theta)\right), \lambda^D\right] \geq 0$. Thus, competition for votes leads party *D* to redistribute in favor of Democrat voters which induces party *D* to increase t_i^{*D}. However, since commodity *i* is income elastic $\varepsilon_{x_i - q_i}$ is high, as well as the deadweight costs of taxation, which reduces voters' political support to the party. Thus, efficiency concerns induce party *D* to reduce t_i^{*D}.

Now we proceed to evaluate the role of the marginal proportion of the expected vote from the last unit of the public good $\overline{f^D}\left(\Psi(-\theta)\right)\overline{\upsilon}_G^D$. In general, this term has an ambiguous effect over t_i^{*D}. To see this suppose an exogenous change in $\overline{\upsilon}_G^D$ and note

[58] For simplicity, we normalize $p_i = 1$.

from (31) that provided $\sigma^{D}\left[f^{D}\left(\Psi(-\theta)\right),\lambda^{D}\right]\geq 0$ and $\bar{\lambda}^{D}\geq 0$, then a higher $\overline{f^{D}}\left(\Psi\left(-\theta\right)\right)\bar{\upsilon}_{G}^{D}$ tends to reduce (*ceteris paribus*) tax rate t_{i}^{*D}, but also a higher $\overline{f^{D}}\left(\Psi\left(-\theta\right)\right)\bar{\upsilon}_{G}^{D}$ might increase the tax rate if $\sigma^{D}\left[f^{D}\left(\Psi(-\theta)\right),\lambda^{D}\right]\leq 0$ and $\bar{\lambda}^{D}\leq 0$.[59] Hence the net impact of an increase in the willingness to pay for the public across the electorate is ambiguous.

The term $\bar{\lambda}^{D}/\bar{\upsilon}_{G}^{D}$ represents the ratio of the politically weighted measures of the net ($\bar{\lambda}^{D}$) and gross ($\bar{\upsilon}_{G}^{D}$) fiscal exchange gains. The larger the ratio the higher will be the tax rate used in the tax system since the political gains from public provision are exhausted at higher levels of public spending. The expression $E\left[\partial c/\partial y\ T^{D}\left(i\right)\right]=\int_{\underline{\theta}}^{\bar{\theta}}g\left(\theta\right)\partial c/\partial y\ T^{D}\left(i\right)d\theta$ represents the expected extra tax revenue that the government obtains as a result of redistributing one dollar to voters. To see this, note that the government can induce a change in income across the electorate by changing the relative prices of commodities through the tax structure. In the equation, the individuals' share of tax contributions ($T^{D}\left(i\right)$) is a weighing factor of the marginal tax revenue ($\partial c/\partial y$) from returning one dollar to each taxpayer. From the expression in (31), the higher $E\left[\partial c/\partial y\ T^{D}\left(i\right)\right]$ the lower the tax rate t_{i}^{*D} to be used in the tax system.

[59] The *ceteris paribus* condition must be interpreted as considering an increase in $\overline{f^{D}}\left(\Psi\right)\bar{\upsilon}_{G}^{D}$ that leads to a distribution of the net fiscal exchange gains so that $\sigma^{D}\left[f^{D}\left(\Psi(-\theta)\right),\lambda^{D}\right]$ and $\bar{\lambda}^{D}$ remain unchanged. Otherwise the effect of the expected vote from the net fiscal exchange is ambiguous.

A similar tax rule (to that defined in equation 10) can be derived for party *R*.[60] As before, the preferences of voters over policy and the aggregation of voters' interests by party *R* determine the tax platform offered by the candidate. Party *R* aggregates more heavily the preferences of Republican voters if the cumulative distribution, $F^R(-\Psi-(\theta))$, is convex. In this case, $\forall\theta^0,\theta^1\in[\underline{\theta},\overline{\theta}]:\theta^0<0\wedge\theta^1>0$ and ideal policies $t_i^{*\theta^0}\geq t_i^{*\theta^1}$ such that $-\Psi(-\theta^1)\geq-\Psi(-\theta^0)$ $\forall t_i^{*D},t_i^{*R}$ imply $f^R(-\Psi(-\theta^1))\geq f^R(-\Psi(-\theta^0))$, that is, Republican voters have higher marginal propensities to vote for party *R*. Moreover, for an income elastic commodity $T^R(j,y^0)\geq T^R(j,y^1)$ for individuals with $y^1\geq y^0$. Therefore, $MRS_{G-x_0}(\theta^0)\geq MRS_{G-x_0}(\theta^1)$, covariance$[\theta,y]\geq 0$ and $T^R(j,y^0)\geq T^R(j,y^1)$ imply $\lambda^R(j,y^1)\leq\lambda^R(j,y^0)$ for $y^1\geq y^0$ (Republican voters have a lower than average net fiscal exchange gains). Since Republican have higher than averages marginal propensity to vote for party *R* and lower than average net fiscal exchange gains then $\sigma^R\left[f^R(-\Psi(-\theta)),\lambda^R\right]\leq 0$. This implies that redistribution plays a less prominent role in designing tax structure for party *R* compared to the role that distribution plays for party *D*. Similarly, if party *R* weighs more heavily the preferences of Republican voters then $\overline{\lambda}^R/\overline{\upsilon}_G^R\leq\overline{\lambda}^D/\overline{\upsilon}_G^D$, which implies that the expected proportion of votes from the gains derived by the net fiscal exchange is actually lower for party *R* at high tax rates over

[60] For completeness, the tax rule for party *R* is given by:

$$-\frac{\sum_{j=1}^{n}t_j^R\int_{\underline{\theta}}^{\overline{\theta}}g(\theta)S_{ij}d\theta}{X_i}=\frac{\sigma^R\left[f^R(-\Psi(-\theta)),\lambda^R\right]}{\overline{f^R}(-\Psi(-\theta))\overline{\upsilon}_G^R}+\frac{\overline{\lambda}^R}{\overline{\upsilon}_G^R}-E\left[\frac{\partial c}{\partial y}T^R(i)\right] \quad (31')$$

commodity *i*. Thus, $\sigma^R\left[f^R\left(-\Psi(-\theta)\right),\lambda^R\right]\leq 0$ and $\bar{\lambda}^R/\bar{\upsilon}_G^R \leq \bar{\lambda}^D/\bar{\upsilon}_G^D$ implies $t_i^{*R} \leq t_i^{*D}$. In other words, parties *D* and *R* do not converge in their tax policies.

With respect the question of parties' platforms convergence (divergence), we must notice that the distribution of the partisan preferences modifies the individual's marginal probability to vote for either candidate for a given set of parties' policies. A voter with a strong partisan preference for candidate *D* (a voter with a large value of $\theta < 0$) will have a higher probability to vote for party D than to vote for party *R* if both candidates propose the same tax policies. A similar case stands for a Republican voter (a voter with $\theta > 0$) who will have a higher probability of voting for party *R* if both candidates propose the same policies. From the optimality conditions, and our discussion above, it is clear that a party will weigh differently, more heavily/less heavily, the preferences of those individuals with strong partisan preferences in favor of the party when the function F^k is convex/concave. In particular, proposition 3 in Appendix E shows that if the probabilities of the vote, F^D and F^R, are convex then at the Nash equilibrium $t_i^{*D} \geq t_i^{*R}$, if the functions of the probability of the vote are concave then $t_i^{*D} \leq t_i^{*R}$, and for the case of bimodal cumulative distributions $t_i^{*D} \underset{<}{\geq} t_i^{*R}$.

The claims above follow because if $t_i^{*\theta^0} \geq t_i^{*\theta^1}\ \forall\, \theta^0 < 0 \wedge \theta^1 > 0$ leads to $\Psi\left(-\theta^0\right) \geq \Psi\left(-\theta^1\right)$ at t_i^{*D}, t_i^{*R}, and if F^D and F^R are convex cumulative distributions, party *D* expects that the marginal probability of the vote of Democrat voters is higher than that of Republican and Independent voters. Party *D* has an electoral incentive to weigh more heavily the demands of Democrat voters and, consequently, party *D* takes a policy platform closer to the ideal policies of Democrat voters. In contrast, the marginal probability of the vote for party *R* of Democrat voters is lower (compared with that of Republican voters), hence party *R* tends to weigh less heavily the demands of Democrat voters. Therefore, at equilibrium, $t_i^{*D} \geq t_i^{*R}$.

The former discussion implies that parties aggregate differently the preferences of the same electorate and as a result parties diverge in their policy platforms (for a formal proof of this outcome see proposition 6 in Appendix F). Convergence of parties' policy platforms is the dominant strategy for parties if policies satisfy condition (29) and the probabilities of voting for candidates *D* and *R* are a continuous, uniform cumulative distribution of Ψ (for a formal proof of this outcome see proposition 5 in Appendix F). In this case, parties do not gain by differentiating tax burdens under the basis of voters' political affiliation (since voters' propensity of the vote is the same) and parties' tax policies converge. In this case, the relative political influence of voters over policy makers (parties) is explained only by the relative size of coalition of voters in the electorate (larger coalitions are expected to deliver higher number of votes and hence parties design policies that please these groups of voters).

The Distribution of Voters' Partisan Preference and the Redistributive Properties of Tax Structure

Empirical evidence from the American National Election Studies 1952-2004 indicates that in the last decades the proportion of individuals identified as Democrats fell while the proportion of Republicans increased. This fact suggests that the relative political influence of Democrats and Republicans has changed over time. In this section, we are interested in analyzing the influence of different distributions of voters' partisan identification over the provision of the public good and the degree of progressivity of the tax system. A change in the distribution of partisan preferences affects the way parties aggregate voters' interests for policy since different distributions of voters' loyalties affect the marginal propensity of the vote across the electorate and the relative proportion of votes delivered by different coalitions of voters.

To analyze these issues, let us define the concept of first order partisan dominance as a distribution of the partisan bias in which a higher proportion of loyal voters implies a higher probability of winning the election for the party. Figure 3 in Appendix C provides an example, the distribution of voters' partisan attitudes in 1964 dominates the distribution in 2002. Formally, for given policy vectors $\mathbf{P}^D, \mathbf{P}^R \in \mathbf{P}$, consider two distributions of voters' party identification $\hat{G}(\theta)$ and $\tilde{G}(\theta)$ such that if $\tilde{G}(\theta)$ partisan-dominates $\hat{G}(\theta)$ then party *D* has a higher probability of winning the election (for a formal proof see proposition 7 in Appendix G . Formally:

$$\hat{G}(\theta) \leq \tilde{G}(\theta)\ \forall \theta \in [\underline{\theta}, \overline{\theta}] \ \Rightarrow\ \pi^D\left(\mathbf{P}^D, \mathbf{P}^R, \tilde{G}(\theta)\right) \geq \pi^D\left(\mathbf{P}^D, \mathbf{P}^R, \hat{G}(\theta)\right)\ \forall \mathbf{P}^D, \mathbf{P}^R \in \mathbf{P} \qquad (32)$$

The changes in tax structure due to changes in the dominance of voters' political attitudes follow from the optimality conditions. Thus, let $\mathbf{t}^{*k} \in \Re^1$, differentiate (29) with respect $G(\theta)\ \forall \theta \in [\underline{\theta}, \overline{\theta}]$ to obtain $\frac{dt_i^{*D}}{dG(\theta)} = -\frac{\partial^2 \pi^D / \partial t_i^D \partial G(\theta)}{\partial^2 \pi^D / \partial^2 t_i^D} \substack{\geq \\ <} 0$ as $\partial^2 \pi^D / \partial t_i^D \partial G(\theta) \substack{\leq \\ <} 0$ since the concavity of $\pi^D\left(\mathbf{P}^D, \mathbf{P}^R\right)$ implies $-\partial^2 \pi^D / \partial^2 t_i^D \geq 0$.

Moreover, $G(\theta) = \int_{\underline{\theta}}^{\theta} g(\theta) d\theta$ is a non decreasing monotone function, then there exists an inverse function $\theta = \chi(G(\theta)) : \chi' = \left[g(\theta)\Big|_{\underline{\theta}}^{\overline{\theta}}\right]^{-1}$ such that $\dfrac{\partial^2 \pi^D}{\partial t_i^D \partial G(\theta)} = \dfrac{\partial t_i^D}{\partial \theta}\dfrac{\partial \theta}{\partial G(\theta)}$.

Hence:

$$\frac{\partial^2 \pi^D}{\partial t_i^D \partial G(\theta)} = \frac{\int_{\underline{\theta}}^{\overline{\theta}} g'(\theta) f^D(\Psi(-\theta))\partial\Psi/\partial t_i^D d\theta - \int_{\underline{\theta}}^{\overline{\theta}} g(\theta)\left(f^D(\Psi(-\theta))\partial\Psi/\partial t_i^D\right)' d\theta}{g(\overline{\theta}) - g(\underline{\theta})} \gtrless 0$$

The expression above says that a change in the distribution of the partisan attitudes will affect the pattern of weights assigned by party *D* to the preferences of voters by modifying the distribution of $g(\theta)$ and the marginal probability of the vote $f^D(\Psi(-\theta))$ across the electorate. To see this, recall $\varpi^D(\theta) = g(\theta) f^D(\Psi(-\theta))$ determines how party *D* aggregates the preferences of individuals' type θ. Positive changes in $\varpi^D(\theta)$ induce party *D* to propose a platform that is closer to the ideal policies of voters' type θ. Hence, the expressions of the numerator reflect the change in the aggregation of preferences due to changes in $G(\theta)$ $\forall \theta \in [\underline{\theta}.\overline{\theta}]$.

The term $g(\overline{\theta}) - g(\underline{\theta}) \gtrless 0$ can be considered as a measure of the extent of the partisan dominance if $\hat{G}(\theta) \le \tilde{G}(\theta)$ $\forall$ $\theta \in [\underline{\theta}, \overline{\theta}]$. The data of the American National Election Studies shows that the proportion of individuals regarded as Strong Democrats (by our convention $g(\underline{\theta})$) is higher than the proportion of strong Republicans (or voters type $g(\overline{\theta})$).[61] That is, the empirical data clearly suggests $-\left\{g(\overline{\theta}) - g(\underline{\theta})\right\}^{-1} \ge 0$.

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[61] For the period 1952-2004 the surveys from ANES provide a 7-point scale measure of the intensity of party identification. We can denote θ from $\underline{\theta} \approx$ strong Democrats to $\overline{\theta} \approx$ strong Republicans. The survey suggests that the proportion of strong Democrats has represented 19% of the electorate while the proportion

We integrate by parts the second term of the numerator to obtain:

$$\frac{\partial^2 \pi^D}{\partial t_i^D \partial G(\theta)} = \left\{ \frac{-1}{g(\bar{\theta}) - g(\underline{\theta})} \right\} \left\{ g(\underline{\theta}) f^D\left(\Psi(-\underline{\theta})\right) \left.\frac{\partial \Psi}{\partial t_i^D}\right|_{\underline{\theta}} - g(\bar{\theta}) f^D\left(\Psi(-\bar{\theta})\right) \left.\frac{\partial \Psi}{\partial t_i^D}\right|_{\bar{\theta}} \right\} \begin{matrix} > \\ < \end{matrix} 0 \qquad (33)$$

To interpret (33) assume commodity *i* is income elastic and preferences of strong Democrat and Republican voters are given by $\partial\Psi/\partial t_i^D\big|_{\underline{\theta}, t_i^{*D}} \geq 0$ and $\partial\Psi/\partial t_i^D\big|_{\bar{\theta}, t_i^{*D}} \leq 0$.[62] In this case, $\partial^2 \pi^D / \partial t_i^D \partial G(\theta) \geq 0$ implies $dt_i^{*D} / dG(\theta) \geq 0$, therefore the partisan dominance (equivalently, an increase of $G(\theta)\ \ \forall \theta \in [\underline{\theta}, \bar{\theta}]$) induces party *D* to increase the tax rate of equilibrium over commodity *i* and, consequently, the degree of progresivity of the tax system increases.

In other words, an increase in the proportion of voters with a bias in favor of party *D*, changes the pattern of weights assigned by the party to the preferences of voters by modifying the distribution of the partisan bias and the marginal probability of the vote across the electorate. As a result of a more dominant partisan distribution, there is an increase in the proportion of the expected votes from Democrat voters for party *D*. By assumption, strong Democrat voters (or voters type $\underline{\theta}$) prefer an increase in the tax rate. Hence, if party *D* increases the tax rate, the expected proportion of the votes for the party increases by a proportion given by $g(\underline{\theta}) f^D(\Psi(-\underline{\theta}))$. Simultaneously, a more dominant

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of strong Republicans the 11%. The difference between strong Republicans-strong Democrats has always been non positive (that is $g(\bar{\theta}) - g(\underline{\theta}) \leq 0$) with an average difference for the period 1952-2004 of -8%.

[62] That is, the ideal policy of strong Democrat voters $t_i^{*\underline{\theta}}$ is higher than the policy platform t_i^{*D} of party D. Thus, $\partial\Psi/\partial t_i^D\big|_{\underline{\theta}, t_i^{*D}} \geq 0$ implies that an increase of the tax rate increases the welfare of voters type $\underline{\theta}$, while a decrease of the tax rate increases the welfare of strong Republican, or $\partial\Psi/\partial t_i^D\big|_{\bar{\theta}, t_i^{*D}} \leq 0$

partisan distribution reduces the proportion of the expected votes for party *D* from the rest of voters (this effect is approximated by a fall in the proportion of Republican voters $g(\bar{\theta})f^{D}(\Psi(-\bar{\theta}))$ in equation 12). By assumption, strong Republican voters (or voters type $\bar{\theta}$) support a decrease in t_i^{*D}. Consequently, party *D* has an incentive to take a policy position closer to Democrat voters. Therefore, a distribution of preferences $\partial\Psi/\partial t_i^D\big|_{\underline{\theta},t_i^{*D}} \geq 0$ and $\partial\Psi/\partial t_i^D\big|_{\bar{\theta},t_i^{*D}} \leq 0$ implies $dt_i^{*D}/dG(\theta) \geq 0$ if there is an increase in the partisan dominance of Democrat voters in the electorate.

Interestingly, the increase in the partisan dominance might induce party *D* to take a policy position that reduces the welfare of Democrat voters if Republican and Democrat voters share similar views on policy. To see this, assume $\partial\Psi/\partial t_i^D\big|_{\underline{\theta},t_i^{*D}} \geq 0$ and $\partial\Psi/\partial t_i^D\big|_{\bar{\theta},t_i^{*D}} \geq 0$, $t_i^{*\underline{\theta}} \geq t_i^{*\bar{\theta}}$: $\Psi(-\underline{\theta}) \geq \Psi(-\bar{\theta})$, and F^D is concave enough such that $f^D(\Psi(-\bar{\theta})) \geq f^D(\Psi(-\underline{\theta}))$. In this case, an increase $G(\theta)$ $\forall\theta$ implies $dt_i^{*D}/dG(\theta) \leq 0$. The interpretation of this result is simple, under a concave function of the probability of the vote, an increase in the proportion of Democrat voters might actually reduce their expected proportion of the votes for party *D* since the marginal probability of the vote of Democrats is decreasing as $\theta \to \underline{\theta}$. As a result, party *D* might increase the probability of winning the election if the party designs a policy platform in the opposite direction of a welfare increase of Democrat voters.

To see this, note that if party *D* takes a policy position closer to strong Democrat voters as a response of an increase $G(\theta)$ $\forall\theta$ (in our example with $\partial\Psi/\partial t_i^D\big|_{\underline{\theta},t_i^{*D}} \geq 0$, if party *D* increases t_i^{*D}) then the proportion of the expected votes by voters type $\underline{\theta}$

increases by $g(\underline{\theta})f^{D}(\Psi(-\underline{\theta}))$ and the expected proportion of the votes from strong Republican voters falls by $g(\overline{\theta})f^{D}(\Psi(-\overline{\theta}))$. Under a concave F^{D} the second effect might dominate, and therefore the expected plurality of party *D* falls if the party increases t_i^{*D}. In contrast, parties' plurality increases, as a result of an increase in the partisan dominance of Democrat voters, if party *D* takes a policy position in the opposite direction to a welfare increase of strong Democrat voters (if party *D* reduces t_i^{*D}).

The former result is counterintuitive and explained by the assumption of the concavity of the probability of the vote. Note that the electoral competition induces party *D* to redistribute in favor of those coalitions of voters that deliver a high expected marginal proportion of the votes. Under a concave probability of the vote, an increase $G(\theta)\ \ \forall\theta$ is equivalent to an increase in the proportion of individuals with a low marginal probability of voting for party *D*. This reduces the expected proportion of votes to be deliver in the election by Democrat voters and hence party *D* assigns a lower weight to the preferences of Democrat voters. As a result, party *D* changes (marginally) its platform in the opposite direction of a policy that increases the welfare of Democrat voters.

Concluding Remarks

In a democracy, political parties perform the important role of aggregating voters' preferences for public policies. The issue of representation is central to the design of fiscal policies, since the aggregation of interests is closely related to the tradeoff between efficiency and redistribution, and the size and composition of government expenditure. In the deterministic models of electoral competition, the leading paradigm suggests that the efficiency-redistribution tradeoff is explained by the preferences over policy of the median voter. The probabilistic voting models suggest that the preferences of all voters in the electorate influence public policy (that is, in this context there is no decisive voter). However, in the probabilistic voting models there is little research on the roles that redistributive politics and efficiency play on guiding the design of tax rules for an economy with electoral constraints when policy is multidimensional and there is political-economic heterogeneity. In this essay we expect to contribute in filling this gap.

We propose a model in which the individuals' choice of the vote is determined by parties' policies and voters' partisan preferences to explain the design of the tax system. The voter's partisan attitude is a form of political heterogeneity that helps to explain the distribution of votes in an election. Parties use voters' loyalties to redistribute the gains of public policy across the electorate and maximize parties' chances to win the election. Redistribution is guided by parties' electoral incentives to maximize the net fiscal exchange gains to voters (or group of voters) that deliver a high marginal proportion of the expected votes while parties penalize those voters with low marginal proportion of the expected votes. This, in turn, leads to a process of preference aggregation that determines the roles that redistributive politics and efficiency play on tax design.

The data from the American National Election Studies suggests that Democrat voters prefer higher public spending when compared with the status quo while Republican voters prefer lower spending. Moreover, individuals at the lowest (highest) ranks of the distribution of income are identified as Democrats (Republicans). In this case, Democrat voters would prefer high spending and a progressive commodity tax system while Republican voters would prefer low spending and a regressive commodity tax structure. We identify conditions (if the function of the probability of the vote for the party is convex) in which a differential commodity tax system will be used to redistribute tax burdens in favor of individuals with a partisan bias towards the party. In other words, the Republican (Democrat) party would tend to design tax and spending policies that are closer to the ideal policies of voters identified as Republican (Democrat) voters.[63]

Hence, the model predicts that the Democrat party has an electoral incentive to propose a commodity tax system in which redistribution plays a more prominent role than efficiency in guiding the design of tax structure (taxes on income elastic goods are higher than on income inelastic commodities) and public spending is high. In contrast, the Republican party has an electoral incentive to weigh less heavily redistribution (vis-à-vis efficiency) as a guiding principle of tax design and spending is lower compared with the provision of the public good under a Democrat administration. Parties' beliefs that voters with partisan loyalties deliver the highest marginal proportion of the expected votes explain why the Democrat (Republican) party proposes a platform close to the ideal policies of Democrat (Republican) voters.

Recent empirical analysis suggests that parties in the central government and in the states implement different fiscal policies. In particular, the evidence shows that Democrat administrations are associated with higher spending and tax revenue. Our Downsian model can explain tax divergence. Our model suggests that, even if parties are only concerned in winning the election, each party will aggregate differently the demands of the same electorate (due to voters' attitudes) and therefore the fiscal

[63] The opposite holds if the function of the probability to vote for the party is concave and partisan voters deliver the lowest marginal proportion of the votes. In this case, the Republican (Democrat) party has an electoral incentive to be more responsive to the demands for fiscal policy of Democrat (Republican) voters.

platforms of parties will, in general, diverge.[64] Thus, our model provides a different rationale for tax divergence. In particular, our analysis is different to models in which the lack of fiscal convergence is explained by candidates' preferences over policy outcomes.

The probabilistic theory of elections predicts that public policy reflects more closely the preferences of the coalition(s) of voters that are more effective to influence policy makers. By introducing voters' partisan attitudes, we are able to identify groups that may influence parties through the coalitions' propensity to vote for the party and the relative size of the coalition with respect the electorate. In our model, we provide conditions in which a more dominant coalition of Democrat voters in the electorate induce both parties to design a tax policy that reflects more closely the ideal fiscal policy of Democrat voters (higher spending and a more progressive tax structure) even when divergence of parties' policies persist.

[64] Still, we are able to characterize sufficient conditions that guarantee the convergence of parties' policies.

ESSAY III: PUBLIC GOODS AND TAX STRUCTURE UNDER VOTERS' PARTISAN PREFERENCES AND POLICY MOTIVATED PARTIES

The leading paradigm of electoral competition, the Downs' model, explains the design of fiscal policy under two fundamental assumptions: First, citizens vote for the party that advances the platform that is closest to voters' preferences over policies. Second, parties propose policies to win the election. However, evidence suggests that the individuals' choice of the vote is explained, among other things, by parties' policies and voters' partisan attitudes. Evidence also suggests that the voter's party identification is the best predictor of the actual vote (Republican voters tend to vote for the Republican party), and the stylized facts indicate that the vast majority of the American electorate has a partisan attitude.[65] With respect the second Downsian assumption, many researchers have emphasized that parties seek to win the election to advance the interests of parties' supporters.[66] In other words, parties have preferences over policy outcomes and therefore, parties do not seek to propose policies to win the election (Downs, 1957) but seek to win the election to implement their ideal policies**.**

The formulation of fiscal policy when the individuals' choice of the vote is explained by policy issues and partisan attitudes, and parties are policy motivated has not received adequate attention in the literature. In this context, questions such as how voters' preferences will be aggregated, and what is the impact of the representation of voters' interests on the tradeoff between redistributive politics and efficiency have not been addressed. Furthermore, the question on how parties' interest for policy and the electoral

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[65] For analysis on voting behavior and partisan attitudes see Niemi and Weisberg (2001), Miller, and Shanks (1996), Green, Palmquist, and Schickler (2002), Fiorina (1997), Green and Palmquist (1990), Campbell, et al. (1960).

[66] See Wittman (1973, 1990), Hibbs (1987), Alesina (1987, 1988), Roemer (2001) and others.

competition influence the tradeoff between efficiency and redistribution has not received attention.

Finally, considering policy motivated parties and an electorate with partisan attitudes allows us to recognize that parties' electoral constraints are affected by voters' loyalties.[67] To see this, note that if party's share of the vote is explained (at least at some extent) by voters' attitudes then the party's need to design policies with the support of a majority is softened.[68] In this context, it is of significant interest to ask: What is the size of public spending and what determines tax structure when the electoral constraints of policy motivated parties are softened?

A model that incorporates different sets of electoral constraints is not only relevant for the theoretical analysis of fiscal policy design, but also recent empirical evidence suggests that imperfections in political competition affect the tax and spending policies of state governments. For instance, Reed (2006), Alt and Lowry (2001), Caplan (2001) and Rogers and Rogers (2000) find evidence that state taxes increase when Democrats have significant control of the executive and legislative bodies of state governments.[69] Caplan (2001) finds that corporate and income taxes tend to rise under Democrat control of state legislatures and fall with larger Republican majorities. Chernick (2005) finds that party control by Republicans is associated with more regressive state tax structures. Fletcher and Murray (2006) find that party control is

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[67] We define the electoral constraints of a party, as party's need to design policies with the support of a majority to win the election.

[68] To see this, suppose three states of nature in which a party expects to receive respectively, 10%, 20%, and 30%, of party's share of the vote from voters who decide their vote based on their party identification. Thus, conditional to the state of nature, a policy motivated party might select policies that seek to secure the 41%, 31%, and 21%, respectively, of the share of vote to win the election. Hence, the proportion of the vote a party expects to receive because of voters' loyalties reduces party's need to design policies with the support of a majority. In this sense, the electoral constraints of the party are softened.

[69] Party's control of the legislature can be interpreted as an environment in which a majoritarian coalition faces little or imperfect political competition.

positively associated with higher top income tax rates, higher income threshold for the first bracket of the income tax, and Democrat administrations lead to higher earned income tax credits. Thus, for the purpose of explaining the observed spending and tax policies of governments, it is important that our models incorporate how imperfections in the political arena affect the decision making process of policy.

The main contribution of this essay is to extend the literature on tax and expenditure design when the voting behavior is influenced by voters' preferences over policy issues and partisan loyalties, and parties have preferences over fiscal outcomes. In our analysis, the relative merits of efficiency versus redistribution in designing the tax system are determined by the process of aggregation of voters' preferences and parties' preferences over policy. That is, tax policy is the result of two conflicting incentives: On the one hand, parties seek to design a tax system that redistributes in favor of party's followers. On the other hand, parties' need to win the election forces parties to design a tax platform that appeals to a majority. The two conflicting incentives describe the tradeoff between the narrow interests of the party versus the pluralist preferences of the electorate in determining fiscal policy. This tradeoff depends on the electoral constraints faced by parties.

The model of electoral competition developed in this essay allows us to distinguish different sets of electoral constraints for parties. If a party faces soft electoral constraints (due to a high proportion of loyal voters in the electorate) then party's dominant strategy is to select the ideal policy of party's constituency. In this case, the tradeoff between the narrow interests of parties versus the pluralist preferences of the electorate suggests that soft electoral constraints lead to fiscal cycles, that is, increases on tax and spending under Democrat administrations and reductions on tax and spending under Republican governments.

If, in contrast, the electoral constraints are binding then parties select policies that appeal to a majority of voters. However, even in the case in which the electoral constraints are binding, candidates' policies do not converge since voters' loyalties induce parties to aggregate the preferences of the electorate differently. We identify conditions in which a differential commodity tax system will be used to redistribute tax burdens in favor of individuals with a partisan bias towards the party. That is, policies of the Democrat (Republican) party follow closely the preferences of Democrat (Republican) voters.[70] Under certain conditions, re-distributional concerns dominate the design of policy for Democrat governments while efficiency issues are more heavily weighed in the design of the tax system under Republican administrations.

Literature Review and the Case for Policy Motivated Parties in the Analysis of Public Finance

The leading paradigm of the theory of elections, the Downs' model, suggests that parties design fiscal policy to win the election. This assumption has been challenged by Wittman (1973, 1990), Hibbs (1987), Roemer (2001) and others. Their argument is that parties have preferences over policy outcomes since parties represent the interests of their constituencies**.** For example, Hibbs (1987) argues that the Democrat party weighs more heavily the undesired effects on the economy of unemployment (vis-à-vis the negative

[70] Evidence from the American National Election Studies (ANES) suggests that Democrat (Republican) voters support high (low) spending. Moreover, voters with low (high) levels of income are identified with the Democrat (Republican) party. This suggests that income transfers and a progressive tax structure would be supported (opposed) by Democrat (Republican) voters.

effects of inflation) since voters favoring the Democrat party (those typically with incomes around the median income or below) weigh more heavily unemployment concerns than inflation concerns. The opposite is said to hold for the Republican party.[71]

If parties seek to advance the interests of their constituencies then the analysis of parties with preferences over policy outcomes (or Wittman's electoral competition) is relevant for the study of public finance. To see this, we use data from the ANES which shows voters' characteristics and preferences over spending. This data suggests that on average, for the period 1952-2004, Democrat (Republican) voters prefer an increase (decrease) in government expenditure compared to the level of spending at the status quo. Data from the ANES also shows that individuals with low levels of income are identified with the Democrat party, while voters at high levels of income are identified with the Republican party. Thus, if parties represent the preferences over policies of their constituencies, then the Democrat party would propose higher government spending and redistribution would play a more prominent role (vis-à-vis efficiency) on tax design compared to the policies proposed by the Republican party. Therefore, the analysis of public policies when parties are policy motivated is relevant for the tradeoff between redistributive politics and efficiency, the indirect-direct tax controversy, and the size and composition of public spending.

Empirical evidence seems to be on line with the conventional wisdom that Democrat administrations lead to higher spending and redistribution. For instance, Blomberg and Hess (2003) finds evidence of a fiscal cycle with federal taxes and spending increasing (falling) under Democrat (Republican) administrations. Alesina,

[71] For arguments along the same lines see Alesina (1987, 1988), Alesina and Rosenthal (1995), and Paldam (1997).

Roubini and Cohen (1999) also find that budget deficits are higher under Republican administrations.[72] Caplan (2001) finds that corporate and income taxes tend to rise under Democrat control of state legislatures and fall with larger Republican majorities. Overall, this evidence suggests the existence of cycles in the fiscal policies of the federal and state governments in the U.S.

Our review of the literature and the surveys conducted by Hettich and Winer (1997, 1999, 2004), Mueller (2003), Gould and Baker (2002), Roemer (2001), Poterba (1999), and Holcombe (1998) indicate that the theoretical applications of the Wittman's electoral competition to the analysis of public finance have received little attention. For example, insights might be gained by analyzing the type of tax structure, the selection of tax bases, and the special provisions that would arise in the context of the Wittman's electoral competition. For instance, Roemer (1997, 1999, 2001) considers the possibility of progressive income taxes. Roemer (2001) shows that under certain assumptions, policy motivated candidates propose the ideal policy of the median voter.[73] According to this prediction, the electoral constraints are binding as to remove any distortion on the representation of voters' preferences that might have been created by parties seeking to advance the interests of their political base. However, the median voter outcome is not the only equilibrium that might arise under the Wittman's political competition. In the analysis of Roemer (1997, 2001), the ideal policies of parties might also be an equilibrium. In this case, the electoral constraints are not binding at all and a party is able

[72] For international evidence on differences of parties' fiscal policies, see Mueller (2003) and Alesina, Roubini and Cohen (1999), Mueller (2003).

[73] These assumptions include: Policy motivated parties have perfect information on voters' preferences, the individuals' voting behavior is driven only by policy issues, policy is one-dimensional, and the ideal policy of the median voter is bounded by the ideal policies of parties.

to advance the interests of a faction inside the party without any consideration to the preferences of the median voter (or for that matter of the rest of the electorate).

Roemer assumes that parties have perfect information on voters' preferences, and the individuals' choice of the vote is driven by policy issues. However, Roemer's analysis of the Wittman's electoral competition cannot be extended to study multidimensional policies when there is political-economic heterogeneity of voters and parties have perfect information on voters' preferences, since the model does not produce an equilibrium.[74] Thus, to be able to predict policies, we need to extend the analysis of the Wittman's electoral competition from the perspective of the probabilistic theory of elections.[75] If we assume that parties have imperfect information on voters' preferences, then the properties of the probabilistic function that translates policies into votes and the individuals' voting behavior become central elements to explain the design of fiscal policies.

Most of the probabilistic models of electoral competition assume that the individuals' vote is driven by policy issues. In contrast, empirical evidence shows that the voting behavior depends not only on policy issues but also on voters' partisan loyalties. Furthermore, an overwhelming majority of the American electorate has a partisan attitude, and voter's party identification is considered the best predictor of the choice of the vote.[76] However, the analysis of tax design when policy motivated parties have

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[74] See Roemer (2001) for a careful analysis of the existence of an electoral equilibrium under the Wittman's model.

[75] Based on imperfect information of parties, the probabilistic theory of elections produces an electoral equilibrium when policy is multidimensional and there is heterogeneity of voters' preferences over policies.

[76] See Niemi and Weisberg (2001), Miller, and Shanks, (1996), Green, Palmquist, and Schickler, (2002), Fiorina (1997), Green, and Palmquist (1990), and Campbell, et al. (1960).

uncertainty on voters' preferences and the individuals' vote is explained by policy issues and partisan loyalties has not received attention.

Voters' partisan attitudes might influence the design of tax policy in several ways. First, voters' partisan loyalties affect the individuals' choice of the vote and therefore affect the way parties aggregates voters' preferences.[77] Second, when parties have preferences over policies, voters' partisan loyalties might lead to softer electoral constraints allowing parties to set their own agenda on taxation. To see this, note that the proportion of partisan voters favoring the party increases the party's chance to win the election. Therefore, if the party has significant political support (or votes) from loyal voters, then party's dominant strategy is to propose the ideal policy of party's constituency instead of designing a policy that seeks to represent the preferences over policy of a majority of the electorate.[78] In this sense, an electorate with partisan attitudes might soften the electoral constraints of the party and affect the design of fiscal policies.

Empirical evidence suggests that imperfections in the process of political competition affect the tax and spending policies of state governments. For instance, Reed (2006), Alt and Lowry (2001), Caplan (2001) and Rogers and Rogers (2000) find evidence that state taxes increase when Democrats have significant control of the executive and legislative bodies of state governments.[79] Nelson (2000) reports that Democrat administrations enacted 59% of the statutory state tax increases between 1943

[77] See Ponce-Rodriguez (2006).

[78] To see this, note that under the absence of electoral constraints (in the special case that the party wins the election with certainty) a party with preferences over policies selects the party's ideal policy. On the opposite case, if the party has an intrinsic disadvantage to win the election (for example, because of the well known incumbency advantage, see Mueller, 2003) then the party will have to look for additional votes by taking policy positions that appeal not only to party's base but also to a majority of the electorate to win the election.

[79] Party's control of the legislature can be interpreted as an environment in which a majoritarian coalition faces little or imperfect political competition.

and 1993, and 39% of total tax increases were approved under Democrat control of the legislature. Fletcher and Murray (2006) find that party control is positively associated with higher top income tax rates, higher income threshold for the first bracket of the income tax, and Democrat administrations lead to higher earned income tax credits. Chernick (2005) finds that party control by Republicans is associated with more regressive state tax structures. Rogers and Rogers (2000) also find that imperfect political competition (in this case measured by an index that depends on the share of the vote in the governor's election) leads to greater state tax revenue and spending. Thus, for the purpose of explaining the observed spending and tax policies of governments, it is important that our models incorporate how imperfections in the political arena affect the decision making process of policy.

Another important difference between the Downs' and the Wittman's models of electoral competition lies on how voters' preferences for policy are aggregated. In a representative democracy, the question of representation of preferences is central for the tradeoff between redistributive politics and efficiency. In the case of the leading model of elections, the process of preference aggregation is characterized by the tastes of the median voter, see Romer (1975, 1977), Roberts (1977), and Meltzer and Richard (1981, 1983). In the probabilistic theory of elections, voters' demands are aggregated according to voters' propensity to vote for the party (see Hettich & Winer, 1997, 1999; and Coughlin, 1992). Roemer finds that in the case of the Wittman's electoral competition when parties have perfect information of voters' preferences and policy is one-dimensional, the aggregation of interests is characterized by either: The preferences of the median voter or the interests of the party's constituency. However, the aggregation of voters' preferences in the Wittman's electoral model when parties have imperfect information on voters' preferences (when the voting behavior is probabilistic) remains an unanswered question.

To sum up, applications of the electoral competition with policy motivated parties to public finance have received little attention. In particular, Wittman's electoral competition model has not been extended to the study the tradeoff between redistributive politics and efficiency in a setting with multidimensional tax/spending policies and heterogeneity of preferences (endowments) of voters. In this context, there exists a tradeoff between parties' interests and the preferences of the electorate in determining fiscal policy. Moreover, in this setting, the aggregation of voters' preferences and the effect of the representation of voters' interests on tax design remain open questions.

In addition, empirical evidence suggests that imperfections in political competition increases spending and tax revenue under Democrat administrations. Evidence also suggests that the lack of convergence of parties' policies leads to cycles in the fiscal policies of the federal and state governments. The main focus of this essay is to find answers to the questions outlined above and to develop a model that introduces soft electoral constraints to explain tax policy and fiscal cycles.

Voters' Preferences for Tax Structure

Consider an economy with a continuum of voters-consumers. In this economy, individuals choose their consumption vector over the opportunity set and participate politically by voting for a party. We consider two candidates-parties denoted by k and $-k$

competing to form the government. Preferences and the opportunity set for individuals are characterized as follows:

$$U^{hk} = \beta\mu^{h}\left(\mathbf{x}^{h}, G_{s}^{k}\right) + \left(1-\beta\right)\varepsilon^{hk} \text{ and } \mathbf{q}^{k}\mathbf{x}^{h} = \mathbf{p}\mathbf{x}^{h} + \mathbf{c}^{h}\left(\mathbf{t}^{k}\right) \leq w^{h}L^{h} \quad \forall h \qquad (34)$$

Where U^{hk} is the overall utility of consumer *h* if party *k* forms the government. $\mu^{h}\left(\mathbf{x}^{h}, G_{s}^{k}\right)$ represents the preferences over private consumption $\mathbf{x}^{h} \in \Re^{n}$ and the public good G_{s}^{k}. The parameter ε^{hk} measures the partisan preference or attachment of consumer *h* for party *k* and β^{h} is a weighing parameter such that $\beta^{h} = \beta \in \left[0,1\right] \quad \forall h$. Equation (34) implies that the overall utility of individuals depend not only on the policies that each party might enact (through the influence of $\mathbf{t}^{k}$ on $\mathbf{x}^{h}$ and the provision of G_{s}^{k}) but also that individuals have a preference relation over the party in power. Here we adopt the Michigan school approach to partisan preference. Consequently, we assume that the voters' party identification (or preference) is learned during childhood through a process of socialization, and it is largely exogenous (not based on policy views), see Campbell et al. (1960), Miller and Shanks (1996), among others.[80]

The opportunity set is defined by consumers' price $\mathbf{q}^{k} = \mathbf{p} + \mathbf{t}^{k}$. We assume that the supply of private commodities is perfectly elastic at $p_{i} \;\forall\; i = 1, 2....n$. The producers' value is $\mathbf{p}\mathbf{x}^{h}$ and $\mathbf{c}^{h}\left(\mathbf{t}^{k}\right) = \mathbf{t}^{k}\mathbf{x}^{h}$ is the tax liability of individual *h* under tax policies $\mathbf{t}^{k} \in \Re^{n}$ proposed by party *k*, and labor income is given by $w^{h}L^{h}$.

[80] This explains why we introduce the partisan preference as an additive parameter in (34).

From (34) we can derive the indirect utility function V^{hk} :[81]

$$V^{hk} = \beta\upsilon^h\left(\mathbf{t}^k, G_s^k, y^h\right) + (1-\beta)\,\varepsilon^{hk} = Max\left\{\beta\mu^h\left(\mathbf{x}^{*h}, G_s^k\right) + (1-\beta)\,\varepsilon^{hk}\text{s.t: } \mathbf{q}^k\mathbf{x}^{*h} \le w^h L^{*h}\right\} \qquad (35)$$

From equation (35) we obtain the ideal policy of voter h (denoted as $\mathbf{t}^{*h}, G_s^{*h}$) by maximizing the indirect utility V^{hk} subject to the constraint that the public good is financed by taxation. That is, we consider voters' preference relation over the policy space constrained by the public budget condition $G_s^h = R(\mathbf{t})$, where the right hand side of the constraint is the tax revenue function $R(\mathbf{t}) = \sum_{h=1}^{n} t_i^h \int_{\forall h} x_i(\mathbf{t}^h, y)dh$, and where $x_i(\mathbf{t}^h, y)$ is the Marshallian demand which depends on full income y and tax structure. Hence, the ideal fiscal policies $\mathbf{t}^{*h}, G_s^{*h}$ for voter h can be found by:[82]

$$\underset{\{\mathbf{t}^h\}}{Max}\ \delta^h(\mathbf{t}^h, G_s^h, y^h) = V^h(\mathbf{t}^h, G_s^h, y^h)/\beta = \upsilon^h\left(\mathbf{t}^h, \sum_{h=1}^{n} t_i^h \int_{\forall h} x_i(\mathbf{t}^h, y)dh\right) + (1-\beta)/\beta\,\varepsilon^{hk} \qquad (36)$$

The indirect utility function that recognizes the opportunity budget set of the individual and the public government's constraint (that is $\delta^h\left(\mathbf{t}^h, G_s^h, y^h\right)$) is our primitive preference relation over the policy space and it is assumed to be a concave function of taxes.[83] By finding $t_i^{*h} : \partial\delta^h/\partial t_i = 0\ \forall\ t_i^*,\ i = 1,...n$ we obtain the optimal tax structure for

[81] Equation (35) is obtained by finding $\mathbf{x}^{*h} \in \text{argmax}\, U^{hk} = \beta\mu^h\left(\mathbf{x}^h, G_s^k\right) + (1-\beta)\,\varepsilon^{hk}\text{s.t: } \mathbf{q}^k\mathbf{x}^h = \mathbf{p}\mathbf{x}^h + \mathbf{c}^h\left(\mathbf{t}^k\right) \le w^h L^h$.

[82] For convenience we normalize (35) as shown in (36).

[83] Note that $\partial\delta^h/\partial t_i^k = \partial\upsilon^h/\partial t_i^k + \partial\upsilon^h/\partial G_s^k\{R_i\}$, where $R_i = \partial R(\mathbf{t})/\partial t_i^k$ is the marginal tax revenue and $\partial^2\delta^h/\partial^2 t_i^k = \partial^2\upsilon^h/\partial^2 t_i^k + \partial^2\upsilon^h/\partial^2 G_s^k\{R_i\}^2 + \partial\upsilon^h/\partial G_s^k\{R_{ii}\} \le 0$ where $\partial^2\upsilon^h/\partial^2 t_i^k \ge 0$, decreasing marginal utility on public goods implies $\partial^2\upsilon^h/\partial^2 G_s^k\{R_i\}^2 \le 0$ while $\partial\upsilon^h/\partial G_s^k\{R_{ii}\} \le 0$ if the marginal tax revenue is

voter *h* denoted as $\mathbf{t}^{*h} = [t_1^{*h}, t_2^{*h}, ...t_n^{*h}]$, while the most preferred level of the public good is obtained by using $\mathbf{t}^{*h} = [t_1^{*h}, t_2^{*h}, ...t_n^{*h}]$ into $G_s^{*h} = \sum_{i=1}^{n} t_i^{*h} \int_h x_i^h (\mathbf{t}^{*h}, y^h) dh$. Finally the utility of the individual's ideal policies is given by $\delta^{*h}(\mathbf{t}^{*h}, G_s^{*h}(\mathbf{t}^{*h}), \varepsilon^{*h})$.

Let us define $\theta^h = \Delta\varepsilon(1-\beta)/\beta = \{\varepsilon^{h,-k} - \varepsilon^{hk}\}(1-\beta)/\beta$, where $\Delta\varepsilon = \{\varepsilon^{h,-k} - \varepsilon^{hk}\}$ represents the partisan bias, θ^h is the partisan bias normalized by a factor related with the weight in which the partisan preference explains the individuals' choice of the vote. Let voters identified with the Democrat party have a preference bias $\theta < 0$ for party *k* (or Democrat party) and Republican voters have a bias $\theta > 0$ for party *–k* (or Republican party). Evidence from the American National Election Studies (ANES) suggests that Democrat (Republican) voters support high (low) spending. Moreover, voters with low (high) levels of income are identified with the Democrat (Republican) party. We use these stylized facts to characterize voters' preferences and type as follows: Let the domain of the distribution of voters' partisan type be $\theta^h \in [\underline{\theta}, \overline{\theta}]$. Also, let the most preferred level of public good for $\forall \theta^0, \theta^1 \in [\underline{\theta}, \overline{\theta}] : \theta^0 < 0 \wedge \theta^1 > 0$ be denoted as $G_s^*(\theta^0) \geq G_s^*(\theta^1)$, and $\alpha(\theta)$ represents the marginal utility of income of voter type θ. According to the available evidence from the ANES, voters' preferences for policy and parties are characterized as follows: $\forall \theta^0, \theta^1 \in [\underline{\theta}, \overline{\theta}]$: $\theta^0 \leq \theta^1 \rightarrow \upsilon_G(\theta^0) \geq \upsilon_G(\theta^1) \wedge \alpha(\theta^0) \geq \alpha(\theta^1)$: $G_s^*(\theta^0) \geq G_s^*(\theta^1)$ where $\upsilon_G(\theta)$ is the marginal utility of the public good for voter type θ, and $\text{Covariance}(\theta, y) \geq 0$ where y is full income.

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decreasing in tax rates, that is if $R_{ii} = \partial^2 R / \partial^2 t_i^k \leq 0$. Thus, concavity of $\delta^h(\mathbf{t}^h, G_s^h, y^h)$ implies that the decreasing marginal utility of public goods and decreasing marginal tax revenue dominate $\partial^2 \upsilon^h / \partial^2 t_i^k \geq 0$.

Electoral Competition between Policy Motivated Parties and the Tradeoff between Redistribution and Efficiency

In this section we characterize tax policy as a result of the electoral competition between policy motivated parties that seek to hold office. We assume parties *k* and -*k* compete by selecting fiscal policies. The parties' objective is to design fiscal policies that maximize the expected utility of a faction inside the party. Parties' platforms, however, need to recognize the electoral constraints in order to maximize the parties' chance to hold office.

Let $\pi^k\left(\mathbf{P}^k,\mathbf{P}^{-k}\right)$ be the probability of winning the election for party k where the vector $\mathbf{P}^k \in \Re^{n+1} : \mathbf{P}^k = \left[\mathbf{t}^k, G_s^k\right]$ denotes the public policies proposed by party *k* and $\mathbf{P}^{-k}$ are the policies of party -*k*. Also, assume that parties are uncertain about the voting behavior.[84] Thus, parties' system of beliefs on the voting behavior is characterized as follows: Let there exists a voter *h* with a partisan attitude θ^h and a pair of policies $\mathbf{P}^k,\mathbf{P}^{-k}$ such that the probability voter *h* votes for candidate *k* is $\Pr^{hk}$.[85] Let f^k be the probability distribution function (pdf) over $\Psi^h\left(-\theta^h\right) = \upsilon^{hk}\left(\mathbf{t}^k, G_s^k, y\right) - \upsilon^{h-k}\left(\mathbf{t}^{-k}, G_s^{-k}, y\right) - \theta^h$ which is defined as the net utility from policy and partisan issues for voter type θ^h if party *k* is elected. Note that $\upsilon^k\left(\mathbf{t}^k, G_s^k, y\right)$ is the utility for voter *h* when party *k* selects policies $\mathbf{t}^k, G_s^k$, and a similar interpretation is given to $\upsilon^{-k}\left(\mathbf{t}^{-k}, G_s^{-k}, y\right)$. Thus, $\Pr^{hk}$ is given by

[84] The choice of the vote can be influenced, among other things, by policy issues, partisan attitudes, voters' perceptions over candidates (such as candidates' religion, gender, ethnic background, honesty), and a retrospective view of candidates' performance (see Fiorina, 1997). Therefore, it is quite compelling to assume that parties do not have perfect information on the determinants of the vote.

[85] See Appendix H for the characterization of the individuals' voting calculus.

$$\Pr^{hk}\left(h\ voting\ k\right)=\Pr^{hk}\left(\upsilon^{hk}\left(\mathbf{t}^{k},G_s^{k}\right)-\upsilon^{h,-k}\left(\mathbf{t}^{-k},G_s^{-k}\right)-\theta^{h}\right)=\int_{-\infty}^{\Psi^h} f^{k}\left(\psi^{h}\right)d\psi^{h}=F^{k}\left(\Psi^{h}\left(-\theta^{h}\right)\right).$$

The expression $F^k : \mathbf{P}^k \times \mathbf{P}^{-k} \times \theta^h \to [0,1]$ is the cumulative distribution function evaluated at $\Psi^h\left(-\theta^h\right)$ for some θ^h and $\mathbf{P}^k, \mathbf{P}^{-k}$. Assume F^k is a continuous, and non decreasing function of $\Psi^h\left(-\theta^h\right)$.

For convenience of the analysis, let the distribution of types of the partisan preference be given by $\theta^h \in \left[\underline{\theta}, \overline{\theta}\right]$ where $\underline{\theta} = Min\left\{\theta^h\right\}_{\forall h}$, $\overline{\theta} = Max\left\{\theta^h\right\}_{\forall h}$ with $\underline{\theta} < 0 \wedge \overline{\theta} > 0$. Let $\forall\, \theta^h \in \left[\underline{\theta}, \overline{\theta}\right]$ there is a fraction of voters $g(\theta)$ such that

$$\forall\, h \neq h' \in g(\theta), \theta^h = \theta^{h'} = \theta : \Pr^{hk} = \Pr^{h'k} = \Pr^{\theta k}\left(\upsilon^{k}\left(\mathbf{t}^{k},G_s^{k}\right)-\upsilon^{-k}\left(\mathbf{t}^{-k},G_s^{-k}\right)-\theta\right)=\int_{-\infty}^{\Psi(-\theta)} f^{k}\left(\psi\right)d\psi$$

for $\Psi(-\theta) = \upsilon^k\left(\mathbf{t}^k, G_s^k, y\right) - \upsilon^{-k}\left(\mathbf{t}^{-k}, G_s^{-k}, y\right) - \theta$. The proportion of the expected votes is a function that aggregates the probabilities of voting for a candidate across voters' partisan type $\forall\, \theta \in \left[\underline{\theta}, \overline{\theta}\right]$. Hence, the proportion of the expected votes for party *k* is:

$$\phi^{k}\left(\mathrm{P}^{k},\mathrm{P}^{-k}\right)=\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)F^{k}\left(\Psi\left(-\theta\right)\right)d\theta \qquad (37)$$

In the same fashion the proportion of the expected vote for candidate –*k* is $\phi^{-k}\left(\mathbf{P}^{k},\mathbf{P}^{-k}\right)=\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)F^{-k}\left(-\Psi\left(\theta\right)\right)d\theta$.[86]

[86] The equation is derived as follows: A voter *h* will vote for candidate –*k* iff $-\Psi^h = \theta^h - \Delta\upsilon^h \geq 0$. The probability that a voter *h* votes for candidate -*k* is given by $\Pr^{h-k}\left(\text{voting } -k\right)=\Pr^{h-k}\left(-\Psi^{h}\right)=\Pr^{h-k}\left(\theta^{h}-\Delta\upsilon^{h}\right)=\int_{-\infty}^{-\Psi^{h}} f\left(\psi^{h}\right)d\psi^{h}=F^{-k}\left(-\Psi^{h}\left(\theta^{h}\right)\right)$. Hence the proportion of the expected vote for party $-k$ is:

$$\phi^{-k}=\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)F^{-k}\left(-\Psi\left(\theta\right)\right)d\theta \qquad (37')$$

The probability to win the election is denoted as the cumulative distribution over the plurality of parties. Let $W^k : \phi^k \times \phi^{-k} \to [0,1]$ where we assume W^k is a continuous non decreasing and concave cumulative distribution function of taxes. Let $W^{k\prime} = w^k\left(\rho^k\right) \geq 0$ be the corresponding pdf. Therefore the probability of winning the election is:

$$\pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) = \pi^k\left(\mathbf{t}^k \times G_s^k, \mathbf{t}^{-k} \times G_s^{-k}\right) = \pi^k\left(\rho^k\right) = \pi^k\left(\phi^k - \phi^{-k}\right) \tag{38}$$

Where $\rho^k = \phi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) - \phi^{-k}\left(\mathbf{P}^k, \mathbf{P}^{-k}\right)$ is the proportion of the expected plurality for party *k*. Let $\lim_{\rho^k \to -1} \pi^k\left(\rho^k\right) = 0 \wedge \lim_{\rho^k \to 1} \pi^k\left(\rho^k\right) = 1$ while $\pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) = W^k(0) = 1/2$ for $\rho^k = \phi^k - \phi^{-k} = 0$. Hence we can characterize the probability of winning the election as: [87]

$$\pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) = \int_{-\infty}^{\rho^k} w\left(\rho^k\right) d\rho = W\left[\phi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) - \phi^{-k}\left(\mathbf{P}^k, \mathbf{P}^{-k}\right)\right] \tag{39}$$

As mentioned earlier, the problem for candidate *k* is to select the tax vector and the public good that leads to the highest expected utility of the candidate subject to the spatial mobility constraints imposed by electoral competition. Formally, the problem for candidates is:

$$\begin{aligned} k:\ & \underset{\{\mathbf{t}^k, G_s^k\}}{Max}\ \Im^k = \pi^k \delta^k\left(\mathbf{t}^k, G_s^k\right) + \left\{1 - \pi^k\right\} \delta^k\left(\mathbf{t}^{-k}, G_s^{-k}\right) \quad \text{s.t:} \quad \pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) = \int_{-\infty}^{\rho^k} w^k\left(\rho^k\right) d\rho \\ -k:\ & \underset{\{\mathbf{t}^{-k}, G_s^{-k}\}}{Max}\ \Im^{-k} = \pi^{-k} \delta^{-k}\left(\mathbf{t}^{-k}, G_s^{-k}\right) + \left\{1 - \pi^{-k}\right\} \delta^k\left(\mathbf{t}^k, G_s^k\right) \quad \text{s.t:} \quad \pi^{-k}\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) = \int_{-\infty}^{\rho^{-k}} w^{-k}\left(\rho^{-k}\right) d\rho \end{aligned} \tag{40}$$

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[87] The expression for party –*k* is $\pi^{-k}\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) = \int_{-\infty}^{\rho^{-k}} w\left(\rho^{-k}\right) d\rho = W\left[\phi^{-k}\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) - \phi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right)\right]$

For party *k*, $\Im^k$ is the expected utility of candidate k , $\left\{1-\pi^k\right\}\delta^k\left(\mathbf{P}^{-k}, y^k\right)$ is the expected utility under the state in which the opposition wins and implements policies $\mathbf{t}^{-k}, G_s^{-k}$, and $\pi^k\delta^k\left(\mathbf{P}^k, y^k\right)$ is the expected utility in the state in which party *k* wins and implements policies $\mathbf{t}^k, G_s^k$. A similar interpretation is given for $\Im^{-k}$. To save space we develop the analysis of the policy platform for party *k*, while the case of party –*k* is only discussed in the interpretation of the results. The optimality conditions for the tax system proposed by party *k* are given by:

$$\left\{\Upsilon^k \int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right) f^k\left(\Psi\left(-\theta\right)\right) \frac{d\Psi}{dt_i^k} d\theta\right\}\Delta\delta^k + \pi^k\left\{\frac{d\delta^k}{dt_i^k}\right\} = 0 \;\; \forall \; t_i^{Wk} \;\; i = 1,....n \qquad (41)$$

Where $\Upsilon^k = 2w^k\left(\rho^k\right)$ and $\Delta\delta^k = \delta^k\left(\mathbf{P}^k\right) - \delta^k\left(\mathbf{P}^{-k}\right) \geq 0$. At equilibrium, the marginal gain of the candidate's spatial mobility is the marginal expected payoff for candidate *k* of holding office (the first expression in 8). The term $\pi^k\left\{\partial\delta^k / \partial t_i^k\right\}$ is the expected marginal utility change (or cost) for the candidate where $d\delta^k / dt_i^k = \partial\upsilon^k / \partial t_i^k + \left\{\partial\upsilon^k / dG_s^k\right\} R_i$ and $R_i = \partial R / \partial t_i^k$ is the marginal tax collection.

It is instructive to distinguish among the different types of policies that might arise. Hence we denote $t_i^{Dk} \in \arg\max \pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}\right) : \partial\pi^k / \partial t_i \big|_{t_i^{Dk}} = 0$ as the tax system $\mathbf{t}^{Dk}$ under the Downs' electoral equilibrium. This policy arises when electoral competition leads all parties to advance a platform that maximizes a politically aggregated welfare function. Let the vector $\mathbf{t}^D = \left[\mathbf{t}^{Dk}, \mathbf{t}^{D-k}\right]$ denote the set of policies compatible with the Downsian electoral equilibrium. Now let the vector $\mathbf{t}^W = \left[\mathbf{t}^{Wk}, \mathbf{t}^{W-k}\right]$ denotes the set of public policies derived from the Wittman's electoral competition where

t_i^{Wk} arg max $\left\{\pi^k\delta^k\left(\mathbf{t}^k\right)+\left\{1-\pi^k\right\}\delta^k\left(\mathbf{t}^{-k}\right)\right\}$: $\partial\Im^k/\partial t_i^k\big|_{t_i^{Wk}}=0$. Lastly, we define

$t_i^{*k}\in\arg\max\ \delta^k\left(\mathbf{t}^k,G_s^k,y^k\right)$: $\partial\delta^k/\partial t_i^k\big|_{t_i^{*k}}=0$ as the candidate's most preferred policy

platform leading to the set of policies $\mathbf{t}^*=\left[\mathbf{t}^{*k},\mathbf{t}^{*-k}\right]$. Following Roemer (2001) we

assume the distribution of parties' preferences are given as follows $\mathbf{t}^{*k}\geq\mathbf{t}^{*-k}$.

Now, we can proceed to analyze the properties of our model of electoral equilibrium. Rearranging the optimality conditions in (41) we characterize the tradeoff between political redistribution and efficiency as follows:

$$-\frac{\sum_{j=1}^{n}t_j^k\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)S_{ij}d\theta}{X_i}=\frac{\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)f^k\left(\Psi(-\theta)\right)\lambda d\theta+\left(\pi^k/\Upsilon^k\Delta\delta^k\right)\lambda^k}{\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)f^k\left(\Psi(-\theta)\right)\upsilon_G d\theta+\left(\pi^k/\Upsilon^k\Delta\delta^k\right)\upsilon_G^k}-\left\{\int_{\underline{\theta}}^{\bar{\theta}}\frac{\partial c}{\partial y}T(i)g(\theta)d\theta\right\}\qquad(42)$$

In (42), $\lambda=\alpha\left\{MRS_{G-x_0}-T(i)\right\}$ is the marginal utility of the net fiscal exchange for voter type θ characterized by the product of the marginal utility of income (α) and the difference between the voter's valuation of the public good in terms of the nummeraire private good x_0 (that is MRS_{G-x_0}) and the voter's tax share in tax instrument *i*, $T(i)=t_i^k x_i/t_i^k X_i$, where $X_i=\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)x_i d\theta$. The expressions $\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)f^k\left(\Psi(-\theta)\right)\lambda d\theta$ and $\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)f^k\left(\Psi(-\theta)\right)\upsilon_G d\theta$ are the marginal proportion of the expected votes from the electorate obtained from λ and the marginal utility of the public good υ_G. Similarly, λ^k and υ_G^k correspond to the marginal utility of the net fiscal exchange and the marginal utility of the public good of candidate *k*. The term $E\left[\partial c/\partial y\,T(i)\right]=\int_{\underline{\theta}}^{\bar{\theta}}\partial c/\partial y\,T(i)g(\theta)d\theta$

is the expected extra tax revenue that the government obtains as a result of redistributing one dollar to voters. The left hand side of (42) is the percentage change along the compensated demand of commodity i as a result of the tax system where $S_{ij} = \partial x_i^c / \partial t_j^k$ is the change in the compensated demand (x_i^c) due to a change in prices. The tax rule in (42) can be characterized as follows:

$$-\frac{\sum_{j=1}^{n} t_j^k \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) S_{ij} d\theta}{X_i} = \frac{\sigma^k \left[f^k(\Psi(-\theta)), \lambda \right] + \overline{f^k}(\Psi(-\theta))\bar{\lambda} + \left(\pi^k / \Delta\delta^k \, Y^k \right) \lambda^k}{\overline{f^k}(\Psi(-\theta))\bar{\upsilon}_G + \left(\pi^k / \Delta\delta^k \, Y^k \right) \upsilon_G^k} - E\left[\frac{\partial c}{\partial y} T(i) \right] \quad (43)$$

Expression (43) suggests that the efficiency-redistribution tradeoff is explained by a combination of party's own preferences over tax structure and the electoral incentives to redistribute tax burdens in favor of voters who deliver the highest expected proportion of the vote. To see this, consider the case $\pi^k \to 1$, then the tax design problem is the one describing an economy in which parties do not face electoral constraints.[88] We impose condition $\pi^k = 1$ in (40) and solve the candidate's problem to obtain:

$$\frac{\partial \delta^k \left(\mathbf{t}^k, G_s^k \right)}{\partial t_i^k} = \frac{\partial \upsilon^k}{\partial t_i^k} + \frac{\partial \upsilon^k}{\partial G_s^k} \left[\int_{\forall\theta} x_i g(\theta) d\theta + \sum_{j=1}^{n} t_j^k \int_{\forall\theta} \partial x_j / \partial t_i^k \, g(\theta) d\theta \right] = 0 \quad t_i^{*k}, \forall i \quad (44)$$

Rearranging terms, equation (44) can be expressed as follows:

$$-\frac{\sum_{j=1}^{n} t_j^k \int_{\underline{\theta}}^{\bar{\theta}} S_{ij} g(\theta) d\theta}{X_i} = \frac{\lambda^k}{\upsilon_G^k} - \int_{\underline{\theta}}^{\bar{\theta}} \frac{\partial c}{\partial y} T(i) g(\theta) d\theta \;\; \forall \; t_i^{*k}, \; i = 1, \ldots n \quad (45)$$

[88] We define the electoral constraints of a party, as the party's need to design policies with the support of a majority to win the election. If $\pi^k \to 1$, party *k*, wins the election with certainty.

In (45), $\lambda^k = \alpha^k \left[MRS^k_{G^k_s - x_0} - T^k(i) \right]$ is the marginal utility of the net fiscal exchange for candidate *k*, and υ^k_G is the marginal utility of the public good for party *k*. Equation (45) says that under the absence of electoral constrains for party *k*, the aggregation of preferences is dominated by the tastes of the representative faction inside party *k*. In this case, the tax rate over a commodity i in the most preferred tax system of candidate *k* is explained by the normalized net fiscal exchange gain (λ^k / υ^k_G) of the candidate, and the cost sharing gains delivered by the collective action ($\int_{\forall\theta} \partial c/\partial y \, T(i) \, g(\theta) \, d\theta$).

From (45), the higher λ^k / υ^k_G the higher is the ideal tax rate t^{*k}_i to be used in the tax system $\mathbf{t}^{*k} \in \Re^n$, since the net fiscal exchange gains obtained by candidate *k* are exhausted at high levels of spending on the public good and, therefore, the tax revenue to be collected is high. Fixing candidates' preferences for the public good, the lower the tax share $T^k(i)$ from tax instrument t^{*k}_i, the higher is the tax rate that candidate *k* would propose in the tax system. For instance, if party *k* represents followers with low income and commodity i is an income elastic good then $T^k(i, y^1) \geq T^k(i, y^0)$ for $y^1 \geq y^0$ (i.e the share of tax liability in good i is higher for individuals with higher levels of income). Therefore, the tax rate t^{*k}_i over an income elastic commodity that candidate *k* proposes in the tax system will be high.

The term $\int_{\underline{\theta}}^{\overline{\theta}} \partial c/\partial y \, T(i) \, g(\theta) \, d\theta$ is a weighted measure of the marginal tax revenue obtained by redistributing one dollar to all voters through the commodity tax system. From $c = \sum_{i=1}^{n} t^k_i x_i$ we obtain the marginal tax contribution of voter type θ due to an increase of one dollar income ($\partial c/\partial y = \sum_{i=1}^{n} t_i \, \partial x_i/\partial y \;\; \forall h$), and the term $T(i)$ in (45) is a weighing parameter. Hence, the higher is the marginal tax revenue obtained by redistributing one dollar to all voters through the tax system (the higher $\int_{\forall\theta} \partial c/\partial y \, T(i) \, g(\theta) \, d\theta$), the lower will be t_i^{*k} in the tax system.

Condition (45) can characterize differences in tax policies between parties *k* and –*k* that are attributed to parties' preferences over policy. If party *k* represents the preferences of a faction of voters with low income and with a high valuation of the public good, while party –*k* represents a faction of voters with high income and low valuation of spending, then according to (45) party *k* proposes a higher tax rate over an income elastic commodity compared of that proposed by party –*k*.

Equation (43) also allows us to study tax design when the electoral constraints are binding. As mentioned before, the tradeoff between efficiency and redistributive politics is explained by a combination of party's own preferences over tax structure and the electoral incentives. The relative weight for the party's preferences in determining the tradeoff between redistribution and efficiency is determined by $\pi^k / \Delta\delta^k \Upsilon^k$ in equation (43). If $\pi^k \to 0$ leads to $\pi^k / \Delta\delta^k \, \Upsilon^k \to 0$ then the electoral concerns dominate the design of the tax system for party *k*. In this case, a policy motivated party proposes a platform in which the tax rule becomes:

$$-\frac{\sum_{j=1}^{n} t_j^k \int_{\underline{\theta}}^{\overline{\theta}} g(\theta) S_{ij} \, d\theta}{X_i} = \frac{\sigma^k \left[f^k \left(\Psi(-\theta) \right), \lambda \right]}{\overline{f^k} \left(\Psi(-\theta) \right) \overline{\upsilon}_G} + \frac{\overline{\lambda}}{\overline{\upsilon}_G} - E\left[\frac{\partial c}{\partial y} T(i) \right] \;\; \forall \; t_i^{wk} \;\; i = 1, \ldots .n \qquad (46)$$

From (46), the pattern of redistributive taxation is explained by the covariance between voters' marginal probability of voting for candidate k ($f^k\left(\Psi\left(-\theta\right)\right)$) and the net fiscal exchange λ (denoted as $\sigma^k\left[f^k\left(\Psi\left(-\theta\right)\right),\lambda\right]$). Hence, party k proposes a tax system with a higher tax rate t_i^{*Wk} when the distribution of preferences for the public good and tax liabilities are such that, higher than average marginal probabilities of voting for k are positively related with higher than average (positive) net fiscal exchange gains.[89]

The relationship between the partisan preference bias, the aggregation of voters' preferences for tax policy, and the candidates' platforms can be explained as follows: From (41) the term (in the integral) $g\left(\theta\right)f^k\left(\Psi\left(-\theta\right)\right)d\Psi/dt_i^k$ is the marginal proportion of the expected vote due to a change in the well being of voter type θ. The expression $g\left(\theta\right)f^k\left(\Psi\left(-\theta\right)\right)$ represents a weighing factor that determines how responsive candidate k is to the preferences over policy of voters type θ, while $\partial\Psi/\partial t_i^k \gtreqless 0$ provides the marginal welfare change of the voter and, consequently, it shows the direction of the spatial mobility of the candidate.[90]

Now, consider two different types of citizens with a partisan bias $\theta^0,\theta^1 \in \left[\underline{\theta},\overline{\theta}\right]:\theta^0 < 0 \wedge \theta^1 > 0$ and ideal policy positions $t_i^*\left(\theta^0\right) \geq t_i^*\left(\theta^1\right)$, leading to $\Psi\left(-\theta^0\right) \geq \Psi\left(-\theta^1\right) \ \ \forall t_i^{*k}, t_i^{*-k}$. Assume the probability of the vote (F^k) is convex and, to

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[89] In this case $\sigma^k\left[f^k\left(\Psi\left(-\theta\right)\right),\lambda\right] \geq 0$, thus the higher the covariance the higher the tax rate t_i^{*k}.

[90] Suppose $\left.\partial\Psi/\partial t_i^k\right|_\theta \geq 0$, then at the margin, if candidate k increases tax rate *i,* then the candidate changes his expected proportion of the votes by $g\left(\theta\right)f^k\left(\Psi\left(-\theta\right)\right)$.

simplify let $g(\theta^0) = g(\theta^1)$, then it is satisfied $f^k\left(\Psi\left(-\theta^0\right)\right) > f^k\left(\Psi\left(-\theta^1\right)\right)$.[91] In words, controlling for the proportion of voters' type in the electorate, a Downsian candidate *k* will weigh more heavily the preferences over fiscal policies from individuals type θ^0, who have a partisan bias in favor of candidate *k* (that is, the Democrat/Republican party will weigh more heavily the preferences of Democrat/Republican voters).

If differences in the partisan preferences are also associated with differences in the ideal policy positions of voters, that is, if $\forall\, \theta^0 < \theta^1 \Rightarrow G_s^*(\theta^0) \geq G_s^*(\theta^1)$, then the provision of the public good will be closer to the ideal level of the public good of citizens with a partisan bias towards party *k* (voters type θ^0) and therefore, the provision of the public good by party *k* will be high at the Nash equilibrium. The opposite holds for the case F^k is a concave cumulative function of $\Psi(-\theta)$. Thus, for $g(\theta^0) = g(\theta^1)$ and $t_i^*(\theta^0) \geq t_i^*(\theta^1)$ leading to $\Psi(\theta^0) \geq \Psi(\theta^1)\ \ \forall t_i^{*k}, t_i^{*-k}$, and given $\mathbf{P}^k, \mathbf{P}^{-k}$ then $f^k\left(\Psi\left(-\theta^0\right)\right) < f^k\left(\Psi\left(-\theta^1\right)\right)$ for $\theta^0 < 0 \wedge \theta^1 > 0$. This implies that a Downsian candidate *k* will weigh more heavily the preferences over fiscal policies from voters type θ^1 (or voters with a partisan bias towards candidate –*k*). Therefore, the provision of the public good will be lower compared with the previous case since by assumption $t_i^*(\theta^0) \geq t_i^*(\theta^1)$.[92]

Furthermore, assume commodity i is income elastic, let F^k be a convex function, $\theta^0 < 0 \wedge \theta^1 > 0$, and $t_i^*(\theta^0) \geq t_i^*(\theta^1)$ leads to $\Psi(\theta^0) \geq \Psi(\theta^1)\ \ \forall\, t_i^{*Wk}, t_i^{*W-k}$, then it must be

[91] A convex cumulative density can be justified through an exogenous system of beliefs of parties in which loyal voters have the highest propensity to vote for the party.

[92] Since parties select policies in the region in which marginal tax revenues are positive (see Hettich & Winer, 1997,1999) then $t_i^*(\theta^0) \geq t_i^*(\theta^1) \Rightarrow G_s^*(\theta^0) \geq G_s^*(\theta^1)$ if $t_i^*(\theta^0), t_i^*(\theta^1) \in \Re^1$.

$\sigma^k\left[f^k(\Psi(-\theta)),\lambda\right]\geq 0$, which implies that party *k* proposes a tax structure in which luxury goods are taxed more heavily. In the case commodity *i* is income inelastic, the tax rate of equilibrium t_i^{*Wk} will be lower. To see this, note that by assumption $MRS_{G-x_0}\left(\theta^0\right)\geq MRS_{G-x_0}\left(\theta^1\right)$ (i.e voters with partisan bias for party *k* prefer a higher level of spending compared to the ideal expenditure of voters with a partisan attitude towards party –*k*). If commodity i is an income elastic commodity then $T(i,y^0)\geq T(i,y^1)$ for individuals with $y^1\geq y^0$ (the share of the tax liability in good i is higher for voters with higher levels of income). Data from ANES suggests that covariance$[\theta,\mathrm{y}]\geq 0$, therefore voters with a partisan bias for party *k* will be associated with lower than average shares of the tax price and therefore with higher than average values of the net fiscal exchange gains, hence $\lambda(i,y^0)\geq\lambda(i,y^1)$.[93] Furthermore, for a convex F^k, it holds $f^k\left(\Psi\left(\theta^0\right)\right)\geq f^k\left(\Psi\left(\theta^1\right)\right)$ for $\theta^0<\theta^1$. Therefore, higher than average values of $f^k\left(\Psi\left(-\theta\right)\right)$ will be associated with higher than average values of λ which implies $\sigma^k\left[f^k(\Psi(-\theta)),\lambda\right]\geq 0$. Consequently, for an income elastic commodity, the tax rate t_i^{*Wk} in the tax system proposed by party *k* will be higher.[94]

[93] The notation $\lambda(i,y^0)$ reflects the net fiscal exchange gains from tax instrument *i* when voter type θ has income y^0.

[94] A similar analysis can be made for an income inelastic good. Suppose commodity *j* is income inelastic such that $\lambda(i,y^0)\leq\lambda(i,y^1)$ is satisfied for $y^1\geq y^0$. By the convexity of $F^k\left(\Psi\left(\theta\right)\right)$, $f^k\left(\Psi\left(-\theta^0\right)\right)\geq f^k\left(\Psi\left(-\theta^1\right)\right)$ for $\theta^0<\theta^1$. Thus, higher than average $f^k\left(\Psi\left(-\theta\right)\right)$ will be associated with lower than average λ which implies $\sigma^k\left[f^k\left(\Psi\left(-\theta\right)\right),\lambda\right]\leq 0$. Therefore, for an income inelastic good, the tax rate t_j^{*k} on the tax system proposed by party *k* will be lower, the more negative is $\sigma^k\left[f^k\left(\Psi\left(-\theta\right)\right),\lambda\right]\leq 0$.

Now, let define $\overline{f^k}\left(\Psi\left(-\theta\right)\right)=\int_{\underline{\theta}}^{\bar{\theta}} g\left(\theta\right)f^k\left(\Psi\left(-\theta\right)\right)d\theta$ as the average of the marginal probability of the vote, $E[\lambda]=\int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\lambda d\theta$ as the expected net fiscal exchange across the electorate, and let define $\bar{\lambda}=\overline{f^k}(\Psi(-\theta))E[\lambda]$. By the mean value Theorem, it is satisfied $\int_{\underline{\theta}}^{\bar{\theta}} g(\theta)f^k(\Psi)\frac{\partial \upsilon}{\partial G_s^k}d\theta=\bar{\upsilon}_G\overline{f^k}(\Psi)$, where $\bar{\upsilon}_G=\overline{\partial\upsilon}/\partial G_s^k$ is a politically weighted marginal utility of the public good. Therefore, the term $\bar{\lambda}/\bar{\upsilon}_G$ represents the ratio of the politically weighted measures of the net ($\bar{\lambda}$) and gross ($\bar{\upsilon}_G$) fiscal exchange gains. The larger the ratio, the higher will be the tax rate used in the tax system since the political gains from the provision of the public good are exhausted at higher levels of public spending.

The model suggests that an increase in the willingness to pay for the public good from the electorate ($\overline{f^k}\left(\Psi\left(-\theta\right)\right)\bar{\upsilon}_G$) does not necessarily implies that the level of the public good at the political equilibrium G_s^{*k} will be higher. To see this, note that provided the numerator in (46) is positive/negative then a higher $\overline{f^k}\left(\Psi\left(-\theta\right)\right)\bar{\upsilon}_G$ tends to reduce/increase the tax rate t_i^{*Wk}.[95] Hence we conclude that an increase in the willingness to pay for the public good from the electorate does not necessarily implies that the level of the public good at the political equilibrium G_s^{*k} will be higher.

The last term $E\left[\partial c/\partial y\, T\left(i\right)\right]=\int_{\underline{\theta}}^{\bar{\theta}} \partial c/\partial y\, T\left(i\right)g\left(\theta\right)d\theta$ is the marginal tax revenue that the government expects to obtain as a result of redistributing one dollar to voters.

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95 Our interpretation requires that an increase in $\overline{f^k}\left(\Psi\left(-\theta\right)\right)\bar{\upsilon}_G$ leads unchanged $\sigma^k\left[f^k\left(\Psi\left(-\theta\right)\right),\lambda\right]$ and $\bar{\lambda}$. Otherwise, the effect of a change in the expected vote from the net fiscal exchange on t_i^{*k} is ambiguous because a change in $\overline{f^k}\left(\Psi\left(-\theta\right)\right)\bar{\upsilon}_G$ would affect σ^k and $\bar{\lambda}$.

Recall the government can induce a change in income across the electorate by changing the relative prices of commodities through the tax structure. In the equation, the individuals' share of tax contributions ($T(i)$) is a weighing factor of the marginal tax revenue ($\partial c/\partial y$) from returning one dollar to each taxpayer. From the expression in (46), the higher $E\left[\partial c/\partial y \; T(i)\right]$ the lower the tax rate t_i^{*Wk} to be used in the tax system.

So far we have analyzed the cases in which $\pi^k \rightarrow 1 \wedge \pi^k \rightarrow 0$. For the case $\pi^k \in (0,1)$, the model suggests that the efficiency-redistribution tradeoff is explained by a combination of party's own preferences over tax structure and the electoral incentives to redistribute tax burdens in favor of voters who might deliver the highest expected proportion of the vote (see equation 10). The (normalized) expected net fiscal exchange for candidate *k*, $\left(\pi^k/\Delta\delta^k\Upsilon^k\right)\lambda^k$, is positively related with t_i^{*k} since $\pi^k \geq 0$, $\Delta\delta^k \geq 0$ and $\Upsilon^k \geq 0$. The numerator of (43) reflects the tradeoff between pluralist interest and narrow representation in designing tax policy. That is, a policy motivated party balances the incentives for designing a policy with the support of a majority of the electorate (the pluralist representation of preferences), or in other words, a policy that maximizes the expected proportion of the votes (this effect is captured by $\sigma^k\left[f^k(\Psi(-\theta)),\lambda\right]$ and $\overline{f^k}\left(\Psi(-\theta)\right)\bar{\upsilon}_G$) versus a policy that maximizes the preferences of party's followers (the narrow interest of a faction inside the party determined by λ^k and υ_G^k). The relative influence of the pluralist versus narrow interest in determining policy is given by $\left(\pi^k/\Delta\delta^k\Upsilon^k\right)$. If $\left(\pi^k/\Delta\delta^k\Upsilon^k\right) \rightarrow 0$, tax policy is determined by the joint interaction of preferences over policy of all voters. In this case, a policy motivated party behaves as a Downsian party, and the electoral competition leads parties to design a policy that maximizes a politically aggregated welfare function and the tax system lies in the Pareto set. If, in contrast, $\left(\pi^{k}/\Delta\delta^{k}\Upsilon^{k}\right)\rightarrow\infty$ then party's electoral constraints are significantly softened and the party can advance its agenda on tax policy. Policy is determined by the narrow interest of groups or factions inside the party.

Assuming the ideal policy of party's followers is higher than the policy that maximizes the probability of winning the election, if $\mathbf{t}^{*k}\geq\mathbf{t}^{Dk}$, then (46) and $\pi^{k}\in\left(0,1\right)$ implies $\mathbf{t}^{*k}\geq\mathbf{t}^{Wk}\geq\mathbf{t}^{Dk}\geq\mathbf{t}^{*-k}$.[96] In other words, a policy motivated party *k* will reduce tax collections ($\mathbf{t}^{Wk}\rightarrow\mathbf{t}^{Dk}$) as the electoral constraints dominate the design of tax policy (as $\pi^{k}\rightarrow 0$). If in contrast, the electoral constraints are softened (if $\pi^{k}\rightarrow 1$) tax collections increase ($\mathbf{t}^{Wk}\rightarrow\mathbf{t}^{*k}$) and redistribution in favor of the interest of parties' followers plays a more prominent role in guiding the design of the tax system. A similar tax rule to that in (46) can be derived for party $-k$.[97] Thus, for $\mathbf{t}^{*-k}\leq\mathbf{t}^{W-k}\leq\mathbf{t}^{D-k}\leq\mathbf{t}^{*k}$, the model implies that under soft electoral constraints for candidate –*k* (if $\pi^{-k}\rightarrow 1$), party –*k* designs a policy with lower tax collections ($\mathbf{t}^{W-k}\rightarrow\mathbf{t}^{*-k}$) and efficiency dominates the design of the tax system (or equivalently, redistribution plays a less prominent role in the design of the tax system). If conversely, the electoral constraints dominate the design of tax policy (as $\pi^{-k}\rightarrow 0$) the party –*k* increases tax collections ($\mathbf{t}^{W-k}\rightarrow\mathbf{t}^{*D-k}$) and the tax policy of party –*k* lies in the Pareto set since the policy maximizes a politically aggregated welfare function.

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[96] This characterization of preferences is used by Roemer (1999, 2001).

[97] For completeness we show that the tax rule for the party –*k* is given by:

$$-\frac{\sum_{j=1}^{n}t_{j}^{-k}\int_{\underline{\theta}}^{\bar{\theta}}g\left(\theta\right)S_{ij}d\theta}{X_{i}}=\frac{\int_{\underline{\theta}}^{\bar{\theta}}g\left(\theta\right)f^{-k}\left(-\Psi\left(-\theta\right)\right)\lambda d\theta+\left(\pi^{-k}/\Delta\delta^{-k}\Upsilon^{-k}\right)\lambda^{-k}}{\int_{\underline{\theta}}^{\bar{\theta}}g\left(\theta\right)f^{-k}\left(-\Psi\left(-\theta\right)\right)\upsilon_{G}d\theta+\left(\pi^{-k}/\Delta\delta^{-k}\Upsilon^{-k}\right)\upsilon_{G}^{-k}}-\int_{\underline{\theta}}^{\bar{\theta}}\frac{\partial c}{\partial y}T\left(i\right)g\left(\theta\right)d\theta \qquad (42')$$

Electoral Constraints, Partisan Composition and Tax Design

In this section we are interested in evaluating how the distribution of voters' loyalties in the electorate affect the design of tax and spending policies proposed by parties. Data from the ANES suggests that the proportion of Democrat voters is higher than that of Republican voters for the period 1952-2004. Different distributions of the partisan preferences imply different electoral constraints for political parties. To see this, suppose a distribution in which there is a dominant coalition of Democrat voters. In this case, for any given set of parties' policies, the probability that the Democrat party wins the election is higher compared with the case of an electorate with a less dominant coalition of Democrat voters. In this case, the electoral constraints of the Democrat party are softened since a more dominant coalition of Democrat voters reduces the need of the Democrat party to design a policy with the support of a majority.

In this context, we ask the following questions: First, does the level of the public good increase (decrease) under a more (less) dominant distribution of the partisan preference? And what is the effect of alternative distributions of the partisan loyalties on the degree of progressivity of the tax system? Another relevant issue for the representation of voters' preferences is the one concerned with the heterogeneity (variance) of the partisan preferences. In particular, we are interested in analyzing the effect of the variance of the distribution of voters' loyalties on tax structure.

To compare distributions of partisan loyalties, let define the concept of first order partisan dominance, as a distribution of the partisan bias in which a higher proportion of individuals with a partisan loyalty for party k (voters type $\theta < 0$) implies a higher probability of winning the election and a reduction of the electoral constraints for party k.

Figure 3 in Appendix C provides an example; The distribution of voters' partisan attitudes in 1964 dominates the distribution in 2002. Formally, for given policy vectors $\mathbf{P}^k, \mathbf{P}^{-k} \in \mathbf{P}$, consider two cumulative distributions of party identification $G(\theta), \tilde{G}(\theta)$ such that $\tilde{G}(\theta)$ partisan-dominates $G(\theta)$. Therefore:[98]

$$G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \left[\underline{\theta}, \overline{\theta}\right] \Rightarrow \pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}, \tilde{G}(\theta)\right) \geq \pi^k\left(\mathbf{P}^k, \mathbf{P}^{-k}, G(\theta)\right)\ \forall \mathbf{P}^k, \mathbf{P}^{-k} \in \mathbf{P} \qquad (47)$$

A change in the electoral constraints faced by parties (due to a change in the composition of the partisan preferences) affects the way parties aggregate the preferences of voters over policy. To see this, note that the weight party *k* assigns to the preferences of individuals' type θ is $\varpi(\theta) = g(\theta) f^k\left(\Psi(-\theta)\right)$. A positive change in the marginal proportion of the expected votes from voters type θ ($\varpi(\theta)$) induces party *k* to propose a platform closer to the ideal policy of voters type θ. Intuition suggests that a higher $g(\theta)$ such that $G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \left[\underline{\theta}, \overline{\theta}\right]$ (the more dominant the partisan preference) the more responsive parties *k* and –*k* will be to the preferences of these type of voters.

However, a change in $g(\theta)$ modifies the whole distribution of the partisan preferences and, consequently, the distribution of $\varpi(\theta)\ \forall\theta \in \left[\underline{\theta}, \overline{\theta}\right]$. Note $\varpi(\theta)$ also depends on how $f^k\left(\Psi(-\theta)\right)$ changes along voters' type. Then it is likely that the marginal proportion of the expected votes from voters with a partisan bias towards party *k* might actually decrease with an increase in $g(\theta)$ if $f^k\left(\Psi(-\theta)\right)$ is decreasing in θ. In this case, parties would move away from the policy positions preferred by voters type

[98] For a formal proof see proposition 7 in Appendix G.

$\theta < 0$ under a more dominant composition of the electorate in which the proportion of voters type $\theta < 0$ increases.

To proceed with the analysis, we use the results from the ANES to assume $\upsilon_G\left(\theta^0\right) \geq \upsilon_G\left(\theta^1\right) \wedge \alpha\left(\theta^0\right) \geq \alpha\left(\theta^1\right) : MRS_{G_s^k - x_o}\left(\theta^0\right) \geq MRS_{G_s^k - x_o}\left(\theta^1\right)$ for $\theta^0, \theta^1 \in \left[\underline{\theta}, \bar{\theta}\right] : \theta^0 < 0 \wedge \theta^1 > 0$. That is, partisan individuals favoring party *k* are associated with lower levels of income and higher government expenditure as their ideal policy. In this case, the net marginal fiscal exchange for θ^0 will tend to be higher under a progressive tax system since $T\left(i, \theta^0\right) \leq T\left(i, \theta^1\right)$ for an income elastic commodity *i* while $MRS_{G_s^k - x_o}\left(\theta^0\right) \geq MRS_{G_s^k - x_o}\left(\theta^1\right)$ and $\alpha\left(\theta^0\right) \geq \alpha\left(\theta^1\right)$, therefore $\lambda\left(\theta^0\right) \geq \lambda\left(\theta^1\right)$. Now let the tax rate of equilibrium $t_i^{*Wk}\big|_{G(\theta)}$ be determined under the partisan distribution $G\left(\theta\right)$. Furthermore, let voters type $\underline{\theta}$ and $\bar{\theta}$ satisfy $\lambda\left(\underline{\theta}\right) \geq \lambda\left(\bar{\theta}\right)$ such that $\partial\Psi/\partial t_i^{Wk}\big|_{\underline{\theta}, t_i^{*Wk}} \geq 0$ and $\partial\Psi/\partial t_i^{Wk}\big|_{\bar{\theta}, t_i^{*Wk}} \leq 0$.[99] This assumption means that at the prevailing rate $t_i^{*Wk}\big|_{G(\theta)}$, the voter with the strongest bias for party *k* (voter type $\underline{\theta}$) prefers a higher tax on commodity *i*, or equivalently a higher degree of progressivity in the tax system, while the voter with the strongest partisan bias for party –*k* (voter type $\bar{\theta}$) prefers a lower tax on commodity *i*.

The change in the tax structure due to a change in the dominance of voters' party identification follows from condition (41). Thus, let $\mathbf{t}^{*Wk} \in \Re^1$, differentiate (41) with

[99] That is, the ideal policy of strong Democrat voters $t_i^*\left(\underline{\theta}\right)$ is higher than the policy platform of party *k* ($t_i^{*Wk}\big|_{G(\theta)}$). Thus, $\partial\Psi/\partial t_i^{Wk}\big|_{\underline{\theta}, t_i^{*Wk}} \geq 0$ implies that an increase of the tax rate increases the welfare of voters type $\underline{\theta}$, while a decrease of the tax rate increases the welfare of strong Republican or $\partial\Psi/\partial t_i^{Wk}\big|_{\bar{\theta}, t_i^{*Wk}} \leq 0$.

respect $G(\theta)\ \forall\theta\in\left[\underline{\theta},\bar{\theta}\right]$ to obtain $\frac{dt_i^{*k}}{dG(\theta)}=-\frac{\partial^2\Im^k/\partial t_i^k\partial G(\theta)}{\partial^2\Im^k/\partial^2 t_i^k}\gtrless 0$. The concavity of $\Im^k\left(\mathbf{P}^k,\mathbf{P}^{-k}\right)$ implies $-\partial^2\Im^k/\partial^2 t_i^k\geq 0$, hence $sign\left[\partial^2\Im^k/\partial t_i^k\partial G(\theta)\right]\Leftrightarrow sign\left[dt_i^{*k}/dG(\theta)\right]$.

Moreover, $G(\theta)=\int_{\underline{\theta}}^{\theta}g(\theta)d\theta$ is a non decreasing monotone function, then there is an inverse function $\chi:G(\theta)\to\theta:\ \theta=\chi\left(G(\theta)\right)\Rightarrow\chi'=\left[g(\theta)\Big|_{\underline{\theta}}^{\bar{\theta}}\right]^{-1}$ such that $\frac{\partial^2\Im^k}{\partial t_i^k\partial G(\theta)}=\frac{\partial\Im^k/\partial t_i^k}{\partial\theta}\frac{\partial\theta}{\partial G(\theta)}$. Therefore:

$$\frac{\partial^2\Im^k}{\partial t_i^k\partial G(\theta)}=\left[g\left(\bar{\theta}\right)-g\left(\underline{\theta}\right)\right]^{-1}\begin{bmatrix}\Upsilon^k\Delta\delta^k\left\{g(\theta)f^k\left(\Psi(-\theta)\right)\frac{d\Psi}{dt_i^k}\Big|_{\underline{\theta}}^{\bar{\theta}}\right\}\quad+\\ \Upsilon^{k\prime}\Delta\delta^k\left\{\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)f^k\left(\Psi(-\theta)\right)\frac{d\Psi}{dt_i^k}d\theta\right\}\left\{g(\theta)F^k\left(\Psi(-\theta)\right)\Big|_{\underline{\theta}}^{\bar{\theta}}\right\}\ +\\ \Upsilon^k\left\{g(\theta)F^k\left(\Psi(-\theta)\right)\Big|_{\underline{\theta}}^{\bar{\theta}}\right\}\left\{\frac{d\delta^k}{dt_i^k}\right\}\end{bmatrix}\qquad(48)$$

We use the optimality condition (41) in condition (48) to obtain:

$$\frac{\partial^2\Im^k}{\partial t_i^k\partial G(\theta)}=\frac{\left\{r^k\pi^k+\Upsilon^k\right\}\left\{g(\theta)F^k\left(\Psi(-\theta)\right)\Big|_{\bar{\theta}}^{\underline{\theta}}\right\}\frac{d\delta^k}{dt_i^k}+\Upsilon^k\Delta\delta^k\left\{g(\theta)f^k\left(\Psi(-\theta)\right)\frac{d\Psi}{dt_i^k}\Big|_{\bar{\theta}}^{\underline{\theta}}\right\}}{g(\underline{\theta})-g\left(\bar{\theta}\right)}\gtrless 0\qquad(49)$$

As we might have suspected an electorate dominated with a higher proportion of loyal voters for party *k* (an electorate with a higher proportion of Democrat voters) reduces the electoral constraints for party *k* and affects the way parties aggregate the preferences of the electorate. The first term in (49), $\left\{r^k\pi^k+\Upsilon^k\right\}\left\{g(\theta)F^k\left(\Psi(-\theta)\right)\Big|_{\bar{\theta}}^{\underline{\theta}}\right\}\frac{d\delta^k}{dt_i^k}$ reflects the expected variation of welfare for candidate *k* due to the change in the distribution of voters' loyalties. This term depends on the net marginal welfare of candidate *k* as a result of a change in t_i^{*k}, $d\delta^k/dt_i^k\big|_{t_i^{*Wk}} \geq 0$ since by assumption $\mathbf{t}^{*k} \geq \mathbf{t}^{*Wk}$, on the change in the expected proportion of the votes from the electorate, $g(\theta)F^k(\Psi(-\theta))\big|_{\bar{\theta}}^{\underline{\theta}}$, and on the first and second order effects of changes of θ on the probability that party *k* wins the election, i.e., on $\Upsilon^k \geq 0$, and $r^k = -\Upsilon'^k/\Upsilon^k \geq 0$. The expression $\{r^k\pi^k + \Upsilon^k\}\left\{g(\theta)F^k(\Psi(-\theta))\big|_{\underline{\theta}}^{\bar{\theta}}\right\}$ reflects the change in the expected proportion of the votes for party *k* that can be attributed to the partisan bias and party's tax platform. The expression $d\delta^k/dt_i^k\big|_{t_i^{*Wk}} \geq 0$ shows the direction of a welfare change for candidate *k*. For, $g(\theta)F^k(\Psi(-\theta))\big|_{\bar{\theta}}^{\underline{\theta}} \geq 0$, the first term in (49) moves in the direction of a welfare increase of the party, hence this expression reflects the extent in which the electoral constraints are softened when candidate *k* faces an electorate in which the proportion of voters with a partisan attitude dominates in the electorate.[100]

The second term in (49) represents the change in the way parties aggregate the preferences over policy from the electorate. Thus, for preferences $\partial\Psi/\partial t_i^{Wk}\big|_{\underline{\theta},t_i^{*Wk}} \geq 0$ and $\partial\Psi/\partial t_i^{Wk}\big|_{\bar{\theta},t_i^{*Wk}} \leq 0$, the term $g(\theta)f^k(\Psi(-\theta))d\Psi/dt_i^k\big|_{\bar{\theta}}^{\underline{\theta}} \geq 0$ is the change in the marginal proportion of the expected votes due to a more dominant distribution of loyal voters to party *k* in the electorate. In other words, an increase in the proportion of voters with a

[100] The condition $g(\theta)F^k(\Psi(-\theta))\big|_{\bar{\theta}}^{\underline{\theta}} = g(\underline{\theta})F^k(\Psi(-\underline{\theta})) - g(\bar{\theta})F^k(\Psi(-\bar{\theta})) \geq 0$ is not restrictive since empirical evidence suggests $g(\underline{\theta}) \geq g(\bar{\theta})$ and it seems reasonable that voters with the strongest bias for party *k* (voters type $\underline{\theta}$) have a higher probability of voting for party *k* than voters with the strongest partisan bias in favor of party –*k* (voters type $\bar{\theta}$). Consequently, $F^k(\Psi(-\underline{\theta})) \geq F^k(\Psi(-\bar{\theta}))$.

bias in favor of party k changes the pattern of weights assigned by the party to the preferences of voters.

This is so, since a change in $G(\theta)\ \forall\theta$ modifies both, the distribution of the partisan bias $\forall\theta$, and the marginal probability of the vote across the electorate. As a result of a more dominant partisan distribution, there is an increase in the proportion of the expected votes of loyal voters to the party and, therefore, party k increases its expected proportion of the votes by designing a platform closer to voters type $\underline{\theta}$, i.e by increasing t_i^{*Wk}. Simultaneously, a more dominant partisan distribution reduces the proportion of the expected votes for party k from voters with a bias towards party $-k$, i.e reduces $g\left(\overline{\theta}\right) f^k\left(-\Psi\left(-\overline{\theta}\right)\right)$. That is, strong Republican voters support a decrease in t_i^{*Wk}, however these type of voters are now less effective to influence party k since Republican voters deliver a lower proportion of the expected votes in the election

Lastly, the term $g(\underline{\theta})-g\left(\overline{\theta}\right)\underset{<}{\geq}0$ in (49) is a measure of the extent of the partisan dominance if $\hat{G}(\theta)\leq\tilde{G}(\theta)\ \ \forall\ \theta\in\left[\underline{\theta},\overline{\theta}\right]$. The data of the American National Election Studies shows that the proportion of individuals regarded as Strong Democrats (by our convention $g(\underline{\theta})$) is higher than the proportion of strong Republicans (or voters type $g\left(\overline{\theta}\right)$).[101] That is, the empirical data clearly suggests $\left\{\ g(\underline{\theta})-g\left(\overline{\theta}\right)\ \right\}^{-1}\geq 0$. We use this empirical data to guide the interpretation of condition (49).

[101] For the period 1952-2004 the survey from ANES provides a 7-point scale measure of the intensity of party ID. We can denote θ from $\underline{\theta}\approx$ strong Democrats to $\overline{\theta}\approx$ strong Republicans. The survey suggests that the proportion of strong Democrats has represented 19% of the electorate while the proportion of strong Republicans the 11%. The difference between strong Democrats- strong Republicans has always been non negative (that is $g(\underline{\theta})-g\left(\overline{\theta}\right)\geq 0$), with an average difference for the period 1952-2004 of 8%.

Therefore, the joint interaction of the effects discussed above induces party *k* to take a policy position closer to voters with a strong partisan bias for the party. In the case depicted above, $\partial^2\pi^k / \partial t_i^k \partial G(\theta) \geq 0$ therefore $dt_i^{*k} / dG(\theta) \geq 0$, which means, that an increase in the partisan dominance (equivalently, an increase of $G(\theta) \;\; \forall\theta \in [\underline{\theta}, \bar{\theta}]$) induces party *k* to increase the tax rate of equilibrium over commodity *i* and, consequently, the degree of progresivity of the tax system increases.

The response of party –*k* to a change in the distribution of the partisan preference is given by:

$$\frac{\partial^2\Im^{-k}}{\partial t_i^{-k}\partial G(\theta)} = \frac{\{r^{-k}\pi^{-k} + \Upsilon^{-k}\}\left\{g(\theta)F^{-k}(-\Psi(-\theta))\Big|_{\bar{\theta}}^{\underline{\theta}}\right\}\frac{d\delta^{-k}}{dt_i^{-k}} + \Upsilon^{-k}\Delta\delta^{-k}\left\{g(\theta)f^{-k}(-\Psi(-\theta))\frac{d\Psi}{dt_i^{-k}}\Big|_{\bar{\theta}}^{\underline{\theta}}\right\}}{g(\bar{\theta}) - g(\underline{\theta})} \tag{50}$$

The first expression in (50) is positive if $g(\theta)F^{-k}(-\Psi(-\theta))\Big|_{\bar{\theta}}^{\underline{\theta}} \leq 0$ (that is, if the expected proportion of votes for party –*k* from voters with a partisan bias in favor of party –*k,* exceeds those from voters with loyalties for party –*k*), since by assumption $d\delta^{-k}/dt_i^{-k}\Big|_{t_i^{*W-k}} \leq 0$, and because $\{r^{-k}\pi^{-k} + \Upsilon^{-k}\} \geq 0$. Also by assumption, $\partial\Psi/\partial t_i^{W-k}\Big|_{\underline{\theta}, t_i^{*W-k}} \geq 0$ and $\partial\Psi/\partial t_i^{W-k}\Big|_{\bar{\theta}, t_i^{*W-k}} \leq 0$, consequently the second expression in (50) is also positive. In this case, party -*k* increases the tax rate over commodity *i*, if there is an increase in the partisan dominance of Democrat voters.

The result mentioned above is intuitive, an electorate with a more dominant distribution of Democrat voters, reduces the marginal utility cost from spatial mobility for party –*k* since the probability of winning the election for this party is lower for all possible policy platforms. This, induces, even a policy motivated party, to propose a platform that seeks to appeal to a majority of voters in the electorate. Simultaneously, the second term in (50) implies that an increase of $G(\theta)\ \forall\theta\in\left[\underline{\theta},\bar{\theta}\right]$ leads to a process of aggregation of voters' preferences in which Democrat voters are more heavily weighed. Party –*k* can obtain a higher share of the vote by taking a policy position closer to Democrat voters because Democrat voters deliver a (marginally) higher proportion of the expected votes. Consequently, party –*k* increases the tax rate of equilibrium over commodity *i*.

The analysis of variance of the distribution of voters' partisan preference is of related interest to the process of preference aggregation and the formation of fiscal policy. We proceed to study the effect on fiscal policy of a mean preserving spread on the distribution of the partisan preference. Formally, an increase in the variance of the distribution of voters' loyalties is analyzed through an exogenous change in β that leads unchanged the expected bias of the electorate. To see this represents a mean preserving spread of the distribution of the partisan preference, note that a fall in β spreads the domain of θ.By keeping constant the expected bias $E(\theta)$, the fall in β is equivalent to an increase in the variance of the distribution of voters' loyalties.

Formally, find $\frac{dt_i^{*k}}{d\beta}=-\frac{\partial^2\Im^k/\partial t_i^k\partial\beta}{\partial^2\Im^k/\partial^2 t_i^k}\gtrless 0$ subject to $\frac{dE(\theta)}{d\beta}=\frac{d\int_{\underline{\theta}}^{\bar{\theta}}\theta g(\theta)d\theta}{d\beta}=0$.

Thus, $sign\left[\partial^2\Im^k/\partial t_i^k\partial\beta\right]$ s.t: $dE(\theta)/d\beta=0 \quad\Leftrightarrow sign\left[dt_i^{*k}/d\beta\right]$ s.t: $dE(\theta)/d\beta=0$.

Hence:

$$\frac{\partial^2 \Im^k}{\partial t_i^k \partial\beta} = \begin{bmatrix} \Upsilon^k \Delta\delta^k \left\{ g(\theta) f^k(\Psi(-\theta)) \dfrac{d\Psi}{dt_i^k} \dfrac{\partial\theta}{\partial\beta}\Bigg|_{\underline{\theta}}^{\bar{\theta}} \right\} \quad + \\ \Upsilon^{k\prime} \Delta\delta^k \left\{ \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(\Psi(-\theta)) \dfrac{d\Psi}{dt_i^k} d\theta \right\} \left\{ g(\theta) F^k(\Psi(-\theta)) \dfrac{\partial\theta}{\partial\beta}\Bigg|_{\underline{\theta}}^{\bar{\theta}} \right\} + \\ \Upsilon^k \left\{ g(\theta) F^k(\Psi(-\theta)) \dfrac{\partial\theta}{\partial\beta}\Bigg|_{\underline{\theta}}^{\bar{\theta}} \right\} \left\{ \dfrac{d\delta^k}{dt_i^k} \right\} \end{bmatrix} \tag{51}$$

We impose the condition $dE(\theta)/d\beta = 0 \Rightarrow \bar{\theta} g(\bar{\theta}) = (\underline{\theta}/\bar{\theta})\underline{\theta} g(\underline{\theta})$ on (51), use equation (41) and $\partial\theta/\partial\beta = -\theta/\beta(1-\beta) \quad \forall\theta \in [\underline{\theta}, \bar{\theta}]$ since $\theta = \Delta\varepsilon(1-\beta)/\beta$, to obtain:

$$\begin{aligned} \frac{\partial^2 \Im^k}{\partial t_i^k \partial\beta} = & \left\{ \frac{\underline{\theta}\, g(\underline{\theta})}{\beta(1-\beta)} \right\} \{\pi^k r^k + \Upsilon^k\} \left\{ F^k(\Psi(-\underline{\theta})) - \underline{\theta}/\bar{\theta}\; F^k(\Psi(-\bar{\theta})) \right\} \frac{d\delta^k}{dt_i^k} \\ & + \Upsilon^k \Delta\delta^k \frac{\partial[\partial\phi^k / \partial t_i^k]}{\partial\beta} \end{aligned} \tag{52}$$

Where $\underline{\theta} < 0,\ \bar{\theta} > 0 \ \wedge\ \beta(1-\beta) \geq 0$, while the expression of the second term of (52) is:

$$\frac{\partial[\partial\phi^k / \partial t_i^k]}{\partial\beta} = \left\{ \frac{1}{\beta(1-\beta)} \right\} \left\{ \underline{\theta} g(\underline{\theta}) f^k(\Psi(-\underline{\theta})) \frac{d\Psi}{dt_i^k}\Bigg|_{\underline{\theta}} - \bar{\theta} g(\bar{\theta}) f^k(\Psi(-\bar{\theta})) \frac{d\Psi}{dt_i^k}\Bigg|_{\bar{\theta}} \right\} \gtrless 0 \tag{53}$$

Equation (53) represents the electoral motivation for party *k* to change tax policy as a response of a change in β. The overall effect of an increase in the variance of the partisan bias on t_i^{*Wk} is decomposed in equation (52). The first term in (52) represents the change in the expected welfare of the candidate due to the increase in the variance of the partisan distribution.

From (52) it is simple to see that the expression

$\left\{\frac{\underline{\theta}\, g(\underline{\theta})}{\beta(1-\beta)}\right\}\left\{\pi^k r^k + \Upsilon^k\right\}\left\{F^k\left(\Psi\left(-\underline{\theta}\right)\right)-\underline{\theta}/\bar{\theta}\;\; F^k\left(\Psi\left(-\bar{\theta}\right)\right)\right\}$ reflects a normalized increase in the expected proportion of the votes for party *k* when β falls. The intuition of the expression is simple, a mean preserving increase in the dispersion of voters' partisan loyalties increases party's marginal cost of spatial mobility and therefore, candidate *k* designs a platform that is closer to the ideal policy of the party. [102,103]

The second term, that is $\Upsilon^k \Delta\delta^k \frac{\partial\left[\partial\phi^k/\partial t_i^k\right]}{\partial\beta} \gtrless 0$, is the change in the process of aggregation of voters' preferences as a result of a more heterogeneous distribution of the partisan loyalties in the electorate. A mean preserving increase in the variance of the distribution of voters' loyalties increase the weight assigned to voters type $\underline{\theta}$ by $\underline{\theta} g\left(\underline{\theta}\right) f^k\left(\Psi\left(-\underline{\theta}\right)\right) d\Psi/dt_i^k\big|_{\underline{\theta}}$ which induces candidate *k* to increase t_i^{*Wk} since $d\Psi/dt_i^k\big|_{\underline{\theta},t_i^{*Wk}} \geq 0$. Simultaneously, the increase in the variance of voters' loyalties

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[102] To see this, note $\underline{\theta}\, g(\underline{\theta})/\beta(1-\beta) \leq 0$, $\left\{\pi^k r^k + \Upsilon^k\right\} \geq 0$, $\left\{F^k\left(\Psi\left(-\underline{\theta}\right)\right)-\underline{\theta}/\bar{\theta}\;\; F^k\left(\Psi\left(-\bar{\theta}\right)\right)\right\} \geq 0$, and $d\delta^k/dt_i^k\big|_{t_i^{*Wk}} \geq 0$. Therefore, $\left\{\frac{\underline{\theta}\, g(\underline{\theta})}{\beta(1-\beta)}\right\}\left\{\pi^k r^k + \Upsilon^k\right\}\left\{F^k\left(\Psi\left(-\underline{\theta}\right)\right)-\underline{\theta}/\bar{\theta}\, F^k\left(\Psi\left(-\bar{\theta}\right)\right)\right\}\frac{d\delta^k}{dt_i^k}\bigg|_{t_i^{*Wk}} \leq 0$ which implies that an increase in the heterogeneity of voters' loyalties (a fall in β subject to $dE(\theta)/d\beta = 0$) leads to an increase in t_i^{*Wk}.

[103] Recall that the marginal cost of the spatial mobility is $\pi^k\left\{d\delta^k/dt_i^k\right\}$, if $d\pi^k/d\beta \leq 0$ then a fall of β subject to $dE(\theta)/d\beta = 0$, increases π^k which, in turn, increases the marginal cost of the spatial mobility for a policy motivated candidate. As a result, the candidate takes a policy platform closer to candidate' ideal tax policy and increases t_i^{*Wk}, since by assumption $d\delta^k/dt_i^k \geq 0$ at t_i^{*Wk}. Simultaneously, it can be verified that the marginal gain of spatial mobility (the first term in 8) falls due to a reduction of β subject to $dE(\theta)/d\beta = 0$. This effect also induces party *k* to increase t_i^{*Wk}. At the optimal condition, the marginal gain of the spatial mobility can be expressed in terms of the marginal cost of spatial mobility for candidate *k*. Thus, the two effects of an increase of the variance (the increase in candidates' marginal cost and the fall in candidates' marginal gain from of spatial mobility) are expressed in the first term of (52) as a change in the marginal cost of spatial mobility for the candidate.

increase the weight assigned to voters type $\bar{\theta}$ by $-\bar{\theta}g(\bar{\theta})f^{k}(\Psi(-\bar{\theta}))d\Psi/dt_i^k|_{\bar{\theta}}$ which induces candidate *k* to reduce t_i^{*Wk} since $d\Psi/dt_i^k|_{\bar{\theta},t_i^{*Wk}} \leq 0$.

If $F^k(\bullet)$ is convex then the first effect tends to dominate, and party *k* aggregates more heavily the preferences of voters with partisan bias for party *k* and discount the preferences of voters with loyalties towards party –*k*.[104] Accordingly, party *k* has the electoral incentive to increase t_i^{*Wk}. The opposite hold if $F^k(\bullet)$ is concave enough such that the second effect in (53) dominates and party *k* has an electoral incentive to reduce t_i^{*Wk}. Therefore, for the case of an income elastic commodity *i*, $F^k(\bullet)$ is convex, and a distribution of preferences given by $d\Psi/dt_i^k|_{\underline{\theta},t_i^{*Wk}} \geq 0$, $d\Psi/dt_i^k|_{\bar{\theta},t_i^{*Wk}} \leq 0$ and $d\delta/dt_i^k|_{t_i^{*Wk}} \geq 0$, the analysis suggest that the response of the policy motivated party *k* to a mean preserving spread on the partisan preference is $dt_i^{*k}/d\beta \leq 0$.

In other words, an increase in the variance of the partisan distribution (a fall in β subject to $dE(\theta)/d\beta = 0$) increases t_i^{*Wk}, while it is easy to verify that t_i^{*W-k} falls.[105] This means that an increase of the variance of the distribution of voters' party identification

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[104] Recall that a fall in β implies an increase of the net utility $\Psi(-\underline{\theta})$, given a pair of tax policies $\mathbf{P}^k, \mathbf{P}^{-k} \in \mathbf{P}$ for voters type $\underline{\theta}$ since the term $-\underline{\theta}$ increases. Furthermore, a fall in β reduces $\Psi(-\underline{\theta})$ for voters type $\bar{\theta}$ since the term $-\bar{\theta}$ falls. Consequently, a fall in β implies that the vote from the group of voters type $\bar{\theta}$ is more costly (since $f^k(\Psi(-\bar{\theta}))$ falls with a fall in β). For that reason, the preferences for policy of voters $\bar{\theta}$ are less heavily weighed while those of voters type $\underline{\theta}$ are more heavily weighed (since $f^k(\Psi(-\underline{\theta}))$ increases with a fall in β) in the calculus of the party.

[105] A similar expression can be found for the case of party –*k* such that $dt_i^{-k}/d\beta \geq 0$, hence party –k reduces t_i^{*W-k}. To see this, find:

$$\frac{\partial^2 \Im^{-k}}{\partial t_i^{-k}\partial\beta} = \left\{\frac{\theta\, g(\theta)}{\beta(1-\beta)}\right\}\left\{\pi^{-k}r^k + \Upsilon^{-k}\right\}\left\{F^{-k}\left(-\Psi(-\underline{\theta})\right) - \underline{\theta}/\bar{\theta}\; F^{-k}\left(-\Psi(-\bar{\theta})\right)\right\}\frac{d\delta^{-k}}{dt_i^{-k}} + \Upsilon^{-k}\Delta\delta^{-k}\frac{\partial\left[\left(\partial\phi^{-k}/\partial t_i^{-k}\right)\right]}{\partial\beta} \geq 0 \quad (52')$$

leads to a polarization of parties' platforms, that is, the Democrat party increases the tax rate (to increase redistribution) and the Republican party reduces the tax rate (to reduce redistribution).

Concluding Remarks

In a democracy, representatives are elected to design policies in favor of the electorate. However, the actual representation of preferences is the outcome of different institutions performing the aggregation of voters' interests. In this essay, we analyze the interaction between the voting behavior of a partisan electorate and the electoral competition of policy motivated parties to determine the tax structure and the provision of a public good. In this setting, the tradeoff between efficiency and political redistribution is explained by a combination of party's own preferences over tax structure and the electoral incentives to redistribute tax burdens in favor of voters who might deliver a high proportion of the expected votes.

That is, tax policy reflects two conflicting incentives: On the one hand a party seeks to win the election to implement the ideal policy of the party's constituency. On the other hand, the competition for votes forces the party to design policies that appeal to a majority and, hence, the design of policy recognizes a wider set of preferences from the electorate. The conflict between the narrow interest of the party and the pluralist preferences of the electorate on determining tax policy depends on the electoral constraints of the party.[106] In this essay we argue that voters' partisan preferences influence parties' electoral constraints since the share of the vote parties receive in an

[106] We have defined the electoral constraints of a party, as the need of a party to design policies with the support of a majority to win the election.

election is explained (at some extent) by voters' loyalties. Consequently, the party's need to design policies with the support of a majority falls when the party faces an electorate with a high proportion of loyal voters in the electorate.

Our model of electoral competition allows us to distinguish different sets of electoral constraints for parties. If a party faces soft electoral constraints (as a result of a high proportion in the electorate of loyal voters to the party) then party's dominant strategy is to select the ideal tax policy of party's constituency. Redistribution will guide the tax policy of a party that represents the interests of low income voters who support high taxes and government spending. Similarly, efficiency will dominate the design of tax structure if the party represents voters with high income who prefer low government spending.

Evidence from the ANES suggests that the American electorate is divided along these dimensions, with Democrat (Republican) followers supporting high (low) spending and having low (high) levels of income. Therefore, the tradeoff between the narrow interests of parties versus the pluralist preferences of the electorate suggests that soft electoral constraints lead to increases on tax and spending under Democrat administrations and reductions on tax and spending under Republican governments. A growing body of empirical evidence suggests the existence of tax and spending cycles in the federal and state fiscal policies in the U.S. Our theory can explain this stylized fact.

If, conversely, the electoral constraints are binding then parties have the incentive to select a tax policy with the support of the electorate to maximize party's chance to win the election. In this case, the tradeoff between redistributive politics and efficiency depends on how the party aggregates the preferences of the electorate for tax policy. The pattern of redistribution is guided by the parties' electoral incentives to maximize the net fiscal exchange gains to voters (or group of voters) that deliver a high proportion of the expected votes, while parties penalize to those voters with low expected marginal proportion of the votes. Our analysis predicts that candidates' policies do not converge since voters' loyalties induce parties to aggregate the preferences of the electorate differently.

We identify conditions in which a differential commodity tax system will be used to redistribute tax burdens in favor of individuals with a partisan bias towards the party. That is, the model predicts that under Democrat administrations taxes on income elastic goods increase while taxes on income inelastic commodities fall implying that the Democrat party has an electoral incentive to propose a commodity tax system in which redistribution plays a more prominent role than efficiency on tax design. In contrast, the Republican party has an electoral incentive to weigh less heavily redistribution (vis-à-vis efficiency). These outcomes are explained by parties' beliefs that voters with partisan loyalties deliver the highest marginal proportion of the expected votes. Evidence, indeed, suggests that the choice of the vote is heavily influenced by partisan attachments (Republican voters tend to vote for the Republican party) which supports the notion that partisan voters could have the highest propensity to vote for the party.

The theory of elections emphasizes that the observable features of individuals (preferences over policy and income) are the main determinants of fiscal outcomes. In our framework, if the electoral constraints are binding then parties' policies reflect more closely the preferences of those voters (or groups of voters) that are more effective to influence policy makers (parties). We develop a comparative analysis that seeks to capture the relative political influence of voters through the composition of the partisan identification of voters in the electorate. Our analysis suggests that under a more dominant partisan distribution of Democrat voters (in the case of a high proportion of voters identified as Democrats in the electorate), both parties design a tax platform closer to the ideal policy of Democrat voters (even when parties do not converge). Thus, a more dominant distribution of Democrat voters leads to higher redistribution and spending.

The analysis of variance of the distribution of voters' partisan loyalties is also of significant interest to the process of preference aggregation and the formation of fiscal policy. We analyze the effect on fiscal policy of a mean preserving spread on the distribution of the partisan preference. Our model identifies conditions in which an increase in the variance of the distribution of voters' loyalties leads to a polarization of parties' platforms. That is, an increase of the variance of the distribution of voters' party identification leads to the Democrat party to increase the tax rate (to increase redistribution) and the Republican party to reduce the tax rate (to reduce redistribution).

APPENDIX A. EXISTENCE OF EQUILIBRIUM FOR THE ELECTORAL GAME AND TAX STRUCTURE

In this section we identify conditions for the existence of equilibrium of the electoral game. Consider first the voter's problem. The consumer-voter is assumed to choose the most preferred consumption vector in a compact convex set and to vote for his dominant political alternative. By assumption, the utility derived from consumption is a continuous quasiconcave function and hence a maximizing vector of consumption on the feasible set is guaranteed to exist. On the other dimension of the consumer's decisions, the voter chooses among a compact set of alternatives (either to vote for the party k or its opposition) and clearly a maximizing voting choice also exists for each of the strategy policy space of the parties. Therefore the best response correspondences of the voters defined by $\{b^h\}_{h=1}^{H}$ are non empty, convex valued and upper hemicontinuous.[107]

Now consider the parties' problem. Let $\delta(\mathbf{t},\lambda)$ be the corresponding Lagrangian for the expected vote function *on* the restricted policy space as shown in (4). A sufficient condition for a maximum on $\delta(\mathbf{t},\lambda)$ is that the function be concave or equivalently its bordered Hessian matrix $\mathbf{H}^B_{\delta(\mathbf{t},\lambda)}$ over the constrained policy space be negative semidefinite, that is:

$$\mathbf{H}^B_{\delta(\mathbf{t},\lambda)} \leq 0 \tag{A1}$$

For expository purposes assume $n = 2$ so we can outline the condition (A1) in a simple context. For a two commodity economy the condition (A1) can be expressed in

[107] Equivalently, the correspondence for the voters with elements $Cs^{*h} \in b^h$ has a closed graph and it is a compact set.

terms of the determinant of the third principal minor for the bordered Hessian matrix for the Lagrangian which is defined as $\left|\mathbf{H}^{B}_{\delta(\mathbf{t},\lambda)}\right|$. First let define $\mathbf{H}^{B}_{EV(\mathbf{t})}$ and $\mathbf{H}^{B}_{R(\mathbf{t})}$ as the bordered Hessian matrices of the expected votes and revenue functions while the corresponding third principal minors are denoted by $\left|\mathbf{H}^{B}_{EV(\mathbf{t})}\right|$ and $\left|\mathbf{H}^{B}_{R(\mathbf{t})}\right|$. Therefore the sufficient second order condition for the existence of a maximum of (4) evaluated at an optimum is given by:

$$\left|\mathbf{H}^{B}_{\delta(\mathbf{t},\lambda)}\right| = \lambda^{-2}\left|\mathbf{H}^{B}_{EV(\mathbf{t})}\right| + \lambda\left|\mathbf{H}^{B}_{R(\mathbf{t})}\right| \geq 0 \qquad \text{(A1')}$$

To see this, note that by assumption the expected vote function is a concave function of taxes then it holds $\left|\mathbf{H}^{B}_{EV(\mathbf{t})}\right| = -\left(EV_i\right)^2 EV_{jj} + EV_i EV_j\left[EV_{ij} + EV_{ji}\right] - \left(EV_{jj}\right)^2 EV_{ii} \geq 0$ meaning that the bordered Hessian matrix for the expected votes function $\mathbf{H}^{B}_{EV(\mathbf{t})} \leq 0$ is negative semidefinite since the second principal minors for the bordered Hessians of the expected votes is $\left|\mathbf{H}^{B}_{EV(\mathbf{t}),S}\right| = -\left(EV_i\right)^2 \leq 0$.[108] Moreover under the assumption that the revenue function is quasiconcave then $\mathbf{H}^{B}_{R(\mathbf{t})} \leq 0$ is negative semidefinite and its determinant is equivalent to $\left|\mathbf{H}^{B}_{R(\mathbf{t})}\right| = -\left(R_i\right)^2 R_{jj} + R_i R_j\left[R_{ij} + R_{ji}\right] - \left(R_j\right)^2 R_{ii} \geq 0$ where R_i is the marginal revenue from tax instrument t_i.

Finally from the optimality conditions of (4), $\lambda = -EV_i/R_i = -EV_j/R_j \geq 0 \;\; \forall i \neq j$ is the marginal political cost of relaxing the public revenue constraint which is used on the determinants of the Hessian matrices to obtain the result in (A1'). Therefore to obtain a maximum of (4) the second order conditions in (A1) require that the bordered Hessian

[108] Where the notation used is as follows, $EV_i = \partial EV/\partial t_i$ and $EV_{ij} = \partial\left(\partial EV/\partial t_i\right)/\partial t_j^2$.

from the function of the expected vote *on* the restricted policy space given by $S^k, S^{-k} \in S^c$ be concave.[109] We assume that (A1') holds and then an interior maximum is guaranteed to exist which will be represented by the first order conditions of (4).

Since the constrained maximization problem is a quasiconcave function *on* the policy space (under the satisfaction of A1) and the strategy set is compact and convex then the best response correspondences of the candidates b^c for $c = \{k, -k\}$ are non empty, convex valued and upper hemicontinuous. By the Kakutani's fixed point Theorem the best correspondences of the players map into itself and a fixed point is guaranteed to exist. The fixed point is the Nash equilibrium of the electoral game.[110]

In this essay we will weak even more our theory by assuming that the condition (A1) holds with a strict inequality, this is assumed for convenience since it rules out a linear segment in the policy space set.[111] In the absence of this assumption we would have to compare the indirect utility level of an interior maximum with the level of utility at the extremes of the policy set. This is inconvenient to do in our model since it would force us to make a specific parametric assumption for the indirect utility function.[112] To

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[109] As it is custom in optimization problems involved with taxation, and after the work of Mirrless (1989), we need to stress the need to be careful with the interpretations derived from the first order conditions and also to point out the fragility of the satisfaction of the second order conditions. With respect the critical points in the optimality conditions Mirrless (1989) proved that the first order conditions might not even be necessary, this holds if the marginal revenue vector is an extension of the price vector $\mathbf{p}$. In this case the constraint qualifications of the constrained optimization problem are not satisfied and it is not valid to solve the problem in (4) by the means of a Lagrangian. With respect the second order conditions, Mirrless showed that the optimization problems as in (4) might not be a well behaved mathematical problem if the objective function in the constrained space is not quasiconcave for the whole range of the domain.

[110] For a more detailed proof of the existence of the electoral equilibrium for concave objective functions in the context of the probabilistic voting model see Coughlin (1992) and Enelow and Hinich (1989). See also Roemer (2001) for the existence of the Nash equilibrium in a different context to our Downsian electoral model.

[111] It is desirable to rule out this possibility because otherwise the first order conditions might not be necessary for the optimum.

[112] It also makes more difficult to characterize the notion of single peakedness of preferences for tax instruments. A difficulty that we will choose to avoid here.

avoid the former we will assume that the expected vote function *on* the restricted policy space is strictly concave.

A related point of interest is the issue of convergence of the policies of equilibrium for the candidates. We have assumed that the information sets in the game and the systems of beliefs of the candidates are the same. Moreover the policy space is also the same for both parties and by the assumption (A1) a solution to the parties' problem exists. Therefore the policy platforms at equilibrium will converge and hence $\mathbf{t}^{*k} = \mathbf{t}^{*-k} = \mathbf{t}^{*}$.[113,114] The convergence of the policy platforms implies by (5) that the expected number of votes at equilibrium is one half of the polity for each party. At this equilibrium, the elected party will be the one with the closest Euclidean distance to the most preferred position to the majority of voters. Since at equilibrium the policies will converge then now we can analyze the selection of the tax structure derived as a result of the political competition as the set of tax instruments defined in $\mathbf{t}^{k} = \left[t_1^k, t_2^k, ...t_n^k\right]$ from the government's (incumbent's party in power) problem which is characterized by:[115]

$$\begin{aligned} &\underset{\{\mathbf{t}^k,\bar{\mathbf{t}}^k,\}}{Max}\; EV^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\varphi^l\right) = \sum_{\forall \varphi^l \in \Theta} \varphi^l \Pr^{lk}\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\varphi^l\right) = \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right)\right) \\ &\text{s.t:} \quad \mathbf{t}^k, \mathbf{t}^{-k} \in S^c = \left\{ \exists \; \{t_i\}_{i=1}^n : \; \bar{R} = \sum_{i=1}^n t_i \left(\sum_{h=1}^H x_i^h\right) \right\} \end{aligned} \tag{A2}$$

The Lagrangian is given by:

$$\delta\{\mathbf{t},\lambda\} = \sum_{\forall \varphi^l \in \Theta} \varphi^l F^{lk}\left(\upsilon^l\left(\mathbf{t}^k\right) - \upsilon^l\left(\mathbf{t}^{-k}\right)\right) + \lambda\left[\sum_{i=1}^n t_i\left(\sum_{h=1}^H x_i^h\right) - R\right] \tag{A3}$$

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[113] By solving the maximization problem in (4) it can be noticed the equivalence of the solution from the first order conditions which imply that $\mathbf{t}^{*k} = \mathbf{t}^{*-k} = \mathbf{t}^{*}$.

[114] Convergence of the policy platforms at the electoral equilibrium is a general characteristic of the Downs model. For formal proofs of convergence see Coughlin (1992), and Roemer (2001).

[115] Clearly solving for the maximization problem of party *k* will be equivalent to finding the policies at equilibrium of the electoral game.

The optimality conditions are:[116]

$$-\frac{\sum_{j=1}^{n} t_j \sum_{h=1}^{n}\left(S_{ij}^h\right)}{\overline{X}_i} = \left[1-\sum_{l=1}^{L}\frac{b^l x_i^l}{\overline{X}_i}\right] \quad \forall \ t_i^* > 0 \tag{A4}$$

Where $b^l = \left(\varphi^l f^l\right)\left(\frac{\alpha^l}{\lambda}\right)+\sum_{j=1}^{n} t_j \sum_{\varphi^l \in \Theta} \varphi^l \frac{\partial x_j^l}{\partial I^l}$ where $f^l = \partial F^l / \partial \upsilon^l = \partial F^h / \partial \upsilon^h = f^h$ $\forall \ h \in \varphi^l$ and it represents the probabilistic distribution function within each group of voters, b^l represents the politically determined net marginal utility of income, $\alpha^h = \alpha^l \ \forall \ h \in \varphi^l$ is the marginal utility of income from voter h in group l, λ is the marginal cost associated with relaxing the public revenue constraint (or marginal change in parties' expected votes of having collected the last unit of revenue) while the second term represents the sum of the marginal tax contributions as the voter's income changes given by $\frac{\partial c^l}{\partial I^l} = \varphi^l \sum_{j=1}^{n} t_j \, \partial x_j^l / \partial I^l$, and $\overline{X}_i = \sum_{h=1}^{H} x_i^h$ is the aggregate consumption of commodity i.

The left hand side of (A4) is the proportional reduction in the consumption of the i^{th} commodity along the compensated demand S_{ij}^h due to a change in prices j's for voters $h = 1, 2 ... H$. The interpretation of the optimality conditions is as follows: The reduction in the compensated demand by the establishment of a tax $t_i^* > 0$ is smaller;

(a) The higher is the preference for the consumption of commodity i by individuals whose voting behavior is highly responsive to the policy issues. In other words, the

[116] The solution can also be represented as $-\left\{\sum_{j=1}^{n} t_j \sum_{h=1}^{n}\left(S_{ij}^h\right) \Big/ \overline{X}_i\right\} = \left[1-\sum_{h=1}^{H}\frac{b^h x_i^h}{\overline{X}_i}\right]$ for $t_i^* > 0 \ \ \forall i = 1, ... n$ where $b^h = \left(f^h \alpha^h\right)/\lambda + \sum_{j=1}^{n} t_j \sum_{h=1}^{H} \partial x_j^h / \partial I^h$.

tax rate t_i^* at equilibrium will be lower if the commodity i is primarily consumed by individuals with a high $f^h \;\forall\; h \in \varphi^l$.

(b) The higher is the expected number of votes delivered by group $\varphi^l \in \Theta$.

(c) The higher is the marginal utility of income of voters in group $\varphi^l \in \Theta$, and

(d) The higher is the marginal propensity to consume the taxed goods by voters in $\varphi^l \in \Theta$.

Therefore the, politically determined, optimal tax structure is given by the vector $\mathbf{t}^* = \left[t_1^* ......t_n^*\right]$ which satisfies the set of equations $i = 1, 2....n$ specified in (A3). In summary, equations (1), (6) and (A3) characterize the electoral equilibrium for this economy. Moreover the tax structure of equilibrium derived by the electoral competition is Pareto optimal.[117]

[117] Hettich and Winer (1988, 1999) were the first in analyzing the tax structure in the multidimensional case derived by a Downsian electoral competition model. Their analysis is different to the one presented here. They used the direct utility function in the implicit assumption of the candidates' expectation of the voting behavior. In their work they showed that the tax structure at equilibrium is Pareto optimal.

APPENDIX B. CHANGES IN TAX STRUCTURE DUE TO A TAX RATE LIMIT

We proceed to characterize the reaction functions of the government $r_2(\overline{t_i}),...r_n(\overline{t_i})$ that are derived within the context of electoral competition. The parties' problem if the tax rate limit were approved is:

$$\underset{\{\mathbf{t}^k\}}{Max}\ E\tilde{V}^k\left(\mathbf{t}^k,\mathbf{t}^{-k}\middle|\tilde{\alpha}_y\right)=\sum_{\forall\varphi^l\in\Theta}\varphi^l\tilde{F}^{lk}\left(\upsilon^l\left(\mathbf{t}^k\right)-\upsilon^l\left(\mathbf{t}^{-k}\right)\right)$$
$$\text{s.t}:\ i)\quad \overline{R}=\sum_{i=1}^{n}t_i^k\left(\sum_{h=1}^{H}x_i^h\right) \qquad \text{(B1)}$$
$$ii)\quad t_i=\overline{t}_i<t_i^*$$

Letting $\overline{t_i}=\overline{t_1}$ we can obtain the optimality conditions which are given by:

$$\tilde{\delta}_2=0 \quad\Rightarrow\quad \sum_{\forall\varphi^l\in\Theta}\varphi^l\tilde{F}'^{lk}\upsilon_2^l+\tilde{\lambda}R_2=0 \quad\Rightarrow\quad r_2\left(\overline{t_1}\right)$$
$$\tilde{\delta}_3=0 \quad\Rightarrow\quad \sum_{\forall\varphi^l\in\Theta}\varphi^l\tilde{F}'^{lk}\upsilon_3^l+\tilde{\lambda}R_3=0 \quad\Rightarrow\quad r_3\left(\overline{t_1}\right) \qquad \text{(B2)}$$
$$\tilde{\delta}_{\tilde{\lambda}}=0 \quad\Rightarrow\quad \sum_{j=1}^{n}t_j\left(\sum_{h=1}^{H}x_j^h\right)-\overline{R}=0 \quad\Rightarrow\quad \tilde{\lambda}\left(\overline{t_1}\right)$$

Where $R_j=\dfrac{\partial R}{\partial t_j}=\sum_{h}^{H}x_j^h+\sum_{o=1}^{n}t_o\left(\sum_{h}^{H}\dfrac{\partial x_o^h}{\partial t_j}\right)$ is the marginal revenue from tax on commodity j for $j=2,3$ and $r_2(\overline{t_1})$ and $r_3(\overline{t_1})$ are the reaction functions derived from a government seeking to maximize their expected votes and subject to a tax rate limit, and $\tilde{\lambda}\geq 0$ is the marginal political cost of relaxing the public revenue constraint. Note that the reaction function are not equal to zero, that is, the electoral competition will lead to a tax structure such that $r_2\neq t_2^*$ and $r_3\neq t_3^*$.

The second order conditions require that the Hessian for the constrained function of the proportion of the expected votes be concave. If (A1) holds then an interior maximum is guaranteed to exist and the first order conditions identify the maximizers. Totally differentiating the system in (B2) we obtain:

$$\begin{bmatrix} \tilde{\delta}_{22} & \tilde{\delta}_{23} & R_2 \\ \tilde{\delta}_{32} & \tilde{\delta}_{33} & R_3 \\ R_2 & R_3 & 0 \end{bmatrix} \begin{bmatrix} dr_2 \\ dr_3 \\ d\tilde{\lambda} \end{bmatrix} = \begin{bmatrix} -\tilde{\delta}_{21} d\overline{t_1} \\ -\tilde{\delta}_{31} d\overline{t_1} \\ -R_1 d\overline{t_1} \end{bmatrix} \qquad \text{(B3)}$$

Where $\tilde{\delta}_{33} = -\sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}'^{lk} \alpha^l \frac{\partial x_3^l}{\partial t_3} + \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}''^{lk} \left(\alpha^l \frac{\partial x_3^l}{\partial t_3} \right)^2 + \lambda R_{33} \leq 0$, similarly for changes in the tax rate of commodity two, $\tilde{\delta}_{22} = -\sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}'^{lk} \alpha^l \frac{\partial x_2^l}{\partial t_2} + \sum_{\forall \varphi^l \in \Theta} \varphi^l \tilde{F}''^{lk} \left(\alpha^l \frac{\partial x_2^l}{\partial t_2} \right)^2 + \lambda R_{22} \leq 0$. The determinant of the system is given by $\tilde{\Delta} = -(R_2)^2 \tilde{\delta}_{33} + R_2 R_3 \left[\tilde{\delta}_{23} + \tilde{\delta}_{32} \right] - (R_3)^2 \tilde{\delta}_{22} \geq 0$ due to the assumption of concavity of the constrained objective function.

Provided that $\tilde{\Delta} \neq 0$, the reaction functions $\frac{dr_2}{d\overline{t_1}}, \frac{dr_3}{d\overline{t_1}}$ are:

$$\begin{aligned} \frac{dr_2}{d\overline{t_1}} &= \frac{(R_3)^2 \tilde{\delta}_{21} - R_1 R_3 \tilde{\delta}_{23} - (R_2)^2 \tilde{\delta}_{31} + R_2 R_1 \tilde{\delta}_{33}}{\tilde{\Delta}} \\ \frac{dr_3}{d\overline{t_1}} &= \frac{(R_2)^2 \tilde{\delta}_{31} - R_2 R_1 \tilde{\delta}_{32} + R_2 R_3 \tilde{\delta}_{21} + R_3 R_1 \tilde{\delta}_{22}}{\tilde{\Delta}} \end{aligned} \qquad \text{(B4)}$$

As it is shown in (B4) the sign of the reaction function is ambiguous as we don't know the nature of the relationship between the commodities among x_1^l, x_2^l and x_3^l. That is we don't know the sign of $\tilde{\delta}_{21}$ and $\tilde{\delta}_{31}$ in order to determine $dr_2 / d\overline{t_1}$ and a similar situation holds for $dr_3/d\overline{t_1}$. Our assumption that cross price effects are zero implies

$\tilde{\delta}_{ji} = 0 \quad \forall\, j \neq i$. In this case the determinant in (B4) is reduced to

$\tilde{\Delta} = -(R_2)^2\,\tilde{\delta}_{33} - (R_3)^2\,\tilde{\delta}_{22} \geq 0$ and the reaction functions $\frac{dr_2}{d\overline{t_1}}, \frac{dr_3}{d\overline{t_1}}$ are:

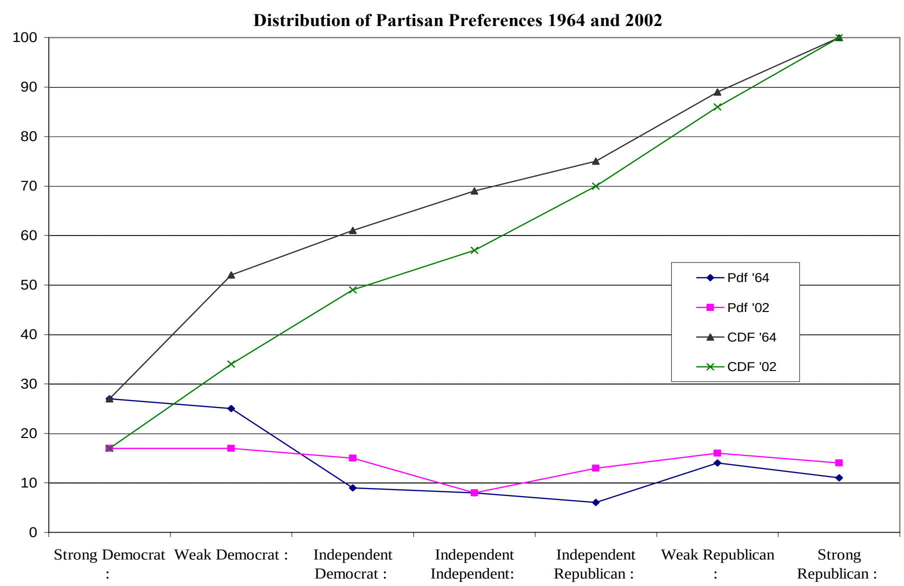
$$\begin{aligned} \frac{dr_2}{d\overline{t_1}} &= \frac{R_2 R_1 \tilde{\delta}_{33}}{\tilde{\Delta}} \leq 0 \quad \text{for } \tilde{\delta}_{33} \leq 0 \\ \frac{dr_3}{d\overline{t_1}} &= \frac{R_3 R_1 \tilde{\delta}_{22}}{\tilde{\Delta}} \leq 0 \quad \text{for } \tilde{\delta}_{22} \leq 0 \end{aligned} \tag{B5}$$

Since $\tilde{\Delta} \geq 0$, $R_1 \geq 0, R_2 \geq 0$ and $R_3 \geq 0$ and finally $\tilde{\delta}_{33} \leq 0$, $\tilde{\delta}_{22} \leq 0$. The reaction functions in (B5) are the results shown in equation (20).

APPENDIX C. PARTISAN PREFERENCES, ITS DISTRIBUTION AND STYLIZED FACTS OF THE ELECTORATE

The evidence from the American National Election Studies (ANES) provides the next stylized facts: First, the proportion of the electorate identified with the Democrat party (or Democrat voters) is higher than the proportion of voters identified as Republicans.[118] For the period 1952-2002 the average proportion of Democrats is 52%, 35% Republicans, around 11% independents and the rest apoliticals. Second, the distribution (pdf) and cumulative distribution (CDF) of the partisan preferences clearly indicates that the partisan preference is characterized by a bimodal distribution (in Figure 3 we show only the distribution for 1964 and 2002).[119]

Figure 3. Distribution of Voters' Party Identification, 7-Point Scale, 1964 and 2002



Source: The American National Election Studies, Center for Political Studies, University of Michigan. Ann Arbor, MI.

[118] The proportion is measured from the three point scale (where people are asked to identify them selves as democrats, independents or republicans) from the period 1952-2004.

[119] Binomal partisan distributions is a general feature of the partisan preference for the period 1952-2004, see data ANES.

The survey also measures the preferences of voters for government services and spending. Individuals are asked to evaluate whether public spending should be cut or increased. The survey reveals that for the period 1982-2002, from the group of voters who prefer an *increase* in government services, 42% were identified as Democrats and 21% as Republicans. Furthermore, from the group of voters who prefer a *reduction* in government services, 16% were identified as Democrats and 43% as Republicans. In other words, Democrats along the period from 1982 to 2002 have consistently being associated with preferences which support an increase in public spending and services in relation to Republicans. The surveys from the ANES also provide information that relates the distribution of income and the partisan identification of the respondents. As shown on Table 1 (shown below) voters at the low/high ranks of income have a party identification with the Democrat/Republican party.

Table 1. Partisan Preference and Distribution of Income

The information of the table reflects the proportion of voters in each percentile of the distribution of income that has a party identification with the Democrat-Republican party. The label Independent implies that the voter does not identify with a party. For instance, in the year 2000, 62% of voters on the 0-16 percentile of the distribution of income, had an identification with the Democrat party.

	Democrats	Republicans	Independents	Democrats	Republicans	Independents	Democrats	Republicans	Independents	Democrats	Republicans	Independents	Democrats	Republicans	Independents
	DISTRIBUTION OF INCOME														
Period	0-16 Percentile	0-16 Percentile	0-16 Percentile	17-33 Percentile	17-33 Percentile	17-33 Percentile	34-67 Percentile	34-67 Percentile	34-67 Percentile	68-95 Percentile	68-95 Percentile	68-95 Percentile	96-100 Percentile	96-100 Percentile	96-100 Percentile
'52	57	29	4	58	31	8	61	33	5	58	37	5	28	59	13
'54	58	25	7	55	29	11	58	33	7	58	34	6	32	63	5
'60	47	38	7	55	32	11	54	34	11	53	35	10	24	68	8
'64	65	24	9	66	24	9	66	25	8	55	38	6	44	48	8
'68	64	25	9	55	29	13	55	34	11	53	36	11	41	52	6
'72	57	30	10	53	31	16	53	30	15	49	41	10	35	52	13
'76	60	26	13	60	28	12	54	30	15	45	37	18	23	68	9
'80	60	25	11	62	26	11	50	32	16	48	41	10	32	53	13
'84	56	26	15	55	31	12	48	40	10	43	48	8	29	62	9
'88	55	30	12	53	36	10	46	41	11	42	48	9	19	77	2
'92	55	27	16	57	30	11	53	35	12	44	47	9	30	60	10
'96	63	26	10	61	31	8	52	35	11	40	52	7	41	55	4
'00	62	22	14	52	33	13	47	40	13	50	40	10	36	54	10
Mean	**58**	**27**	**11**	**57**	**30**	**11**	**54**	**34**	**11**	**49**	**41**	**9**	**32**	**59**	**8**
variance	**23**	**16**	**12**	**17**	**9**	**5**	**32**	**20**	**10**	**37**	**34**	**11**	**56**	**67**	**12**

Source: The National Election Studies, Center for Political Studies, University of Michigan. Ann Arbor, MI. The proportions might not add to 100% which reflects that some groups did not respond to the question.

*The percentiles appearing here correspond to the following:

YEAR	0-16 PERCENTILE	17-33 PERCENTILE	34-67 PERCENTILE	68-95 PERCENTILE	96-100 PERCENTILE
1952	none-$1999	$2000-2999	$3000-3999	$4000-9999	$10000+
1956	none-$1999	$2000-3999	$4000-5999	$6000-9999	$10000+
1960	none-$1999	$2000-3999	$4000-5999	$6000-14999	$15000+
1964	none-$2999	$3000-4999	$5000-7499	$7500-14999	$15000+
1968	none-$2999	$3000-5999	$6000-9999	$10000-19999	$20000+
1972	none-$3999	$4000-5999	$6000-11999	$12000-24999	$25000+
1978	none-$5999	$6000-10999	$11000-19999	$20000-34999	$35000+
1982	none-$6999	$7000-12999	$13000-24999	$25000-49999	$50000+
1986	none-$8999	$9000-14999	$15000-34999	$35000-74999	$75000+
1990	none-$9999	$10000-16999	$17000-34999	$35000-89999	$90000+
1992	none-$9999	$10000-19999	$20000-39999	$40000-89999	$90000+
1996	none-$11999	$12000-21999	$22000-49999	$50000-104999	$105000+
2000	none-$14999	$15000-34999	$35000-64999	$65000-124999	$125000+

APPENDIX D. PROPERTIES OF THE ELECTORAL EQUILIBRIUM: EXISTENCE

In this section we identify conditions for the existence of equilibrium of the electoral game. Consider first the voter's problem. The consumer is assumed to choose the most preferred consumption vector in a compact, convex set and to vote for his dominant political alternative. By assumption the utility derived from consumption is a continuous, quasiconcave function and hence a maximizing vector of consumption on the feasible set is guaranteed to exist. On the other dimension of the consumer's decision, the voter chooses among a compact set of alternatives (i.e., either to vote for party k or party -*k*) and clearly a maximizing voting choice also exists for each of the strategy policy space of parties. Therefore the best response correspondences of voters defined by $\{b^h\}_{\forall h}$ are non empty, convex valued and upper hemicontinuous.[120]

Now consider parties' problem. Assume first that the policy space is a compact convex set then a sufficient condition for a maximum of $\pi^k\left(\mathbf{P}^D, \mathbf{P}^R\right)$ $k = \{D, R\}$ is that the function of the probability of winning the election for party *k* is concave, or equivalently, the Hessian matrix $\mathbf{H}_{\pi^k\left(\mathbf{P}^D, \mathbf{P}^R\right)} \leq 0$ for $k = \{D, R\}$ over the constrained policy space is negative semidefinite.

[120] Equivalently, the best response correspondence for the voters $\{b^h\}_{\forall h}$ has a closed graph on a compact convex set.

That is:[121]

$$\mathbf{H}_{\pi^k\left(\mathbf{P}^D,\mathbf{P}^R\right)} \leq 0 \quad \forall \;\; k = \{D, R\} \tag{D1}$$

Equation (D1) represents a sufficient second order condition for a maximum to exist in the parties' electoral competition problem. We assume that (D1) holds and then an interior maximum is guaranteed to exist which will be represented by the first order conditions (equation 29). Since the maximization problem in (29) implies the maximization of a quasiconcave function on the policy space (under the satisfaction of (D1), and the strategy set is compact and convex then the best response correspondences of candidates b^k for $k = \{D, R\}$ are non empty, convex valued and upper hemicontinuous. By the Kakutani's fixed point Theorem the best correspondence of a party maps into itself and a fixed point is guaranteed to exist. The fixed point is the Nash equilibrium of the electoral game.[122] In this essay we assume that condition (D1) holds with strict inequality. This is assumed for mathematical convenience. In the absence of this assumption we would have to compare the indirect utility level of an interior maximum with the level of utility at the extremes of the policy set. This is inconvenient

[121] As it is custom in optimization problems involved with taxation, and after the work of Mirrless (1989), we need to stress the need to be careful with the interpretations derived from the first order conditions and also to point out the fragility of the satisfaction of the second order conditions. With respect the critical points in the optimality conditions, Mirrless (1989) identified situations in which the first order conditions might not even be necessary, this holds if the marginal revenue vector is an extension of the price vector $\mathbf{p}$. In his analysis the tax problem considered was a constrained maximization problem and in that case if the marginal revenue vector is an extension of the price vector $\mathbf{p}$ the constraint qualifications of the constrained optimization problem is not satisfied. Therefore, it is not valid to solve the problem in (31) by the means of a Lagrangian. With respect the second order conditions, Mirrless showed that the optimization problems as in (31) might not be well behaved mathematical problems if the objective function in the constrained space is not quasiconcave for the whole range of the domain. Nevertheless, Diamond and Mirrless (1971) identify sufficient conditions in which a critical point leads to the finding of the optimal tax system.

[122] For a detailed proof of the existence of the electoral equilibrium for concave objective functions in the context of the probabilistic voting model see Coughlin (1992) and Enelow and Hinich (1989). See also Roemer (2001) for the existence of Nash equilibrium in a different context to our Downsian electoral model.

to do in our model since it would force us to make a specific parametric assumption for the indirect utility function. To avoid the former we will assume that the function of the probability to win the election is strictly concave.

In summary, under quasiconcavity of consumers' preferences over their the feasible commodity set, (D1), and for the policy space set being a compact, convex set then the electoral equilibrium is guaranteed to exist for the n-dimensional problem. A particular case of interest is the existence of an electoral equilibrium when the function of the probability of the vote F^k for $k = \{D, R\}$ is convex on the net gain from the joint effect of policy positions and the partisan bias $\Psi(-\theta)$. The sufficient condition in (D1) implies that $\mathbf{H}_{\pi^k(\mathbf{P}^D,\mathbf{P}^R)} \leq 0 \;\; \forall \; k = \{D, R\}$, note that

$\partial^2 \pi^k / \partial^2 t_i^k \leq 0$ for $t_i^{*k} \;\; \forall i \Rightarrow \mathbf{H}_{\pi^k(\mathbf{P}^D,\mathbf{P}^R)} \leq 0 \;\; \forall \; k = \{D, R\}$ and consequently the condition (D1') (shown below) guarantees the satisfaction of the sufficient second order condition (D1):

$$\partial^2\pi^k/\partial^2 t_i^k = \Upsilon^{k\prime}\left(\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(\Psi(-\theta)) \partial\Psi/\partial t_i^k d\theta\right)^2 + \Upsilon^k\left\{\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) F^{k\prime\prime}(\Psi(-\theta))\left(\frac{\partial\Psi}{\partial t_i^k}\right)^2 d\theta + \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(\Psi(-\theta)) \frac{\partial^2\Psi}{\partial^2 t_i^k} d\theta\right\} \leq 0 \text{ for } t_i^{*k}\; i = 1,2..n \quad \text{(D1')}$$

Where the first term of the right hand side of (D1') is non positive since by assumption $\pi^k(\mathbf{P}^D, \mathbf{P}^R)$ is concave and hence $\Upsilon^{k\prime} \leq 0$, the second term is non negative since $F^{k\prime\prime} \geq 0$ under the assumption that the probability of vote is a convex function and $\Upsilon^k \geq 0$, while the third term is non increasing since $\partial^2\Psi/\partial^2 t_i^k \leq 0$ if the fiscal exchange gains depict a concave function. Therefore condition (D1) and (D1') can still be satisfied under a convex probability function of the vote over the net gain from the joint effect of policy positions and partisan bias $\Psi(-\theta)$, if the function of the probability to win the election $\pi^k(\mathbf{P}^D, \mathbf{P}^R)$ is a concave function of the tax vector $\mathbf{t}^k \ \forall k = \{D, R\}$. Hence the condition (D1') represents a sufficient condition that guarantees the existence of the electoral equilibrium when F^k is convex.

APPENDIX E. PROPOSITION 3: ELECTORAL EQUILIBRIUM AND TAX DIVERGENCE

Proposition 3. Let $i)\ \forall\ \theta^0,\theta^1 \in \left[\underline{\theta},\bar{\theta}\right]: \theta^0 < 0 \wedge \theta^1 > 0$ have ideal policies $t_i^{*\theta^0} \geq t_i^{*\theta^1}$ leading to:

$i)$ $\Psi\left(-\theta^0\right) \geq \Psi\left(-\theta^1\right)\ \forall t_i^{*D}, t_i^{*R}$.

$ii)$ $\partial\Psi/\partial t_i^k\big|_{\theta^0,t_i^{*c}} \geq 0 \wedge \partial\Psi/\partial t_i^k\big|_{\theta^1,t_i^{*c}} \leq 0$ for $c=\{D,R\}$,

$iii)$ $\upsilon^D\left(\mathbf{P}^D,\mathbf{P}^R\right) \wedge \upsilon^D\left(\mathbf{P}^D,\mathbf{P}^R\right)$ are concave on taxes.

If F^D and F^R are concave on Ψ then $t_i^{*D} \leq t_i^{*R}$, if F^D and F^R are convex $t_i^{*D} \geq t_i^{*R}$ and for bimodal cumulative distributions $t_i^{*D} \underset{<}{\geq} t_i^{*R}$.

Proof

By the first order condition $\mathbf{t}^{*D} \in \arg\max \pi^D\left(\mathbf{P}^D,\mathbf{P}^R\right)$ therefore

$\forall t_i^{*D} \in \mathbf{t}^{*D},\ \partial\pi^D/\partial t_i^D = 0\ \Rightarrow$

$$\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D\left(\Psi(-\theta)\right)\frac{d\Psi}{dt_i^D}d\theta = \sigma^D\left[f^D\left(\Psi(-\theta)\right),\frac{\partial\Psi}{\partial t_i^D}\right] + E\left[\frac{\partial\Psi}{\partial t_i^D}\right]E\left[f^D\left(\Psi(-\theta)\right)\right] = 0$$ where

$\sigma\left[f^D\left(\Psi(-\theta)\right),\frac{\partial\Psi}{\partial t_i^D}\right] = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\left\{f^D\left(\Psi(-\theta)\right) - E\left[f^D\left(\Psi(-\theta)\right)\right]\right\}\left\{\frac{\partial\Psi}{\partial t_i^D} - E\left[\frac{\partial\Psi}{\partial t_i^D}\right]\right\}d\theta$, is the covariance between $f^D\left(\Psi(-\theta)\right)$, $\partial\Psi/\partial t_i^D$, $E\left[\frac{\partial\Psi}{\partial t_i^D}\right] = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\frac{\partial\Psi}{\partial t_i^D}d\theta$, and

$E\left[f^D\left(\Psi(-\theta)\right)\right] = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^D\left(\Psi(-\theta)\right)d\theta.$

Hence:

$$E\left[\frac{\partial\Psi}{\partial t_i^D}\right]=\frac{-\sigma^D\left[f^D\left(\Psi\left(-\theta\right)\right),\frac{\partial\Psi}{\partial t_i^D}\right]}{E\left[f^D\left(\Psi\left(-\theta\right)\right)\right]} \tag{E1}$$

Similarly, for party *R*, $t_i^{*R}:\partial\pi^R/\partial t_i^R=\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)f^R\left(-\Psi\left(-\theta\right)\right)\frac{d\Psi}{dt_i^R}d\theta=0$ implies:

$$E\left[\frac{\partial\Psi}{\partial t_i^R}\right]=\frac{-\sigma^R\left[f^R\left(-\Psi\left(-\theta\right)\right),\frac{\partial\Psi}{\partial t_i^R}\right]}{E\left[f^R\left(-\Psi\left(-\theta\right)\right)\right]} \tag{E2}$$

Case I *Let F^D and F^R be concave.*

As $\theta^0\to-\infty,\ \Psi\left(-\theta^0\right)\geq\Psi\left(-\theta^1\right)\ \forall t_i^{*D},t_i^{*R}\ \Rightarrow f^D\left(\Psi\left(-\theta^0\right)\right)\leq f^D\left(\Psi\left(-\theta^1\right)\right)$

hence $\left\{f^D\left(\Psi\left(-\theta^0\right)\right)-E\left[f^D\left(\Psi\left(-\theta\right)\right)\right]\right\}\leq 0$. Moreover, by assumption

$\left\{\partial\Psi/\partial t_i^D\Big|_{\theta^0,t_i^{*D}}-E\left[\partial\Psi/\partial t_i^D\right]\Big|_{t_i^{*D}}\right\}\geq 0$. Similarly, as $\theta^1\to+\infty,\ f^D\left(\Psi\left(-\theta^0\right)\right)\leq f^D\left(\Psi\left(-\theta^1\right)\right)$

$\Rightarrow\ \left\{f^D\left(\Psi\left(-\theta^1\right)\right)-E\left[f^D\left(\Psi\left(-\theta\right)\right)\right]\right\}\geq 0$ while $\left\{\partial\Psi/\partial t_i^D\Big|_{\theta^1,t_i^{*D}}-E\left[\partial\Psi/\partial t_i^D\right]\Big|_{t_i^{*D}}\right\}\leq 0$.

Consequently, $\sigma\left[f^D\left(\Psi\left(-\theta\right)\right),\frac{\partial\Psi}{\partial t_i^D}\right]\leq 0$. In addition, since $g(\theta),f^D\left(\Psi\left(-\theta\right)\right)\in\Re_+$ then

$E\left[f^D\left(\Psi\left(-\theta\right)\right)\right]\geq 0$ and $\sigma\left[f^D\left(\Psi\left(-\theta\right)\right),\frac{\partial\Psi}{\partial t_i^D}\right]\leq 0$ imply (by E.1) that $E\left[\partial\Psi/\partial t_i^D\right]\geq 0$ at t_i^{*D}.

Now consider party *R*. As $\theta^0\to-\infty,\ -\Psi\left(-\theta^0\right)\leq\Psi-\left(-\theta^1\right)\ \forall t_i^{*D},t_i^{*R}$ since

$-\Psi\left(-\theta\right)=\upsilon^R\left(\mathbf{t}^R,G_s^R\right)-\upsilon^D\left(\mathbf{t}^D,G_s^D\right)+\theta$. By concavity of F^R, $f^R\left(-\Psi-\left(-\theta^0\right)\right)\geq f^R\left(-\Psi\left(-\theta^1\right)\right)$

$\Rightarrow \left\{ f^R\left(-\Psi\left(-\theta^0\right)\right) - E\left[f^R\left(-\Psi\left(-\theta\right)\right)\right]\right\} \geq 0$ and $\left\{ \partial\Psi/\partial t_i^R \Big|_{\theta^0, t_i^{*R}} - E\left[\partial\Psi/\partial t_i^R \right]\Big|_{t_i^{*R}} \right\} \geq 0$. Now,

as $\theta^1 \to +\infty$, $f^R\left(-\Psi\left(-\theta^0\right)\right) \geq f^R\left(-\Psi\left(-\theta^1\right)\right) \Rightarrow \left\{ f^R\left(-\Psi\left(-\theta^1\right)\right) - E\left[f^R\left(-\Psi\left(-\theta\right)\right)\right]\right\} \leq 0$

while $\left\{ \partial\Psi/\partial t_i^R \Big|_{\theta^1, t_i^{*R}} - E\left[\partial\Psi/\partial t_i^R \right]\Big|_{t_i^{*R}} \right\} \leq 0$. Consequently, $\sigma^R\left[f^R\left(\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^R} \right] \geq 0$. By

(E.2), $E\left[\partial\Psi/\partial t_i^R \right] \leq 0$ at t_i^{*R}.

Therefore, $E\left[\partial\Psi/\partial t_i^D \right] \geq 0$ at t_i^{*D}, and $E\left[\partial\Psi/\partial t_i^R \right] \leq 0$ at t_i^{*R} implies $t_i^{*D} \leq t_i^{*R}$ since the concavity of $\upsilon^D\left(\mathbf{P}^D, \mathbf{P}^R\right) \wedge \upsilon^D\left(\mathbf{P}^D, \mathbf{P}^R\right)$ imply $\Psi\left(-\theta\right)$ and $-\Psi\left(-\theta\right)$ are, respectively, concave in t_i^{*D} and t_i^{*R} .

Case II *Let F^D and F^R be convex.*

Let $\theta^0 \to -\infty$, $\Psi\left(-\theta^0\right) \geq \Psi\left(-\theta^1\right) \ \forall t_i^{*D}, t_i^{*R}$ and by convexity of F^D,

$f^D\left(\Psi\left(-\theta^0\right)\right) \to +\infty \Rightarrow \left\{ f^D\left(\Psi\left(-\theta^0\right)\right) - E\left[f^D\left(\Psi\left(-\theta\right)\right)\right]\right\} \geq 0$ and by assumption

$\left\{ \partial\Psi/\partial t_i^k \Big|_{\theta^0, t_i^{*D}} - E\left[\partial\Psi/\partial t_i^D \right]\right\} \geq 0$. Moreover, as

$\theta^1 \to +\infty, \Psi\left(-\theta^1\right) \to -\infty \Rightarrow \left\{ f^D\left(\Psi\left(-\theta^1\right)\right) - E\left[f^D\left(\Psi\left(-\theta\right)\right)\right]\right\} \leq 0$ while

$\left\{ \partial\Psi/\partial t_i^D \Big|_{\theta^1, t_i^{*D}} - E\left[\partial\Psi/\partial t_i^D \right]\right\} \leq 0$. Consequently, $\sigma\left[f^D\left(\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^D} \right] \geq 0$. By (E.1),

$\sigma\left[f^D\left(\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^D} \right] \geq 0$, and $E\left[f^D\left(\Psi\left(-\theta\right)\right)\right] \geq 0$ imply $E\left[\partial\Psi/\partial t_i^D \right] \leq 0$ at t_i^{*D}.

For party *R*, as $\theta^0 \to -\infty$, $-\Psi\left(-\theta^0\right) \le -\Psi\left(-\theta^1\right)\ \forall t_i^{*D}, t_i^{*R}$ since

$-\Psi(\theta) = \upsilon^R\left(\mathbf{t}^R, G_s^R\right) - \upsilon^D\left(\mathbf{t}^D, G_s^D\right) + \theta \Rightarrow f^R\left(-\Psi\left(-\theta^0\right)\right) \le f^R\left(-\Psi\left(-\theta^1\right)\right) \wedge f^R\left(\Psi\left(-\theta^0\right)\right) \to 0$

$\Rightarrow \left\{f^R\left(-\Psi\left(-\theta^0\right)\right) - E\left[f^R\left(-\Psi\left(-\theta\right)\right)\right]\right\} \le 0$. By assumption, $\left\{\partial\Psi/\partial t_i^R\Big|_{\theta^0, t_i^{*R}} - E\left[\partial\Psi/\partial t_i^R\right]\right\} \ge 0$.

Moreover, as $\theta^1 \to +\infty$, $f^R\left(-\Psi\left(-\theta^1\right)\right) \to +\infty \Rightarrow \left\{f^R\left(-\Psi\left(-\theta^1\right)\right) - E\left[f^R\left(-\Psi\left(-\theta\right)\right)\right]\right\} \ge 0$

while $\left\{\partial\Psi/\partial t_i^R\Big|_{\theta^1, t_i^{*R}} - E\left[\partial\Psi/\partial t_i^R\right]\right\} \le 0$. Therefore, $\sigma^R\left[f^R\left(-\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^R}\right] \le 0$. By (E.2),

$\sigma^R\left[f^R\left(-\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^R}\right] \le 0$ and $E\left[f^D\left(\Psi\left(-\theta\right)\right)\right] \ge 0$ imply $E\left[\partial\Psi/\partial t_i^R\right] \ge 0$ at t_i^{*R}.

Therefore, by the concavity of $\Psi\left(-\theta\right)$, $E\left[\partial\Psi/\partial t_i^D\right] \le 0$ at t_i^{*D}, and $E\left[\partial\Psi/\partial t_i^R\right] \ge 0$ at t_i^{*R} implies that at equilibrium $t_i^{*D} \ge t_i^{*R}$.

Case III *Let F^D and F^R be a binomial probability cumulative density function.*

Under a binomial cdf $\sigma^D\left[f^D\left(\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^D}\right] \gtreqless 0$ and $\sigma^R\left[f^R\left(-\Psi\left(-\theta\right)\right), \dfrac{\partial\Psi}{\partial t_i^R}\right] \gtreqless 0$.

Hence, $E\left[\dfrac{\partial\Psi}{\partial t_i^D}\right] \gtreqless 0 \wedge E\left[\dfrac{\partial\Psi}{\partial t_i^R}\right] \gtreqless 0$ therefore $t_i^{*D} \gtreqless t_i^{*R}$.

APPENDIX F. PROPERTIES OF THE ELECTORAL EQUILIBRIUM: SPATIAL MOBILITY

In this section we analyze whether parties' fiscal policies converge/diverge. To do so we review briefly some of the findings of the literature. For a two party game in which candidates seek to maximize their probability of winning (the Downs model), under perfect information on voters' most preferred policy positions, for the uni-dimensional policy space, all voters vote, then the Downs model suggests that parties will converge towards the mean of the policy positions, see Downs (1957) and more recently Roemer (2001). Under the case of parties' imperfect information on voters' preferences, the Downsian candidates converge to a policy that maximizes some measure of the expected vote (a, politically, aggregated welfare function), see Hinich, Ledyard and Ordeshook (1973) and Coughlin (1992). For applications of the *n*-dimensional electoral game to the tax design problem in which parties converge see Hettich and Winer (1997, 1999).

Roemer (2001) critiques the Downs model by observing that the property of convergence does not reflect the stylized fact that parties' policy positions diverge in the U.S (the empirical evidence of divergence in parties' fiscal policies is presented in the literature review of this essay). Hinich and Ordeshook (1970) shows that allowing individuals to abstain from voting and considering the case in which the candidates seeks to maximize the expected vote, then the property of convergence of the Downsian policy positions is not guaranteed.[123] Roemer (2001) shows that for policy motivated candidates, unidimensional policy, and parties' perfect information of voters' preferences for policy preferences (for the case of the Wittman electoral equilibrium) then convergence to the

[123] In particular the property of convergence depends on the pattern of abstentions and the variance of the distribution of the ideal policy positions of the voters.

median position is just one of the possible outcomes that are compatible with the political equilibrium. The median voter outcome can be upset (even in the unidimensional policy space) if the most preferred policy positions of both candidates are at the left or the right of the median policy position. Alesina and Rosenthal (1997) argues that in the Wittman equilibrium the candidates will not convergence even in the unidimensional case under imperfect information on voters' ideal policy positions.

In short, the Downsian model that abstracts from including the partisan preference (as a factor that interacts with the issue voting in determining the vote) concludes that parties' policies convergence, even in the presence of imperfect information on the voting behavior. The prediction of convergence holds for the n -dimensional case as long as we assume that all individuals vote in this economy. We proceed to analyze how our model deviates from the prediction of convergence once we include the interaction of policy issues and partisan preferences in determining the voting behavior. Before proceeding to the issue of convergence let consider proposition *4*, which says that under assumption (D1), the optimality conditions from (29) are sufficient for finding the electoral equilibrium. On what follows we denote party *D* as party *k* and party *R* as party *–k*.

Proposition 4. *Let assumption* (D1) from Appendix D *holds and policy vectors* $\mathbf{P}^{*k} = \left[\mathbf{t}^{*k}, G_s^{*k}\right] \wedge \mathbf{P}^{*-k} = \left[\mathbf{t}^{*-k}, G_s^{*-k}\right]$ *satisfy* $\mathbf{t}^{*c} \times G_s^{*c}\left(\mathbf{t}^{*c}\right) : \partial\pi^c / \partial t_i^{*c} = 0 \ \forall\, t_i^{*c}$ *for* $c = \{k, -k\}$ *then*

$$\pi^k\left(\mathbf{P}^{*k}, \mathbf{P}^{*-k}\right) \geq \pi^k\left(\mathbf{P}^k, \mathbf{P}^{*-k}\right) \ \ \forall\ \mathbf{P}^k, \mathbf{P}^{-k} \in \mathbf{P}$$
$$\pi^{-k}\left(\mathbf{P}^{*k}, \mathbf{P}^{*-k}\right) \geq \pi^{-k}\left(\mathbf{P}^{*k}, \mathbf{P}^{-k}\right) \ \forall\ \mathbf{P}^k, \mathbf{P}^{-k} \in \mathbf{P}$$

Where $\mathbf{P}$ *is the set of the policy space. Hence* $\mathbf{P}^{*k} \wedge \mathbf{P}^{*-k}$ *belongs to a pure strategy Nash equilibrium.*

Proof

(*Sufficiency*) Let $\mathbf{P}^{1k}, \mathbf{P}^{0k} \in \mathbf{P}^k$ and $\iota \in (0,1)$,by concavity of $\pi^k\left(\Psi\left(\mathbf{P}^k\right)\right)$ it holds $\pi^k\left(\Psi\left(\mathbf{P}^{\iota k}\right)\right) \geq \iota\pi^k\left(\Psi\left(\mathbf{P}^{1k}\right)\right) + (1-\iota)\pi^k\left(\Psi\left(\mathbf{P}^{0k}\right)\right)$, where $\mathbf{P}^{\iota k} = \iota\, \mathbf{P}^{1k} + (1-\iota)\mathbf{P}^{0k}$ thus:

$$\frac{\pi^k\left(\Psi\left(\mathbf{P}^{0k} + \iota(\mathbf{P}^{1k} - \mathbf{P}^{0k}\right)\right) - \pi^k\left(\Psi\left(\mathbf{P}^{0k}\right)\right)}{\iota} \geq \pi^k\left(\Psi\left(\mathbf{P}^{1k}\right)\right) - \pi^k\left(\Psi\left(\mathbf{P}^{0k}\right)\right)$$

$$\lim_{\iota\to 0}\frac{\pi^k\left(\Psi\left(\mathbf{P}^{0k} + \iota(\mathbf{P}^{1k} - \mathbf{P}^{0k}\right)\right) - \pi^k\left(\Psi\left(\mathbf{P}^{0k}\right)\right)}{\iota} = \pi^{k\prime}\left(\Psi\left(\mathbf{P}^{0k}\right)\right) \geq \pi^k\left(\Psi\left(\mathbf{P}^{1k}\right)\right) - \pi^k\left(\Psi\left(\mathbf{P}^{0k}\right)\right)$$

For $\mathbf{P}^{0k} = \mathbf{P}^{*k}$ it holds $\pi^{k\prime}\left(\Psi\left(\mathbf{P}^{*k}\right)\right) = 0$ thus $\pi^k\left(\Psi\left(\mathbf{P}^{*k}\right)\right) \geq \pi^k\left(\Psi\left(\mathbf{P}^{1k}\right)\right)$ $\forall \mathbf{P}^{1k} \in \mathbf{P}^k \wedge \iota \in (0,1)$. Similarly for $\mathbf{P}^{1,-k}, \mathbf{P}^{0,-k} \in \mathbf{P}^{-k}$, $\iota \in (0,1)$, and concavity of $\pi^{-k}\left(-\Psi\left(\mathbf{P}^{-k}\right)\right)$ it holds that $\pi^{-k\prime}\left(-\Psi\left(\mathbf{P}^{*k}\right)\right) = 0$ evaluated at $\mathbf{P}^{0,-k} = \mathbf{P}^{*,-k}$ implies $\pi^{-k}\left(-\Psi\left(\mathbf{P}^{*-k}\right)\right) \geq \pi^{-k}\left(-\Psi\left(\mathbf{P}^{1,-k}\right)\right)$. $\forall \mathbf{P}^{1,-k} \in \mathbf{P}^{-k} \wedge \iota \in (0,1)$.Therefore $\mathbf{P}^{*k}, \mathbf{P}^{*-k}$ constitute a pure strategy Nash equilibrium.[124]

■

[124] Note that an alternative sufficient condition for an electoral equilibrium that has received attention in the literature is to assume that $F^c\left(\mathbf{P}^k, \mathbf{P}^{-k}\right)$ is concave for $c = \{k, \text{-}k\}$. This assumption guarantees $\phi^k\left(\mathbf{P}^{*k}\right) \geq \phi^k\left(\mathbf{P}^{\iota k}\right)$, by the definition of the probability of winning the election $\int_{-\infty}^{\rho} w\left[2\phi^k\left(\mathbf{P}^{*k}\right) - 1\right] dw \geq \int_{-\infty}^{\rho} w\left[2\phi^k\left(\mathbf{P}^{k}\right) - 1\right] dw \ \Leftrightarrow\ \pi^{-k}\left(\mathbf{P}^{*-k}\right) \geq \pi^{-k}\left(\mathbf{P}^{\iota-k}\right)\ \forall \mathbf{P}^{\iota-k} \in \mathbf{P}^{-k} \wedge \iota \in (0,1)$.

With respect the question whether parties converge or diverge in our model with voters' loyalties, we must notice that the distribution of the partisan preferences modifies voters' probability to vote for either candidate for a given set of policy positions of the parties. A voter with a strong partisan preference for candidate *k* (a voter with a large value for $\theta < 0$) will have a higher probability to vote for party *k* than to vote for party *–k* if both candidates propose the same tax policies. A similar case stands for a voter with a large $\theta > 0$, who will have a higher probability of voting for party *–k* if both candidates propose the same policies. From the optimality conditions, it is clear that a party will weigh differently (more heavily/less heavily) the preferences of those individuals with strong partisan preferences in favor of the party when the function F^k is convex/concave. Hence a sufficient condition for convergence of the policy positions is that the probability of the vote is a uniform cumulative distribution.[125]

Proposition 5. *Let* assumption (D1) from Appendix D *be satisfied and assume the probability of voting is a continuous uniform distribution. At equilibrium parties' policies converge.*

Proof

Let (D1) holds and policy vectors and let $\mathbf{P}^{*k} = \left[\mathbf{t}^{*k}, G_s^{*k}\right] \wedge \mathbf{P}^{*-k} = \left[\mathbf{t}^{*-k}, G_s^{*-k}\right]$ satisfy $\mathbf{t}^{*c} \times G_s^{*c}\left(\mathbf{t}^{*c}\right) : \partial\pi^c / \partial t_i^{*c} = 0 \ \forall\, t_i^{*c}$ for $c = \{k, -k\}$. Hence $\mathbf{P}^{*k} \wedge \mathbf{P}^{*-k}$ belongs to a pure strategy Nash equilibrium. Policies $\mathbf{t}^{*c} \times G_s^{*c}\left(\mathbf{t}^{*c}\right) : \partial\pi^c / \partial t_i^{*c} = 0 \ \forall\, t_i^{*c}$ for $c = \{k, -k\}$, imply $\int_{\underline{\theta}}^{\overline{\theta}} g(\theta) f^k\left(\Psi(-\theta)\right) \frac{d\Psi}{dt_i^k} d\theta = 0 \wedge \int_{\underline{\theta}}^{\overline{\theta}} g(\theta) f^{-k}\left(-\Psi((-\theta))\right) \frac{d\Psi}{dt_i^{-k}} d\theta = 0$. By

[125] Another condition that would guarantee convergence is $\beta = 1$.

assumption, $F^c(\bullet)$ for $c=\{k,-k\}$ is a uniform cumulative distribution, therefore $f^k(\Psi(-\theta)) = f^{-k,}(-\Psi((-\theta))) = \xi > 0\ \forall\theta\in[\underline{\theta},\bar{\theta}]$ where $\xi =$constant. Consequently, $\int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\frac{d\Psi}{dt_i^k}d\theta = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\frac{d\Psi}{dt_i^{-k}}d\theta = 0$ at $\mathbf{P}^k = \mathbf{P}^{-k} = \mathbf{P}^* \in \mathbf{P}$. Parties' policies converge towards $\mathbf{P}^*$.

Parties' policies will not converge if the marginal probability of the vote changes with voters' partisan type. This result is shown in proposition 6.

Proposition 6. *Let* $\pi^c(\mathbf{P}^k,\mathbf{P}^{-k})$ $c=\{k,-k\}$ *be concave on taxes, let the probability distribution function* $f^c(\Psi(\theta^0)) \neq f^c(\Psi(\theta^1))$ $\forall c \wedge \theta^0,\theta^1 \in [\underline{\theta},\bar{\theta}] : \theta^0 \neq \theta^1$. *If* $\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(-\theta)\frac{\partial\Psi}{\partial t_i^k}\Big|_{\mathbf{P}^*} d\theta \neq \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^{-k}(\theta)\frac{\partial\Psi}{\partial t_i^k}\Big|_{\mathbf{P}^*} d\theta$ $\forall$ $\mathbf{P}^k = \mathbf{P}^{-k} \in \mathbf{P}$*, at equilibrium parties' policies will diverge.*

Proof

The argument is by contradiction. Suppose at equilibrium $\mathbf{P}^{*k} = \mathbf{P}^{*-k} = \mathbf{P}^*$ and $f^k(-\theta) \neq f^{-k}(\theta)\forall\theta\in[\underline{\theta},\bar{\theta}]$ leads to $\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(-\theta)\frac{\partial\Psi}{\partial t_i^k}\Big|_{\mathbf{P}^*} d\theta \neq \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^{-k}(\theta)\frac{\partial\Psi}{\partial t_i^k}\Big|_{\mathbf{P}^*} d\theta$. By assumption $\exists$ $\mathbf{t}^{*c} : \partial\pi^c / \partial t_i^{*c} = 0\ \forall t_i^{*c}$ for $c=\{k,-k\}$, by proposition 4 the policy position $\mathbf{t}^{*c}$ is a pure strategy Nash equilibrium and it is satisfied $\mathbf{P}^{*k} = \mathbf{P}^{*-k} = \mathbf{P}^*$. Since policies converge $\Delta\upsilon = \upsilon^k(\mathbf{P}^*) - \upsilon^{-k}(\mathbf{P}^*) = 0$ then $\partial\upsilon^k(\mathbf{P}^*)/\partial t_i^k = \partial\upsilon^{-k}(\mathbf{P}^*)/\partial t_i^{-k}$ at $t_i^{*k} = t_i^{*-k} = t_i^*$ $\forall$ i which implies $\partial\Psi/\partial t_i^k\big|_{\mathbf{P}^*} = \partial\Psi^{-k}/\partial t_i^{-k}\big|_{\mathbf{P}^*}$. Moreover

$\partial F^{k}/\partial\Psi\big|_{\mathbf{P}^{*}} = f^{k}\left(-\theta\right) \;\wedge\; \partial F^{-k}/\partial\Psi\big|_{\mathbf{P}^{*}} = -f^{k}\left(\theta\right)$ since $\Psi\left(\theta\right) = \Delta\upsilon\left(\mathbf{P}^{*}\right) - \theta = -\theta$, and $-\Psi\left(\theta\right) = \theta$.

The first order condition $\partial\phi^{-k}/\partial t_i^{-k}\big|_{t_i^*} = 0$ and $\partial\Psi/\partial t_i^{k}\big|_{\mathbf{P}^*} = \partial\Psi^{-k}/\partial t_i^{-k}\big|_{\mathbf{P}^*}$ imply

$\partial\phi^{k}/\partial t_i^{k}\big|_{t_i^*} - \partial\phi^{-k}/\partial t_i^{-k}\big|_{t_i^*} = \int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right)\frac{\partial\Psi}{\partial t_i^{k}}\bigg|_{\mathbf{P}^*}\left\{f^{k}\left(-\theta\right) - f^{-k}\left(\theta\right)\right\}d\theta \neq 0$ and $\partial\phi^{k}/\partial t_i^{k}\big|_{t_i^*} \neq \partial\phi^{-k}/\partial t_i^{-k}\big|_{t_i^*} = 0$ meaning that $\partial\phi^{k}/\partial t_i^{k}\big|_{t_i^*} > 0$ or $\partial\phi^{k}/\partial t_i^{k}\big|_{t_i^*} < 0$ which contradicts the notion that $\mathbf{P}^{*k} = \mathbf{P}^{*}$ belongs to the Nash equilibrium strategies for candidate k.

■

Parties' policies will converge if $\exists\ \mathbf{t}^{*c} : \partial\pi^{c}/\partial t_i^{*c} = 0\ \forall t_i^{*c}$ for $c = \left\{k, -k\right\}$, $f^{c}\left(\Psi\left(\theta^{0}\right)\right) \neq f^{c}\left(\Psi\left(\theta^{1}\right)\right)\ \forall c \;\wedge\; \theta^{0}, \theta^{1} \in \left[\underline{\theta}, \overline{\theta}\right] : \theta^{0} \neq \theta^{1}$. and if simultaneously $\int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right) f^{k}\left(-\theta\right)\frac{\partial\Psi}{\partial t_i^{k}}\bigg|_{\mathbf{P}^*} d\theta = \int_{\underline{\theta}}^{\overline{\theta}} g\left(\theta\right) f^{-k}\left(\theta\right)\frac{\partial\Psi}{\partial t_i^{k}}\bigg|_{\mathbf{P}^*} d\theta$. This is a singular (not general) condition when the marginal probability of the vote changes across voters' partisan identification. Evidence from the ANES suggests significant variations of $g\left(\theta\right)$ across voters' type and over time. These variations require a complex pattern of changes in the marginal probability of the vote, when evaluated at voters' partisan preference, to guarantee that parties' marginal proportion of the expected votes will be equal at $\mathbf{P}^{*k} = \mathbf{P}^{*-k}$. This is unlikely to become a regular condition of the electoral equilibrium. Therefore, if $f^{c}\left(\Psi\left(\theta^{0}\right)\right) \neq f^{c}\left(\Psi\left(\theta^{1}\right)\right)\ \forall c \;\wedge\; \theta^{0}, \theta^{1} \in \left[\underline{\theta}, \overline{\theta}\right] : \theta^{0} \neq \theta^{1}$, convergence is a singular condition of the electoral equilibrium.

APPENDIX G. PARTISAN DOMINANCE AND PARTIES' PROBABILITY OF WINNING THE ELECTION

Proposition 7. Consider two cumulative distributions of party identification $G(\theta),\tilde{G}(\theta)$ such that $\tilde{G}(\theta)$ partisan-dominates $G(\theta)$. Therefore:

$$G(\theta)\leq\tilde{G}(\theta)\ \forall\theta\in\left[\underline{\theta},\bar{\theta}\right]\ \Rightarrow\ \pi^{k}\left(\mathbf{P}^{k},\mathbf{P}^{-k},\tilde{G}(\theta)\right)\geq\pi^{k}\left(\mathbf{P}^{k},\mathbf{P}^{-k},G(\theta)\right)\ \forall\mathbf{P}^{k},\mathbf{P}^{-k}\in\mathbf{P}$$

Proof.

By definition of the expected proportion of the votes $\phi^{k}\left(\mathbf{P}^{k},\mathbf{P}^{-k}\right)=\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)F^{k}\left(\Psi(\theta)\right)d\theta$. Integrating by parts ϕ^{k} under partisan distributions $G(\theta)$ and $\tilde{G}(\theta)$ we obtain:

$\int_{\underline{\theta}}^{\bar{\theta}}\tilde{g}(\theta)F^{k}(\Psi)d\theta-\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)F^{k}(\Psi)d\theta=\int_{\underline{\theta}}^{\bar{\theta}}f^{k}(\Psi)\left[\tilde{G}(\theta)-G(\theta)\right]d\theta\geq 0$ since it is satisfied $\mathbf{t}^{k}\big|_{G(\theta)}=\mathbf{t}^{k}\big|_{\tilde{G}(\theta)}=\mathbf{t}\Rightarrow f^{k}\left(\Psi(\mathbf{t},\theta)\right)\big|_{G(\theta)}=f^{k}\left(\Psi(\mathbf{t},\theta)\right)\big|_{\tilde{G}(\theta)}=f^{k}\left(\Psi(\theta)\right)\geq 0$ for given policy vectors $\mathbf{P}^{k},\mathbf{P}^{-k}\in\mathbf{P}$ and since by assumption $\tilde{G}(\theta)=\int_{\underline{\theta}}^{\theta}\tilde{g}(\theta)d\theta$ and $G(\theta)=\int_{\underline{\theta}}^{\theta}g(\theta)d\theta$. such that $G(\theta)\leq\tilde{G}(\theta)\ \forall\theta\in\left[\underline{\theta},\bar{\theta}\right]$. The probability to win the election is a non decreasing function of $\phi^{k}\left(\mathbf{P}^{k},\mathbf{P}^{-k}\right)$, therefore

$\int_{\underline{\theta}}^{\bar{\theta}}\tilde{g}(\theta)F^{k}\left(\Psi(\theta)\right)d\theta\geq\int_{\underline{\theta}}^{\bar{\theta}}g(\theta)F^{k}\left(\Psi(\theta)\right)d\theta$ implies

$\pi^{k}\left(\mathbf{P}^{k},\mathbf{P}^{-k},\tilde{G}(\theta)\right)\geq\pi^{k}\left(\mathbf{P}^{k},\mathbf{P}^{-k},G(\theta)\right)\ \forall\mathbf{P}^{k},\mathbf{P}^{-k}\in\mathbf{P}$.

■

APPENDIX H. VOTING CALCULUS

As mentioned before, the individuals' vote reflects a complex calculus of parties' platforms, voters' partisan attitudes, individuals' perceptions over candidates, a retrospective (prospective) view of parties' performance, sociotropic (when the vote is influenced by a collective orientation of voters) and pocketbook voting (see Fiorina1997). We extend the analysis of Coughlin (1984, 1990a, 1992) and assume that the voting behavior is explained by parties' policies, voters' partisan attitudes and voters' perceptions over the characteristics of candidates.

To simplify, we follow Coughlin (1992) and assume parties do not know with certainty the voters' perception over candidates' characteristics. Let the partisan attitude of voter *h* be θ^h, while $\upsilon^k\left(\mathbf{t}^k, G_s^k, y\right)$ and $\upsilon^{-k}\left(\mathbf{t}^{-k}, G_s^{-k}, y\right)$ are, respectively, the utilities for voter *h* when parties *k* and *–k* select policies $\mathbf{t}^k, G_s^k$ and $\mathbf{t}^{-k}, G_s^{-k}$, and $\zeta^{hk}, \zeta^{h,-k}$ reflects an unknown preference relation of voter *h* over the candidates' sociological features (religion, gender, ethnic background). Therefore, voter *h* will vote for party *k* if $\Psi^h\left(-\theta^h\right) = \upsilon^k\left(\mathbf{t}^k, G_s^k, y\right) - \upsilon^{-k}\left(\mathbf{t}^{-k}, G_s^{-k}, y\right) - \theta^h > \zeta^{h,-k} - \zeta^{hk}$, individual *h* votes for party -*k* if the inequality is reversed, and voter *h* is indifferent if $\Psi^h\left(-\theta^h\right) = \zeta^{h,-k} - \zeta^{hk}$. We assume $\Delta\zeta^h = \zeta^{h,-k} - \zeta^{hk}$ is a random variable with $E\left[\Delta\zeta^h\right] = 0$. Let f^k be the probability distribution function over $\Psi^h\left(-\theta\right)$. Therefore, the probability that a voter *h* with a partisan attitude θ^h and pair of policies $\mathbf{P}^k, \mathbf{P}^{-k}$ votes for candidate *k* is

$$\Pr^{hk} = \int_{-\infty}^{\Psi^h\left(-\theta^h\right)} f^k\left(\psi^h\right) d\psi^h .$$

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