Análisis Económico
Núm. 64, vol. XXVII
Primer cuatrimestre de 2012

Electoral competition, tax design and the tradeoff between redistribution and efficiency

(Recibido: agosto/011–aprobado: febrero/012)

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Resumen

This paper analyzes a political economy model of taxation in which political parties design the provision of a public good and the structure of a commodity tax system to maximize votes in the election. In this economy the individuals' vote choice is determined by parties' policies and voters' partisan preferences. In our model, voters' partisan preferences are a form of political heterogeneity that helps to explain the votes distribution in the election and influences parties' fiscal policy design. It also predicts that left parties have a purely electoral incentive to propose a commodity tax system in which income redistribution plays a more prominent role than efficiency in guiding the design of the tax structure and public spending is high. In contrast, right parties have an electoral incentive to weigh less heavily redistribution in tax design and spending is lower compared with the provision of the public good under administrations ruled by left parties. These predictions explain stylized facts suggesting that left (right) parties tend to implement more (less) progressive tax systems. Our paper also contributes to the literature of taxation by providing a new set of empirically verifiable propositions on the role of electoral competition on the government's design of a tax structure.

Palabras clave: efficiency, redistribution, public goods, elections.
Clasificación JEL: H21, H23, H41, D72.

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Introduction

The tradeoff between equity and efficiency in the analysis of optimal taxation is at the core of public economics theory (for a survey of the optimal tax theory see Auerbach & Hines: 2002). In tax design, this tradeoff shapes the decisions of benevolent social planners in the following way. First, by equity considerations, such planner might have incentives to raise government's tax revenue by increasing a tax rate in order to redistribute income or provide goods and services that might contribute to a more equitable distribution of consumption in the economy. Second, by efficiency considerations, the mentioned planner might have incentives to reduce the tax rate if the deadweight costs of taxation (caused by the negative behavioral incentives created by taxes) are significant.

The analysis of the normative theory of taxation ignores the role of political competition and political institutions in tax design. However, empirical evidence –see for instance Alesina, Roubini *et al.* (1999), Persson & Tabellini (2003), Hettich & Winer (1997)– shows that the parties' political competition for votes and the political institutions of a representative democracy have a strong and significant influence on the design of fiscal policy (taxes and public spending). Moreover, in a democracy, political parties perform the important role of aggregating voters' preferences for public policies. The issue of preference representation is central to give legitimacy to governments in a representative democracy, and also central in the design of fiscal policies since the aggregation of voters' interests is closely related with the tradeoff between efficiency and redistribution and the size and composition of government expenditure.

Once we consider that policy makers –candidates of some parties– might face electoral constraints, then it is not clear that the equity-efficiency tradeoff analyzed in the normative theory of public economics might arise in fiscal policy design.[1] Instead, candidates are likely to recognize an electoral incentive to redistribute tax burdens and income while designing the tax structure. Furthermore, rational candidates are also likely to recognize that government's tax policy leads to negative behavioral responses from individuals whom in turn reduce the well being of voters and their electoral support for some parties in elections. Hence, in the context

[1] This is the case because the normative theory assumes that the policy maker is a benevolent social planner that seeks to design tax and spending government policies to maximize the well being of the whole society. However, if we depart from the assumption that policy makers seek to maximize a social welfare function (which in turn leads to the equity-efficiency tradeoff) and replace this assumption with policy makers that are self interested, then, in this context, the equity-efficiency tradeoff might not arise.

of a representative democracy, policy makers are likely to face a tradeoff between politically driven redistribution and efficiency in tax and public spending design.

However, there is little research on the political incentives for policy makers to redistribute tax burdens and how efficiency considerations might be translated into political costs that in turn might influence economy's tax structure of parties' design. In this paper we contribute to fill this gap by analyzing a political economy model of taxation in which parties design the provision of a public good and the structure of a commodity tax system to maximize the votes that parties can obtain in the election.[2] In this economy individuals' vote choice is determined by parties' policies and voters' partisan preferences.[3] After the election takes place the party that wins forms the government and implements the party's ideal tax and spending platform.

In this paper we identify a set of conditions for 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, left (right) parties would tend to design tax and spending policies that are closer to the ideal policies of voters identified as left (right) voters. Hence, the model predicts that left parties have an electoral incentive to propose a commodity tax system in which redistribution plays a more prominent role than efficiency in guiding the design of the tax structure –taxes on income elastic goods are higher than on income inelastic commodities– and public spending is high. In contrast, right parties have 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 administrations conducted by left parties. These predictions explain stylized facts suggesting that left (right) parties tend to implement more (less) progressive tax systems (see Chernick, 2005).

Our analysis contributes to the theory of taxation in several ways. Firstly, to the best of our knowledge this is the first analysis on the tradeoff between political redistribution and efficiency in tax design that incorporates a broader set

[2] The choice of analyzing a commodity tax system is because this tax system is empirically relevant since many developing countries rely heavily on commodity taxes (rather than direct taxation as in the case of developed economies).

[3] An individual express a partisan preference for a party x –another way to express this preference is when the voter identifies himself as an x's voter– when two parties, say parties x and y select the same economic policies, however, the utility of the voter is higher when party x rules the government.

of determinants of individual's vote choice in a probabilistic voting equilibrium. In our model we relax the assumption of many political competition deterministic models (see Downs, 1957; Romer, 1975; Roberts, 1977; Meltzer & Richards, 1981; and more recently Roemer, 1997, 1999 and 2001) and probabilistic voting models (see Hettich & Winer, 1999; and Hotte & Winer, 2001) that assume that individual's voting behavior is determined only by the economic policies of parties.

In particular, the empirical analysis of individuals' voting behavior by Campbell, Converse, Miller & Stokes (1960), Miller & Shanks (1996), Fiorina (1981), Green *et al.* (1998) and Green & Palmquist (1990) show that individuals' vote choice is not only determined by parties' economic platforms but also by voter's partisan preferences. Moreover, the literature on voting behavior (see the list of papers above) has shown that the best predictor of the individual's vote choice are voter's partisan preferences (the voter's party affiliation).[4]

It is relevant to point out that the models that do not take into account voter's partisan preferences ignore that they are a form of political heterogeneity that helps to explain the election's votes distribution. Hence, it is rational to expect that the voters' partisan preferences distribution affects parties' design of tax platforms since parties might use those to redistribute fiscal policy gains across the electorate to maximize parties' chance to win the election. But in this case we are interested in asking: what is the influence of voters' partisan preferences distribution on the parties electoral competition and on parties' fiscal policies design –that is, on taxation and the provision of public goods– for an economy with a representative democracy? This paper as well offers a contribution to the political economy of taxation literature by answering these questions.

Second, our paper also contributes to the literature by providing a new set of empirically verifiable propositions on the role of electoral competition on the government's design of a tax system (for more details see section 3).

Third, the median voter model is a weak theoretical frame to explain the stylized facts of modern economies' tax structure since this model cannot explain multidimensional tax systems for large economies with preferences and income heterogeneity (see Mueller, 2003), in this setting the median voter model cannot produce a political equilibrium which is a significant disadvantage of this model

[4] The mentioned studies find that partisan preference is the best predictor of vote choice, it is important not to interpret this statement as if this is the only determinant. As shown by Fiorina (1997), individual's vote choice is a complex calculus that includes voter's partisan preferences, parties' economic platforms, voters' perceptions over candidates –such as candidates' competence– and a retrospective view of voters over parties' performance while holding public office.

since modern economies use multiple tax instruments. Furthermore, it should be clear that there is a significant interdependence between different taxes within the tax structure and the mentioned model cannot explain it. In contrast, we contribute to the political economy of taxation theory by providing a model that can explain stylized facts of current multidimensional tax systems around the world since our proposal has an electoral equilibrium for a large economy in which there is preferences and income heterogeneity within a multidimensional policy setting.

The paper is organized as follows. The first section contains the characterization of voters' preferences for tax policy. Then, the tax rules and the tradeoff between redistributive politics and efficiency are characterized in the second one. Section 3 provides some comparative static outcomes that relate the role of voters' partisan preference distribution in the electorate and tax design. Finally, the conclusions are presented.

1. Voters' preferences for tax structures

Consider an economy in which individuals decide their consumption vector on the opportunity set and participate politically by voting for a party representative in an election. We consider two candidates-parties denoted by D –left party– and R –right party– competing to form the government. Preferences and the opportunity set for individuals are characterized as follows:

$$\begin{gathered} U^{hk} = \beta^h \mu^h (\vec{x}^h, S^k) + (1 - \beta^h)\varepsilon^{hk} \\ \vec{q}^k \cdot \vec{x}^h = \vec{p} \cdot \vec{x}^h + c\vec{t}^{\,k} \leq w^h L^h \; \forall h \end{gathered} \tag{1}$$

Where:

U^{hk} = overall utility of consumer h if party $k = \{D, R\}$ forms the government;
$\mu^h(\vec{x}^h, S^k)$ = preferences over private consumption $\vec{x}^h \in \mathbb{R}^n : \vec{x}^h = \{x_1^h, \ldots, x_n^h\}$, $x_n^h \neq n \; \forall i$ is the consumption of a private commodity, x_n^h = individual's consumption of leisure and S^k = public good provided by a party $k = \{D, R\}$;
ε^{hk} = partisan preference of consumer h for party k; and
β^h = weighting parameter such that $\beta^h \in (0, 1) \; \forall h$.

Equation (1) implies that the overall utility of individuals U^{hk} depends not only on the fiscal policies that each party might enact while ruling the government, but also that individuals have a preference relation over the party ruling the government.

Regarding the views on partisan preferences, the Michigan school considers that voters' partisan preferences resemble a religious affiliation in the following ways. Partisan preferences could be viewed as psychological attachments heavily influenced by parents and other agents of socialization, these preferences are acquired during childhood, are stable, and are largely exogenous to policy views (see Campbell, Converse, Miller & Stokes, 1960; and Miller & Shanks, 1996).[5] In contrast, Fiorina (1981) argues that party attachments are not exogenous to policy issues but could be viewed as voters' adaptative expectations over parties in office performance. From the latter view, if voters and parties share the same policy positions then party identification strengths and on the contrary it weakens.

The evidence on partisan attachments exogeneity to policy issues is mixed. Fiorina (1981) shows that voter's party identification is sensitive to economic indicators of unemployment and economic development. However, Green *et al.* (1998) and Green & Palmquist (1990) find a quite small effect of economic shocks on aggregate measures of partisanship. That is, Green *et al.* find that only very large economic and political shocks sustained by long periods can alter party attachments. This suggests that in a regular political and economic environment, voters´ partisan attitudes could be thought as exogenous to policy issues.

In this paper we consider the view of the Michigan school on partisan preferences because there is empirical support of this view and it simplifies as well our analysis of political process effect on tax policy design.[6] Consequently, we assume that the party identification –or preference– is learned in childhood, and it is largely exogenous –not based on policy views– (see, among others, Campbell, Converse, Miller & Stokes, 1960; Miller & Shanks 1996).[7]

The individual's opportunity set is defined by the consumers' price $\vec{q}^h = \vec{p} + \vec{t}^k, \vec{q}^k, \vec{p}, \vec{t}^k \in \mathbb{R}^n$, are vectors corresponding to the consumer's price vector. Producer's price vector is $\vec{p} = \{p_1,\ldots,p_n\}$ and $\vec{t}^k$ is a vector identifying the commodity tax structure of the government. We will assume that in this economy the supply of private commodity i is perfectly elastic at p_i $\forall i = 1,\ldots,n$. The producers' value is $\vec{p}\,\vec{x}^k$, $c\left(\vec{t}^k\right) = \vec{t}^k\ \vec{x}^k$ is the tax liability of individual h under tax policies $\vec{t}^k \in \mathbb{R}^n$

[5] Campbell, Converse, Miller & Stokes (1960) argue that if citizens acquire their partisan preferences as children and maintain them thereafter –similar to a religious affiliation–, then these attitudes antecedent –and therefore are exogenous– to election-specific issues and candidates' evaluations.

[6] We leave to future analysis the relaxation of the assumption that voters' political preferences are exogenous.

[7] This explains why we introduce the partisan preference as an additive parameter in (1).

proposed by parties $k = \{D, R\}$, and $w^h L^h$ is the individual's labor income. From (1) we can derive the indirect utility function V^{hk}:[8]

$$V^{hk} = \beta^h v^h\left(\vec{t}^k, S^k, y^h\right) + \left(1 - \beta^h\right)\varepsilon^{hk} \text{ where}$$

$$V^h\left(\vec{t}^k, S^k, y^h\right) = \text{máx}\left\{U^{hk} = \beta^h \mu^h\left(\vec{x}^{*k}, S^k\right) - \left(1 - \beta^h\right)\varepsilon^{hk}: \vec{q}^k \vec{x}^{*k} = \vec{p}\vec{x}^{*k} + c^{*h}\left(\vec{t}^k\right) \forall h\right\} \quad (2)$$

The social choice problem for an economy of individuals with heterogenous preferences and incomes is to define government's fiscal policy. Voters' preferences and income heterogeneity means that these agents disagree over the tax structure and size of the government's provision of the public good. In our economy, an election solves society's problem by delegating the right to design fiscal policy to the party that wins the election.

This implies that the fundamental determinant of government's fiscal policy is the distribution of ideal fiscal policies of voters. From (2) we can obtain the ideal fiscal policies of voter h –denoted as $\vec{t}^h, S^h$– by maximizing the indirect utility V^{hk} subject to the constraint that the public good is financed by taxation. That is, we consider the individual's preference relation over the policy space given by the public budget condition $S^h = R\left(\vec{t}\right)$, the right hand side is the tax revenue function $R\left(\vec{t}\right) = \sum_{i=1}^{n} t_i^h \int_{\forall y} x_i\left(\vec{t}^h, y^h\right) dy^h$, where $x_i\left(\vec{t}^h, y^h\right)$ is the Marshallian demand of individual h which depends on full income y^h and the tax structure desired by voter h, $\vec{t}^h$. The distribution of full income in this economy is given by $y^h \in \left\{\underline{y}^h, y^h_{\text{máx}}\right\}$. Hence, the ideal fiscal policies $\vec{t}^{*k}, S^{*h}$ for voter h are found by:[9]

$$\max_{\vec{t}^h, S^h} \delta^h\left(\vec{t}^h, S^h, y^h\right) = \frac{V^{hk}\left(\vec{t}^h, S^h, y^h\right)}{\beta^h}$$

$$\max_{\vec{t}^h, S^h} \delta^h\left(\vec{t}^h, S^h, y^h\right) = v^h\left(\vec{t}, \sum_{i=1}^{n} t_i^h \int_{\forall y} x_i\left(\vec{t}^h, y^h\right) dy^h, y^h\right) + \frac{1 - \beta^h}{\beta^h}\varepsilon^{kh} \quad (3)$$

[8] Equation (2) is obtained by finding:
$\vec{x}^{*h} \in \arg\text{máx}\left\{U^{hk} = \beta^h\left(\vec{x}^h, S^k\right) + \left(1 - \beta^h\right): \vec{q}^k \vec{x}^{*h} = \vec{p}\vec{x}^{*h} + c^*\left(\vec{t}^k\right) \leq w^h L^h\right\}, \quad c^*\left(\vec{t}^k\right) = \vec{t}^k \vec{x}^*$

[9] For convenience, we normalize (2) as shown in (3).

The indirect utility function that recognizes the opportunity budget set of the individual and the public budget constraint $\delta^h\left(\vec{t}^h, S^h, y^h\right)$ is our primitive preference relation over the fiscal policy space.

2. Electoral competition and the design of fiscal policy

In this section we characterize the electoral competition between parties and the elements that influence parties' tax structure design and the level of provision of the public good. To do so, assume parties D and R propose policy positions on the tax structure and the provision of a public good, voters observe parties' fiscal policies and vote sincerely (this means that voters choose the party that maximizes its own overall utility). The objective of candidates is to maximize their probability of winning the election denoted by $\pi^k\left(\vec{P}^k\right)$ $k = \{D, R\}$, where $\vec{P}^k \in \{\mathbb{R}^{n+1}\} : \vec{P}^k = \{\vec{t}^k, S^k\}$ eflects the fiscal policies proposed by parties $k = \{D, R\}$ and $\vec{t}^k \in \mathbb{R}^n$ is a commodity tax vector.

We define $\theta^h = \left(\varepsilon^{hR} - \varepsilon^{hD}\right)\left(\left(1-\beta^h\right)/\beta^h\right)$, where $\left(\varepsilon^{hR} - \varepsilon^{hD}\right)$ represents the net partisan preference of individual h and θ^h is the partisan preference normalized by a factor related with the weight in which the partisan preferences explain the individuals' vote choice. If $\theta^h < 0$ then the voter has a partisan preference bias in favor of party D, while $\theta^h > 0$ means that the voter has a partisan preference bias in favor of party R.

Moreover, we assume candidates do not know with certainty the determinants of individuals' vote choice.[10] From the candidates' point of view, the policies $\vec{P}^D$, $\vec{P}^R$ and voter's partisan bias θ^h lead to probabilities $\Pr^{hD}$ and $\Pr^{hR}$ that a voter h chooses, respectively, for party D and R. For convenience of the analysis, we partition the electorate such that each voter belongs to the domain $\theta^h = \left\{\underline{\theta}, \bar{\theta}\right\}$, where $\underline{\theta} = \min\left\{\theta^h\right\}_{\forall h}$ and $\bar{\theta} = \max\left\{\theta^h\right\}_{\forall h}$ with $\underline{\theta} < 0 \wedge \bar{\theta} > 0$.

Furthermore, there is a fraction such that $\forall h \neq h' \in g(\theta)$, $\theta^h = \theta^{h'} = \theta$ where $g(\theta)$ is the density of voters in the electorate with a partisan bias of θ and $\Pr^{hD} = \Pr^{h'D}\Pr^{h\theta}\left(\Psi(-\theta)\right)$ where $\left(\Psi(-\theta)\right) = v^D\left(\vec{t}^D, S^D, y\right) - v^R\left(\vec{t}^R, S^R, y\right) - \theta$ is the net utility from policy and partisan issues of a voter type θ if party D is elected, $v^D\left(\vec{t}^D, S^D, y\right)$ is the utility for voter type θ when party D selects policies $\vec{t}^D$, S^D and a similar interpretation is given to $v^R\left(\vec{t}^R, S^R, y\right)$. Define $f^D\left(\Psi(-\theta)\right)$ as the prob-

[10] It is compelling to assume that parties do not have perfect information on the determinants of the vote since, as we mentioned before, the choice of the vote can be influenced by policy issues, partisan preferences, voters' perceptions over candidates (such as the candidates' competence), and a retrospective view of voters over the parties' performance while holding public office (Fiorina, 1997).

ability distribution function over $\Psi(-\theta)$. Thus, the probability that an individual type θ votes for party D is:

$$\Pr^{\theta D}\left(\theta \text{ voting for } D\right) = \int_{-\infty}^{\tilde{\Psi}(-\theta)} f^{D}\left(\Psi(-\theta)\right) d\Psi \tag{4}$$

The expression $F^D\colon \theta \times \vec{P}^D \times \vec{P}^R \to [0, 1]$ is the cumulative distribution function evaluated at $\tilde{\Psi}(-\theta)$ for all partisan bias $\theta \in \{\underline{\theta}, \bar{\theta}\}$ and pair of fiscal policies $\vec{P}^D, \vec{P}^R$.[11] F^D is a common, continuous, non decreasing function of $\Psi(-\theta)$. The properties of F^D reflect prior beliefs of party D on the distribution of voters' net utility $\Psi(-\theta)$. If party D believes the distribution over $\Psi(-\theta)$ is increasing, then $F^D\left(\Psi(-\theta)\right)$ could be convex. The probability of the vote is concave over $\Psi(-\theta)$ if the density over the net utility is concentrated around low values of $\Psi(-\theta)$ and decreases monotonically afterwards.

The proportion of the expected votes for party D –denoted by θ^D– aggregates the probabilities of voting for a candidate across the voters' partisan types $\forall\theta = \{\underline{\theta}, \bar{\theta}\}$. That is:

$$\phi^{D}\left(\vec{P}^{D}, \vec{P}^{R}\right) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, F^{D}\left(\Psi(-\theta)\right) d\theta \tag{5}$$

Similarly, the proportion of the expected votes for party R is:

$$\phi^{R}\left(\vec{P}^{D}, \vec{P}^{R}\right) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, F^{D}\left(-\Psi(-\theta)\right) d\theta \tag{5'}$$

In this economy all individuals vote, then $\phi^D\left(\vec{P}^D, \vec{P}^R\right) + \phi^R\left(\vec{P}^D, \vec{P}^R\right) = 1$, where $\phi^R\left(\vec{P}^D, \vec{P}^R\right)$ is the expected proportion of the votes for party R. The probability that party D wins the election is denoted by the cumulative distribution over the expected proportion of party's plurality defined by $\rho^D = \phi^D\left(\vec{P}^D, \vec{P}^R\right) - \phi^R\left(\vec{P}^D, \vec{P}^R\right)$. Let $W^D\colon \rho^D \to [0, 1]$ be a continuous, non decreasing cumulative distribution and $W^D = w^D \rho^D \geq 0$ is the corresponding probability distribution function. That is, the probability that party D wins the election $\pi^k\left(\vec{P}^D, \vec{P}^R\right)$ is characterized by:

[11] $\tilde{\Psi}(-\theta)$ is a feasible value of $\Psi(-\theta)$. For instance, consider the following domain $\Psi(-\theta) \in \{\underline{\Psi}(-\theta), \bar{\Psi}(-\theta)\}$ then $\tilde{\Psi}(-\theta)$ is a feasible when $\tilde{\Psi}(-\theta) \in \{\underline{\Psi}(-\theta), \bar{\Psi}(-\theta)\}$.

$$\pi^D\left(\vec{P}^D, \vec{P}^R\right) = \int_{-\infty}^{\tilde{\rho}^D} w^D\left(\rho^D\right) d\rho^D \tag{6}$$

Where:

ρ^D = feasible value of the expected proportion of the party's plurality.

We follow the literature by assuming that $\pi^k\left(\vec{P}^D, \vec{P}^R\right)\ \forall k$ is strictly concave function of taxes (see Coughlin, 1992; Hettich & Winer, 1999). Therefore, the problem of candidate D is to select the commodity tax vector and the public good that maximizex his probability of winning the election, subject to the public budget constraint that considers that the public good is financed by taxation (a similar characterization is defined for party R). Formally, the party's problem is:

$$\max_{\{\vec{t}^D, S^D\}} \pi^D = \int_{-\infty}^{\tilde{\rho}^D} w^D\left(\rho^D\right) d\rho^D$$

$$\text{s.t.} \begin{cases} i) & \rho^D = \phi^D\left(\vec{P}^D, \vec{P}^R\right) - \phi^R\left(\vec{P}^D, \vec{P}^R\right) \\ ii) & \phi^R\left(\vec{P}^D, \vec{P}^R\right) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, F^D\left(\Psi(-\theta)\right) d\theta \\ iii) & \phi^R\left(\vec{P}^D, \vec{P}^R\right) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, F^D\left(-\Psi(-\theta)\right) d\theta \\ iv) & \Psi = \Delta v - \theta = v^D\left(\vec{t}^D, S^D, y\right) - v^R\left(\vec{t}^D, S^R, y\right) - \theta\ \forall\theta \in \left[\underline{\theta}, \bar{\theta}\right] \\ v) & S^D = \sum_{i=1}^{n} t_i^D \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, x_i\left(\vec{t}^D, y\right) d\theta \end{cases} \tag{7}$$

The problem of fiscal policy design for party R is symmetric to that shown for party D in condition (7). Hence in Theorem 1 we characterize the politic-economic equilibrium for this economy.

Theorem 1

The electoral equilibrium for this economy is characterized by parties' fiscal policy choices $\vec{t}^{*k}, S^{*k}\ \forall k \in \{D, R\}$ and voters' optimal voting choices such that:

a) In the first stage of the game parties select:

$$\vec{t}^{*k}, S^{*k} \in \ \arg\max \pi^k \text{ s.t. } i;\ ii;\ iii;\ S^{*k} = \sum_{i=1}^{n} t_i^{*k} \int_{\forall\theta} g(\theta) x_i\left(\vec{t}^{*k}, y^h\right) d\theta$$

b) In the second stage voters type $\theta \in = \{\underline{\theta}, \bar{\theta}\}$. observe parties' fiscal policies and vote for party D if:

$$\Psi(-\theta) = v^D(\vec{t}^{*D}, S^{*D}, y) - v^R(\vec{t}^{*R}, S^{*R}, y) - \theta > 0$$

Voters type θ vote for party R if $\Psi(-\theta) < 0$.

After the election, the winning party forms the government and implements its fiscal policy platform.

Theorem 2

Define:

a) $(-1/x_i)\sum_{j=1}^{n} t_j^{*k} \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\gamma_{ij}\, d\theta$ as the percentage change along the compensated demand of commodity i due to taxation and $\gamma_{ij} = \partial x_i^c / \partial t_j^k$ is the change in the compensated demand due to a change in t_j^k.
b) $\sigma^k(f^k(\Psi(-\theta)), \lambda^k)$ is the covariance between the marginal probability that voter type θ votes for party k, $f^k(\Psi(-\theta))$. $\lambda^k = \alpha\{MRS_{S^k-x_0} - T_i^k\}$ is the marginal net gain from the fiscal exchange obtained by a marginal change in the tax rate of commodity i for voter type θ. $MRS_{S^k-x_0}$ is the voter's marginal rate of substitution of the public good in terms of a nummeraire private good x_0. The voter's tax share from tax instrument i is given by $T_i^k = (t_i^k x_i)/(t_i^k X_i)$ where $X_i = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, x_i\, d\theta$.
c) $\bar{f}^k\,(\Psi(-\theta))\ \bar{v}_S^k$ is a politically weighted average of the marginal utility of the public good.
d) $E[\lambda^k]/\bar{v}_S^k$ is a ratio of the politically weighted measures of net, $E[\lambda^k]$, and gross, $\bar{v}_S^k$, marginal fiscal exchange gains from taxing commodity i.
e) $E[\partial c/\partial y]$ is the expected extra tax revenue that the government obtains as a result of redistributing \$1 to voters through the tax system.

At the political equilibrium the politically optimal commodity tax structure $\vec{t}^{*k} = \{t_1^{*k}, \dots, t_n^{*k}\}$ for parties $k = \{D, R\}$ is determined by the following tax rule:

$$\frac{-1}{X_i}\sum_{j=1}^{n} t_j^{*k}\int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\gamma_{ij}\frac{\sigma^k\left(f^k\left(\Psi(-\theta)\right),\lambda^k\right)}{\bar{f}^k\left(\Psi(-\theta)\right)\bar{v}_s^k}+\frac{E\left[\lambda^k\right]}{\bar{v}_s^k}-E\left[\partial c/\partial y\right]\ \forall t_i^{*k} \tag{8}$$

Proof

The optimality conditions for parties $k = \left\{D, R\right\}$ are given by $\partial\pi^k/\partial t_i^{*k} = 0$ which imply the following:[12]

$$\frac{\partial\phi^k}{\partial t_i^{*k}}\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k\left(\Psi(-\theta)\right)\frac{\partial\Psi}{\partial t_i^{*k}}d\theta = 0\ \ \forall t_i^{*k} \tag{9}$$

For $R\left(\vec{t}^k\right)=\sum_{i=1}^{n} t_j^k\int_{\forall\theta} x_i\left(\vec{t}^k, y^h\right)d\theta$ define:

$$R_i = \frac{\partial R\left(\vec{t}^k\right)}{\partial t_i^{*k}} = \int_{\forall\theta} x_i\left(\vec{t}^k, y^h\right)d\theta + \sum_{j=1}^{n} t_j^k\int_{\forall\theta}\partial x_j\left(t^k, y^h\right)/dt_j^k d\theta$$

Then, equation (9) can be arranged as follows:

$$-\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k\left(\Psi(-\theta)\right)\frac{\partial v}{\partial t_i^{*k}}d\theta = \left(\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k\left(\Psi(-\theta)\right)\frac{\partial v}{\partial S^{*k}}d\theta\right)R_i \tag{9'}$$

Using the fact that $\partial v^k/\partial t_i^{*k} = -\alpha x_i \leq 0$, where $x_i \geq 0$, is the Marshallian demand of good i, α is the marginal utility of income of voter type θ, and $v_S^k = \partial v/\partial S^{*k}$ in the left hand side of (9'). Moreover, using the Slutsky equation:

$$\frac{\partial x_j\left(\vec{t}^k, y^h\right)}{\partial t_i^k} = \gamma_{ji} - x_i\left(\vec{t}^k, y^h\right)\frac{\partial x_j\left(\vec{t}^k, y^h\right)}{\partial y}$$

[12] The optimality condition is $\partial\pi^k/\partial t_i^{*k} = 0 \Rightarrow w^k\left(\rho^k\right)\left(\partial\phi^k/\partial t_i^k - \partial\phi^{-k}/\partial t_i^{-k}\right) = 0$ (allowing that if $K = D$ then $-k = R$ and vice versa). $\phi^k + \phi^{-k} = 1 \Rightarrow \partial\phi^k/\partial t_i^k = -\partial\phi^{-k}/\partial t_i^{-k}$, therefore $\partial\phi^k/\partial t_i^k = 0 \Rightarrow \partial\pi^k/\partial t_i^k = 0\ \forall t_i^{*k}$ since $Y^k = 2w^k\left(\rho^k\right) \geq 0\ \forall t_i^{*k}$. From (5) we obtain $\partial\phi^k/\partial t_i^k = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k\left(\Psi(-\theta)\right)\left(\partial\Psi/\partial t_i^{*k}\right)d\theta$.

Where:

$\gamma_{ji} = \partial x_j^c / \partial t_i^k$ is the change in the compensated demand of commodity j due to a change in t_i^k in condition R_i.

Therefore, R_i can be expressed as:

$$R_i = \int_{\forall\theta} x_i \left(\vec{t}^k, y^h\right) d\theta + \sum_{j=1}^{n} t_j^h \int_{\forall\theta} \gamma_{ji} - x_i \left(\vec{t}^k, y^h\right) \frac{\partial x_j \left(\vec{t}^k, y^h\right)}{\partial y} d\theta$$

Then, we can be rearrange condition (9'):

$$\frac{-1}{X_i} \sum_{j=1}^{n} t_j^{*k} \int_{\underline{\theta}}^{\overline{\theta}} g(\theta) \gamma_{ji} \, d\theta = \frac{\int_{\underline{\theta}}^{\overline{\theta}} g(\theta) f^k (\Psi(-\theta)) \, \lambda^k \, d\theta}{\bar{f}^k (\Psi(-\theta)) \bar{v}_s^k} - \int_{\underline{\theta}}^{\overline{\theta}} g(\theta) \frac{\partial c}{\partial y} T_i^k d\theta \quad (10)$$

Where:

$\lambda^k = \alpha \left(MRS_{S^k - x_0} - T_i^k \right)$ is the utility of the net marginal fiscal exchange from taxing commodity i for voter type θ, with $MRS_{S^k - x_0}$ the voter's marginal rate of substitution –or the voter's valuation of the public good in terms of a nummeraire private good x_0–; and

$T_i^k = t_i^k x_i / t_i^k X_i$ is the voter's tax share from tax instrument i, with $X_i = \int_{\underline{\theta}}^{\overline{\theta}} g(\theta) x_i \, d\theta$.

Define $\int_{\underline{\theta}}^{\overline{\theta}} g(\theta) f^k (\Psi)(-\theta)) \, \lambda^k \, d\theta$ as the marginal proportion of the expected vote from the net fiscal exchange of the tax rate t_i^k. Furthermore, by the mean value theorem:

$$\int_{\underline{\theta}}^{\overline{\theta}} g(\theta) f^k (\Psi(-\theta)) \frac{\partial v}{\partial S^{*k}} = \bar{f}^k (\Psi(-\theta)) \bar{v}_s^k$$

Where:

$\bar{v}_S^k = \partial \bar{v}^k / \partial S^{*k}$ is a politically weighted marginal utility of the public good; and

$\bar{f}^k(\Psi(-\theta)) = \int_{\underline{\theta}}^{\overline{\theta}} g(\theta) f^k (\Psi(-\theta)) d\theta$ is a weighted marginal probability of the vote.

Recall $c\left(\vec{t}^{\,k}\right) = \vec{t}^{\,k}\,\vec{x}$, so by using $\partial c/\partial y = \sum_{i=1}^{n} t_i^k \left(\partial x_i/\partial y\right)$ we obtain the last expression in (10), which is a weighted measure of the change in government's tax revenue if parties redistribute one dollar to the electorate through the tax system:

$$E\left[\frac{\partial c}{\partial y}\right] = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, \frac{\partial c}{\partial y} T_i^k \, d\theta$$

Now, using the definition of covariance we can show that:

$$\int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(\Psi)\lambda^k \, d\theta = \sigma^k\left(f^k(\Psi), \lambda^k\right) + \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\,\lambda^k \, d\theta + \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f^k(\Psi) d\theta$$

Moreover, using $\gamma_{ij} = \gamma_{ji}$ to show that the percentage change along the compensated demand of commodity i as a result of the tax system is $\left(-1/X_i\right) \sum_{j=1}^{n} t_j^{*k} \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\,\gamma_{ij}\, d\theta$. Hence we can re-write condition (10) as:

$$\frac{-1}{X_i} \sum_{j=1}^{n} t_j^{*k} \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\,\gamma_{ij}\, d\theta = \frac{\sigma^k\left(f^k\left(\Psi(-\theta)\right), \lambda^k\right)}{\bar{f}^k\left(\Psi(-\theta)\right)\bar{v}_S^k} + \frac{E\left[\lambda^k\right]}{\bar{v}_S^k} - E\left[\frac{\partial c}{\partial_y}\right] \quad \forall t_i^{*k} \tag{11}$$

Theorem 2 characterizes parties' electoral incentives that take into account redistribution and efficiency in the design of a commodity tax structure and the provision of a public good. As mentioned before, voters' partisan preferences are a form of political heterogeneity that helps to explain the vote distribution in the election. Hence, parties use voters' partisan preferences to redistribute fiscal policy gains across the electorate in order to maximize their chance to win the election. This, in turn, leads to a process of preference aggregation that determines the roles that redistributive policies and efficiency play on tax design.

In our economy, politically driven redistribution is guided by parties' electoral incentives to maximize the net fiscal exchange gains to those voters coalitions that deliver a high marginal proportion of the expected votes in the election, while parties penalize those voters with a low marginal proportion of the expected votes. Furthermore, parties also have incentives to recognize the inefficiency costs from the tax system since higher welfare costs from inefficient taxation imply lower electoral support for parties in the election.

Hence, a tradeoff between politically driven redistribution and efficiency might arise when parties seek to redistribute tax burdens in favor of some coalition (to gain votes), but in the process parties select a tax system that necessarily induces significant deadweight costs to some other voters coalitions which in turn lowers their electoral support in the election.

The expression $\left(-1/X_i\right)\sum_{i=1}^{n} t_i^{*k}\int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\,\gamma_{ij}\,d\theta$ in (11) is the percentage change along the compensated demand of commodity i and it measures inefficiency in the allocation of resources induced by the taxation of commodities. Therefore, political parties have incentives to set lower tax rates to those commodities with a high price-consumption elasticity.

In (11), the pattern of redistributive taxation is explained by the covariance between voters' marginal probability of voting for candidate k and the net marginal fiscal exchange from the tax rate on commodity i denoted by $\sigma^k\left(f^k\left(\Psi(-0)\right), \lambda^k\right)$. Hence, if party k forms the government it will implement a tax system with a higher tax rate $t_i^{*\,k}$, in this case voters' preferences for fiscal policies distribution are observed such that voters with above average marginal probabilities of voting for party k are associated with above average marginal net fiscal exchange gains.[13]

To highlight the role of the partisan preference on tax design consider $\vec{t}^{\,*k} = \left[t_i^{*\,k}\right]$ and two different types of voters with partisan preferences given by $\theta^0 < 0 \wedge \theta^1 > 0 : \theta^0, \theta^1 \in \left\{\underline{\theta}\ \bar{\theta}\right\}$ and ideal policies $t_i{}^{*\theta^0} \geq t_i{}^{*\theta^1}$ leading to $\Psi\left(-\theta^0\right) \geq \Psi\left(-\theta^1\right)\ \forall t_i^{*k}, t_i^{*\text{-}k}$. Assume further that the function of the probability of the vote F^D is convex on $\Psi(-\theta)$, then $\Psi\left(-\theta^0\right) \geq \Psi\left(-\theta^1\right)$ implies $f^D\left(-\theta^0\right) \geq f^D\left(-\theta^1\right)$. Additionally, if $g\left(-\theta^0\right) \geq g\left(-\theta^1\right)$, then, unambiguously, a Downsian candidate k will weigh more heavily the preferences over fiscal policies of individuals who have a partisan bias in favor of party k (or voters type θ^0). As a result, party k provides a level of public good S^{*k} that is closer to the ideal size of spending on the public good of citizens with a partisan bias for party D (that is, $S^{*k} \rightarrow S^{*o^0}$).[14]

In addition, if voters with a favorable partisan bias towards party k want high spending on the public good and are also predominantly low income voters, then this party has electoral incentives to tax more heavily income elastic commodities and less heavily income inelastic and inferior goods. To see this, note

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

[14] Since rational parties will select policies where marginal tax revenues are positive (see Hettich and Winer, 1997, 1999) then $t_i^{*\theta^0}, t_i^{*\theta^1} \in \mathbb{R}^1$: $t_i^{*\theta^0} \geq t_i^{*\theta^1} \Rightarrow S^{*\theta^0} \geq S^{*\theta^1}$.

On other hand, the model can rationalize some other interesting hypothesis about how parties might weigh more heavily or discount the preferences for tax policy of partisan and non-partisan voters. Because of space, we don't pursue all these issues in this paper. By request of the interested reader we can provide such analysis.

that $\text{MRS}^{\theta^0}_{S^k-x_0} \geq \text{MRS}^{\theta^1}_{S^k-x_0}$, i.e. if voters with a favorable partisan bias for party k prefer a higher level of spending compared to the ideal expenditures of voters with a favorable partisan bias for party $-k$, and an income elastic commodity implies $T^D(i, y^1) \geq T^D(i, y^0)$ for individuals with $y^1 \geq y^0$, such as the share of tax liability in good i for a voter with income y, $T^D(i, y)$, is higher for voters with higher levels of income). In this case, higher taxes on income elastic commodities imply that voters with a partisan bias in favor of 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 $\lambda^k(i, y^0) \geq \lambda^k(i, y^1)$.

For a convex probabilistic cumulative distribution of the choice of the vote F^k, $t_i^{*\,\theta^0}\ t_i^{*\,\theta^1} : \Psi(\theta^0) \geq \Psi(\theta^1)\ \forall t_i^{*k}, t_i^{*-k} \Rightarrow f^k(-\theta^0) \geq f^k(-\theta^1)$, $\theta^0 < \theta^1$. Therefore, higher than average values of $f^k(-\theta)$ will be associated with higher than average values of λ^k (for $\lambda^k \geq 0$) and hence $\sigma^k\left(f^k(\Psi(-0)), \lambda^k\right) \geq 0$. Consequently, the higher the covariance σ^k, the higher the tax rate t_i^{*k} on the tax system (see condition 11) and the size of the public good proposed by party k.

It should be clear that the covariance σ^k is higher under an income elastic commodity i compared with that of, say an income inelastic commodity z, since the net fiscal exchange gains for voters with a partisan bias in favor of party k are higher under commodity i. Consequently, party k will propose a higher tax rate on income elastic goods compared with the tax rate applied to income inelastic goods.

Moreover, in condition (11), $\bar{f}^D(\Psi(-\theta))\,\bar{v}_G^D$ is the marginal proportion of the expected vote from the last unit of the public good. In general, this term has an ambiguous effect over t_i^{*k}. To see this, suppose an exogenous change in $\bar{v}_S^k$ and note from (11) that, provided $\sigma^k\left(f^k(\Psi(-0)), \lambda^k\right) \geq 0$, then a higher $\bar{f}^D(\Psi(-\theta))\,\bar{v}_S^k$ tends *ceteris paribus* to reduce t_i^{*k}, but also a higher $\bar{f}^D(\Psi(-\theta))\,\bar{v}_G^D$ might increase the tax rate if $\sigma^k\left(f^k(\Psi(-0)), \lambda^k\right) \leq 0$.[15] Hence the net impact of an increase in the willingness to pay for the public across the electorate is ambiguous.

The term $E[\lambda^k] / \bar{v}_S^k$ represents the ratio of the politically weighted measures of the net ($E[\lambda^k]$) and gross ($\bar{v}_S^k$) fiscal marginal exchange gains. The larger this 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.

[15] The *ceteris paribus* condition must be interpreted as considering an increase in $\bar{f}^k(\Psi(-\theta))\,\bar{v}_S^k$ that leads to a distribution of the net fiscal exchange gains so that $\sigma^k\left(f^k(\Psi(-\theta)), \lambda^k\right)$ remains unchanged, otherwise the effect of the expected vote from the net fiscal exchange is ambiguous.

The expression $E\left[\partial c/\partial y\right] = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)(\partial c/\partial y)\, T_i^k \, d\theta$ 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 shifting the relative prices of commodities through the tax structure. In the equation, individuals' share of tax contributions T_i^k is a weighting factor of the marginal tax revenue $\partial c/\partial y$ from returning one dollar to each taxpayer. From the expression in (11), the higher it is, the lower the tax rate t_i^{*k} to be used in the tax system.

3. Partisan preference distribution and tax structure

The composition of electorate's partisan preference might change over time. This fact suggests that the relative political influence of voters with partisan preferences for parties *D* and *R* has changed over time. A change in partisan preferences distribution might in turn modify parties' fiscal policies, a change in such distribution affects the way parties aggregate voters' preferences for policy since different voters' partisan preferences distributions affect the vote marginal propensity across the electorate and the relative proportion of votes that different voters coalitions may deliver in the election. Hence, in this section, we are interested in analyzing the influence of different voters' partisan preferences distributions over parties' fiscal platforms, i.e. the provision of the public good and the size of taxation.

To analyze these issues, we define the concept of first order partisan dominance as a partisan bias distribution in which a higher proportion of partisan voters implies a higher probability of winning the election for some party. Proposition 1 shows that if $G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \{\underline{\theta}, \bar{\theta}\}$, the cumulative distribution of partisan voters $G(\theta)$ with a favorable bias for some party $k = D$ is dominated by the distribution $\tilde{G}(\theta)$, then the probability that party *k* wins under $\tilde{G}(\theta)$ is not lower than the probability of doing it under $\tilde{G}(\theta)$.

Proposition 1

Consider two cumulative distributions of partisan preferences in the electorate:

$$G(\theta), \tilde{G}(\theta) : G(\theta) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, d\theta;\ \tilde{G}(\theta) = \int_{\underline{\theta}}^{\bar{\theta}} \tilde{g}(\theta)\, d\theta;\ G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \{\underline{\theta}, \bar{\theta}\}$$

This implies that $\tilde{G}(\theta)$ partisan-dominates $G(\theta)$.Therefore:

$$G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \{\underline{\theta}, \bar{\theta}\} \Rightarrow \pi^k\left(\vec{P}^k, \vec{P}^{-k}, \tilde{G}(\theta)\right) \geq \pi^k\left(\vec{P}^k, \vec{P}^{-k}, G(\theta)\right)\ \forall \vec{P}^k, \vec{P}^{-k} \in \vec{P} \quad (13)$$

Proof

By definition of the expected proportion of votes is:

$$\phi^k\left(\vec{P}^k, \vec{P}^{-k}\right) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) = F^k\left(\Psi(\theta)\right) d\theta \quad \forall k \in \{D, R\}$$

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 at:

$$\vec{t}\Big|_{G(\theta)} = \vec{t}\Big|_{\tilde{G}(\theta)} = \vec{t} \Rightarrow f^k\left(\Psi(\vec{t}, \theta)\right)\Big|_{G(\theta)} = f^k\left(\Psi(\vec{t}, \theta)\right)\Big|_{\tilde{G}(\theta)} = f^k\left(\Psi(\theta)\right) \geq 0$$

for given policy vectors $\vec{P}^k, \vec{P}^{-k} \in \vec{P}$. And since by assumption:

$$\tilde{G}(\theta) = \int_{\underline{\theta}}^{\bar{\theta}} \tilde{g}(\theta)\, d\theta \wedge G(\theta) \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, d\theta : G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \{\underline{\theta}, \bar{\theta}\}$$

Then, the probability to win the election for party k is a non decreasing function of $\phi^k\left(\vec{P}^k, \vec{P}^{-k}\right)$. Therefore:

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

$$\Downarrow$$

$$p^k\left(\vec{P}, \vec{P}^{-k}, \tilde{G}(\theta)\right) \geq p^k\left(\vec{P}^k, \vec{P}^{-k}, G(\theta)\right)\ \forall \vec{P}^k, \vec{P}^{-k} \in \vec{P}$$

The latter inequality means that, for given fiscal policies $\vec{P}^k, \vec{P}^{-k}$, the probability that party k wins under $\tilde{G}(\theta)$ is not lower than doing it under $G(\theta)$.

Theorem 3

Consider two cumulative distributions of partisan preferences in the electorate:

$$G(\theta),\ \tilde{G}(\theta) : G(\theta) \leq \tilde{G}(\theta)\ \forall\theta \in \{\ \underline{\theta}, \bar{\theta}\}$$

Suppose that $\vec{t}^{*k} = [t_i^{*k}]$ is compatible with the partisan cumulative distribution. If:

a) $\left.\dfrac{\partial\Psi^k}{\partial t_i^{*k}}\right|_{\underline{\theta},\, t_i^{*k}} \geq 0$

b) $\left.\dfrac{\partial\Psi^k}{\partial t_i^{*k}}\right|_{\bar{\theta},\, t_i^{*k}} \leq 0$

c) $g(\bar{\theta}) - g(\underline{\theta}) \geq 0$

Then, a change in the partisan preferences from $G(\theta)$ to $\tilde{G}(\theta)$, induces both parties to increase both the level of t_i^{*k} and the provision of the public good.

Proof

The changes in tax structure due to changes in the dominance of voters' political preferences cumulative distribution follows from the optimality conditions in (9). For simplifying the mathematical calculations, let $\vec{t}^{*k} \in \mathbb{R}^1$, differentiate (9) with respect to $G(\theta)\ \forall\theta\in\{\underline{\theta}, \bar{\theta}\}$ in order to obtain:

$$\frac{d\vec{t}_i^{*k}}{dG(\theta)} = -\frac{\partial^2\pi^k / \partial t_i^k \partial G(\theta)}{\partial^2\pi^k / \partial^2 t_i^k} \boxed{>,=,<}\ 0 \ \text{ as } \partial^2\pi^k / \partial t_i^k\, \partial G(\theta) \boxed{>,=,<} 0$$

Since the concavity of $\pi^k(\vec{P}^D, \vec{P}^R)$ on taxes implies $\partial^2\pi^k / \partial t_i^k \partial G(\theta) \geq 0$. Moreover, $G(\theta) = \int_{\underline{\theta}}^{\bar{\theta}} g(\theta)\, d\theta$ is a non decreasing monotone function, so there exists an inverse function:

$$\theta = \chi(G(\theta)), \chi' = \left[g(\theta)\Big|_{\underline{\theta}}^{\bar{\theta}}\right]^{-1} : \frac{\partial^2\pi^k}{\partial t_i^k \partial G(\theta)} = \frac{\partial t_i^k}{\partial\theta}\ \frac{\partial\theta}{\partial G(\theta)}$$

Hence, for the case of party *D*:[16]

$$\frac{\partial \pi^D}{\partial t^{*D} \partial G(\theta)} = \frac{\int_{\underline{\theta}}^{\bar{\theta}} g'(\theta) f^D\left(\Psi(\theta)\right)\left(d\Psi/\partial t_i^D\right) d\theta - \int_{\underline{\theta}}^{\bar{\theta}} g(\theta) f'^D\left(\Psi(\theta)\right)\left(d\Psi/\partial t_i^D\right) d\theta}{g(\bar{\theta}) - g(\underline{\theta})} \boxed{>,=,<}\ 0$$

Now, integrate by parts the second term of the numerator of (13) to obtain:

$$\frac{\partial^2 \pi^D}{\partial t^{*D} \partial G(\theta)} = \frac{g(\bar{\theta}) f^D(\bar{\theta}) \left.\frac{\partial \Psi^k}{\partial t^{*D}}\right|_{\bar{\theta}} - g(\underline{\theta}) f^D(\underline{\theta}) \left.\frac{\partial \Psi}{\partial t^{*D}}\right|_{\underline{\theta}}}{g(\bar{\theta}) - g(\underline{\theta})} \boxed{>,=,<}\ 0 \qquad (14)$$

Following similar steps we also find $\partial^2 \pi^R / \partial t^{*R} \partial G(\theta)$ to characterize the response of party *R* to a change in the distribution of partisan preferences. This is given by:

$$\frac{\partial^2 \pi^D}{\partial t^{*R} \partial G(\theta)} = \frac{g(\bar{\theta}) f^R(\bar{\theta}) \left.\frac{\partial \Psi}{\partial t^{*R}}\right|_{\bar{\theta}} - g(\underline{\theta}) f^R(\underline{\theta}) \left.\frac{\partial \Psi}{\partial t^{*R}}\right|_{\underline{\theta}}}{g(\bar{\theta}) - g(\underline{\theta})} \boxed{>,=,<}\ (\qquad (14')$$

Note that $g(\bar{\theta}), g(\underline{\theta}), f^k(\bar{\theta}), f^k(\underline{\theta}) \in \mathbb{R}_+\ \forall k \in \{\mathrm{D}, \mathrm{R}\}$, hence conditions a), b) and c) (Theorem 3), as well as (14) and (14') imply that:

$$\frac{\partial t^{*D}}{\partial G(\theta)}, \frac{\partial t^{*R}}{\partial G(\theta)} \geq 0$$

To see the relevance of Theorem 3 assume commodity *i* is income elastic and voters' policy preferences with a strong partisan bias for parties *D* and *R* are given by $\theta\Psi/\partial t_i^D\big|_{\underline{\theta},\, t_i^{*D}} \geq 0$ and $\theta\Psi/\partial t_i^D\big|_{\bar{\theta},\, t_i^{*D}} \leq 0$.[17] In this case, $\partial^2 \pi^k / \partial t_i^k \partial G(\theta) \geq 0$

[16] The comparative analysis for party *R* follows directly from this analysis due to the symmetry of the model.

[17] Assume $k = D$, then an intuitive interpretation of a) and b) is that the ideal policy of voters with a strong partisan preference for party *D* –or policy type $t_i^{*\underline{\theta}}$– is higher than its policy platform –t_i^{*D}–, while strong partisan voters favoring party *R* –or voters type θ– prefer a lower tax rate relative the policy platform of party *D*. Thus condition a), $\theta\Psi/\partial t_i^D\big|_{\underline{\theta},\, t_i^{*D}} \geq 0$, 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 voters with a strong partisan preference for party *R*, $\partial\Psi/\partial t_i^D\big|_{\bar{\theta},\, t_i^{*D}} \leq 0$.

implies $dt_i^{*k}/dG(\theta) \geq 0$, therefore the partisan dominance –equivalently, an increase of $G(\theta)\ \forall\theta \in \{\underline{\theta}, \bar{\theta}\}$– induces parties *D* and *R* to increase the tax rate of equilibrium over commodity *i* and the scale of public good government's provision.

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 voters' preferences by modifying the partisan bias distribution and the vote marginal probability across the electorate. As a result of a more dominant partisan distribution, there is an increase in the expected votes proportion from voters with a favorable partisan bias towards party *D*. By assumption, strong partisan voters –or voters type $\underline{\theta}$– prefer an increase in the tax rate –this is a)–. Hence, if party *D* increases the tax rate, the votes' expected proportion for the party increases in a proportion given by $g(\underline{\theta}) f^D(\Psi - \underline{\theta})$.

Simultaneously, a more dominant 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 voters with strong partisan preference for party $R - g(\bar{\theta}) f^D(\Psi - \bar{\theta})$ – in (14). By assumption, voters with strong partisan preferences for party *R* –voters type $\bar{\theta}$ – support a decrease in t_i^{*D}. Consequently, party *D* has an incentive to take a policy position closer to voters with a strong partisan bias in its favor and, therefore, preferences distributions $\partial\Psi/\partial t_i^D\big|_{\underline{\theta},\, t_i^{*D}} \geq 0$ and $\partial\Psi/\partial t_i^D\big|_{\bar{\theta},\, t_i^{*D}} \leq 0$ imply $dt_i^D/dG(\theta) \geq 0$ if there is an increase in voters' partisan dominance with bias in favor of party *D*.

Interestingly, the increase in the partisan dominance might induce party *D* to take a policy position that reduces the welfare of voters with partisan bias in its favor if voters type $\underline{\theta}$ and $\bar{\theta}$ hare similar views on policy and F^D is concave. To see this, assume $\partial\Psi/\partial t_i^D\big|_{\underline{\theta},\, t_i^{*D}} \geq 0$ and $\partial\Psi/\partial t_i^D\big|_{\bar{\theta},\, t_i^{*D}} \leq 0,\ t_i^{*\underline{\theta}} \geq t_i^{*\bar{\theta}}\colon \Psi(-\underline{\theta}) \geq \Psi(-\bar{\theta})$ leading to $f^D(\Psi(-\underline{\theta})) \geq f^D(\Psi(-\bar{\theta}))$, and F^D is concave enough such that $G(\bar{\theta}) f^D(\Psi(-\bar{\theta})) \geq G(\underline{\theta}) f^D(\Psi(-\underline{\theta}))$. 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 vote probability, an increase in the proportion of *D* voters might actually reduce their expected votes proportion since the vote marginal probability for individuals with a strong partisan bias in its favor is decreasing as $\theta \to \underline{\theta}$. As a result, party *D* might increase the probability of winning the election if it designs a policy platform in the opposite direction of these strong partisan voters welfare increase.[18]

[18] To see this, note that if party *D* takes a policy position closer to voters with strong partisan bias in its favor as a response of an increase $G(\theta)\ \forall\theta$ –in our example with $\partial\Psi/\partial t_i^D\big|_{\bar{\theta},\, t_i^D} \geq 0$, if party *D* increases t_i^{*D}–, then the expected

The former result is counterintuitive and explained by the assumption of concavity for vote's probability. However, the intuition behind this result is also simple, under the conditions identified above parties use voters partisan preferences as an indicator of voters' loyalty towards the party. The higher the loyalty of some voters coalitions towards some party, the higher is the incentive for this party to cultivate the vote from those coalitions that can deliver a high vote expected proportion. Under the mentioned conditions, those voters are identified as partisan voters favoring the competing party.

Conclusions

In a democracy, political parties perform the important role of aggregating voters' preferences for public policies. The issue of preference representation is central to give legitimacy to governments in a representative democracy, as well as in the design of fiscal policies since voters' interests aggregation is closely related with the tradeoff between efficiency and redistribution and the size and composition of government expenditure.

The probabilistic voting models suggest that the preferences of all voters in the electorate influence public policy. However, in such models there is little research on the roles that redistributive politics and efficiency play on guiding the design of tax rules for an economy in which policy makers face electoral constraints when policy is multidimensional and there is politic-economic heterogeneity. This paper contributes to fill this gap.

We propose a model in which individuals' vote choice is determined by parties policies and voters partisan preferences to explain the design of the tax system. Voter's partisan attitude is a form of political heterogeneity that helps to explain the distribution of votes in the election. Parties use voters partisan preferences to redistribute the gains of public policy across the electorate and maximize parties chance to win the election. In this setting, redistribution is guided by parties electoral incentives to maximize net fiscal exchange gains to voters –or group of voters– that deliver a high marginal expected votes proportion while parties penalize those vot-

votes proportion by voters type $\underline{\theta}$ raises in $g(\underline{\theta})f^D(\Psi(-\underline{\theta}))$ and the expected proportion for voters with strong partisan preference in favor of party R falls in $g(\overline{\theta})f^D(\Psi(-\overline{\theta}))$. 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 rises as a result of an increase in voters partisan dominance with bias in favor of party D, if this party takes a policy position in the opposite direction of a of strong partisan voters welfare increase (that is, if party D reduces t_i^{*D}).

ers with a low one. This, in turn, leads to a process of preference aggregation that determines the roles that redistributive policies and efficiency play on tax design.

We identified conditions for which a differential commodity tax system will be used to redistribute tax burdens in favor of individuals with a partisan bias towards a party. In other words, left (right) parties would tend to design tax and spending policies closer to the ideal policies of voters identified as left (right) voters.[19] Hence, the model predicts that left parties have a purely 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, right parties have an electoral incentive to weigh less heavily redistribution –*vis-à-vis* efficiency– in tax design and spending is lower compared with public good provision under administrations conducted by left parties.

The probabilistic theory of elections predicts that public policy reflects more closely voters coalitions preferences that are more effective to influence policy makers. However, one limitation of many probabilistic voting models is that they don't identify the factors that explain why some voters coalitions are more influential than others. By introducing voters partisan preferences, we were able to identify groups that are more effective to influence parties through coalitions' propensity to vote for the party and the relative size of the coalition with respect to the electorate. In our model, we provide conditions for which a more dominant left voters coalition becomes more effective in influencing parties and induces both parties to design a tax policy that reflects more closely the ideal fiscal policy of left voters, that is, parties tend to spend more and to adopt a more progressive tax structure.

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[19] However, we also identified conditions for which voters with favorable partisan bias to some party deliver the lowest marginal votes proportion. In this case, the right (left) party has an electoral incentive to be more responsive to fiscal policy demands of voters with strong partisan preferences for the left (right) party.

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