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Abstract. *In modern democracies, public policies are negotiated among elected policymakers. Yet, most macroeconomic models abstract from post-election negotiation. In order to understand the determinants of redistribution, this paper studies legislative bargaining in a growth model where individuals are heterogeneous in their initial capital. Legislators with time-inconsistent preferences negotiate over a linear capital tax. As often the case in actual budget negotiations, we assume that the default option in every legislative session coincides with the previous period's tax. The endogeneity of the status quo forces policymakers to internalize how current decisions affect their bargaining power in future sessions. This channel has far-reaching implications on equilibrium tax levels and on how taxes vary with the institutional environment. On average we obtain capital taxes between 8% and 50%, depending on the distribution of legislators' wealth and on the specifics of the institutions. Finally, we show that political growth cycles arise: decades with low taxes and growing capital are followed by decades with high taxes and decreasing capital (and vice versa).*

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Keywords: Redistribution, Time Consistency, Capital taxes, Legislative Bargaining, Markov-perfect Equilibria, Political Growth Cycles.

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1. Introduction

In order to understand the determinants of government size, redistribution and taxation, a growing literature in macroeconomics analyzes the political process governing policy decisions. The standard approach in *macroeconomics* is to focus on median-voter equilibria. We depart from this literature by explicitly modeling post-election *legislative bargaining*. Our change of framework is motivated by the observation that in actual democracies public choices are usually the result of some sort of negotiation among elected policymakers.[1]

This paper studies sequential bargaining over redistribution in the context of a standard Neoclassical growth model. We assume that legislators are heterogeneous in their initial wealth and that linear taxes on capital income finance lump-sum redistribution. The key element of the bargaining process analyzed in this paper is the *endogeneity of the status quo* policy. If there is disagreement in the legislative game, the level of taxation (and redistribution) chosen in the previous legislative session is implemented. Thus, the result of the legislative bargaining in any given period affects, by changing the default option, the bargaining process in all subsequent periods.

Quantitatively, we show that this additional mechanism has an important disciplinary role reducing policymakers' temptation to set taxes at confiscatory levels. In particular, when we calibrate the model such that the wealth distribution in the legislature replicates the net worth distribution in the U.S., we obtain average taxes of around 50%. If instead, we calibrate the model such that the wealth distribution in the legislature coincides with the net worth distribution of the U.S. members of Congress, we obtain average capital taxes of around 18%.

In contrast to other solutions analyzed in the literature to mitigate time consistency problems (e.g, implementation lags), our mechanism is endogenous to the model and depends on the political and institutional environment. As such, our setting allows us to investigate how institutions shape economic outcomes. As shown below, we generate a rich set of comparative statics.

[1] The legislative bargaining approach, which was pioneered by Baron and Ferejohn (1989), is widely adopted in political economy. However, to our knowledge, very few papers have used it in the context of a standard macro model. Among the papers using the median voter approach see Meltzer and Richard (1981), Alesina and Rodrik (1994), Persson and Tabellini (1994), Krusell and Rios-Rull (1999), Azzimonti *et al.* (2006), and Corbae *et al.* (2009). See Section 2 for a review of the related literature.

The economy is populated by: (i) consumers, who trade a full set of Arrow securities in order to allocate resources over time; (ii) competitive firms; (iii) and legislators who periodically vote to determine the current capital tax rate. Tax revenues are used to distribute a common lump-sum transfer to all consumers. Consumers as well as legislators differ with respect to their wealth. Legislators vote in order to maximize the utility of the consumers with their same level of wealth. Since taxes are proportional to capital income, capital taxation is a way of redistributing from consumers with high wealth to consumers with low wealth.

Legislative bargaining unfolds as follows. In each period one member of the legislature (the agenda setter) is randomly selected to make a take-it-or-leave-it proposal. If the proposal is rejected, the capital tax from the previous period (the status quo) is kept in place for one more period. If it is accepted, which happens with a probability equal to the measure of legislators favoring the proposal, the tax is implemented and the current policy becomes the default option in the next legislative session. Note that the status quo becomes a payoff-relevant state: forward looking legislators must then internalize the consequences of the current decision on future legislative sessions via its effect on the status quo.

A key feature of our environment is that politicians have endogenous time-inconsistent preferences over taxes and redistribution. Under commitment, legislators with pretax income below the mean would select maximum taxes in the current period (to maximize redistribution) and zero taxes in the long-run (to minimize distortions on savings decisions). However, once capital has been accumulated, taxing capital is no longer distortive. In the absence of commitment, legislators are thus tempted to raise capital taxes up to the maximum possible level in order to redistribute.

We solve for Markov-perfect equilibria of the dynamic game between legislators. Our results show that legislative bargaining with an endogenous status quo strongly reduces policymakers' temptation to raise taxes ex-post. The economic mechanism which disciplines legislators operates through two channels. First, the role of the status quo as the default option generates endogenous *policy persistence*. Policy changes may be rejected in equilibrium because some legislators may prefer the current status quo policy to most (or some) proposed capital taxes. The existence of this status-quo bias implies that legislators have to balance their present desire for high redistribution with their distaste for long-term savings distortions. Second, in equilibrium policy proposals are shown to be monotone increasing in the status quo. The probability of high tax proposals is thus increasing in the status quo. As a result, keeping a low status quo is a way to *strategically manipulate* (namely, improve) equilibrium proposals of future agenda setters.[2]

It is important to emphasize that such long-run considerations would not arise in models focusing on median-voter equilibria, wherein the median voter is able to impose her preferred policy regardless of the policy outcome that was voted in the previous period.

We numerically compute policy proposals and acceptance strategies that are consistent with a sequential equilibrium of the competitive economy. When calibrating the legislators' wealth distribution we have to take a stance on legislators' objectives. On the one hand, if legislators were fully benevolent they should act as representatives of the population that elected them. In this case, the appropriate distribution of wealth would be the distribution of net worth in the whole population. On the other hand, if we believe that legislators are completely self-interested we should calibrate the distribution of wealth to match the distribution of wealth in actual legislatures. We perform both exercises with data for the U.S economy and the U.S. Congress in 2007. Under the first assumption we find that average taxes are around 50% while under the second assumption taxes average 18%.

Legislative bargaining delivers equilibrium capital taxes well below the ones usually obtained by Markov equilibria where, as in this paper, decision makers sequentially choose the *current* capital tax. In order to obtain empirically reasonable tax rates, the literature usually assumes an implementation lag: that is, voting today is over the capital tax for next period. The lesson from this literature is that there needs to be a wedge between policymakers' preferences and policy implementation in order to generate empirically reasonable levels of taxation and redistribution. From this point of view, we believe that this paper is a step toward understanding the institutional determinants and aggregate implications of this wedge.

After computing the politico-economic equilibrium, we investigate how tax levels and the size of government are affected by changes in the political and institutional environment.

[2]Strategic manipulation in models with political turnover is analyzed, among others, by Alesina and Tabellini, (1990), Persson and Svensson, (1989), and Azzimonti, (2011). Note that, due to time consistency problems, current legislators also have incentives to strategic manipulate their future selves (see Laibson, 1997). Usually, the literature considers this type of manipulation separately from the one that is due to political turnover.

First, we modify the bargaining process by adopting a bicameral system instead of an unicameral one. As expected, requiring two concurrent votes to pass legislation aggravates status-quo bias. First, we find that legislators propose more gradual policy changes in order to maximize the probability of acceptance. Second, since higher policy persistence increases the cost of going to the next period with a high status quo, we obtain more fiscal discipline (lower tax proposals). Under our two alternative calibrations we find that average taxes decrease to 35% when legislators represent the population, and to 8% when they are self-interested.

Interestingly, we show that the endogeneity of the status quo induces politically driven growth cycles. This result is obtained because when current capital is low, legislators have a weaker incentive to raise taxes. This implies that periods with low capital tend to be associated with low taxes. Since taxes are persistent, observing low taxes encourages consumers to save. However, as capital accumulates legislators become increasingly tempted to set higher taxes. Eventually, a tax hike passes which leads to negative savings, so that the cycle begins again.

Finally, we conduct the following experiment: we increase the probability that poor legislators are selected to make policy proposals. This might be related to rising inequality which could lead to representatives of poor constituencies occupying key offices in the legislature. We show that a significant shift of power towards the poor raises taxes and redistribution by a small amount. This is because it generates two opposite effects that work against each other. On the one hand, since poor legislators gain more from redistribution, and therefore have a more severe present-bias temptation, inefficient policies are proposed more often. On the other hand, the fact that less fiscally responsible legislators have more power increases the marginal benefit of keeping taxes low in order to constrain future legislators. Because of the latter disciplinary effect, agenda setters change their behavior and propose lower taxes. All in all, we find that expected taxes do not increase by much. Potentially, this may explain why the empirical relation between inequality and amount of redistribution is weaker than what is predicted by median-voter models, where inequality has a strong positive effect on redistribution.[3]

[3]See the empirical papers by Perotti (1996) and Iversen and Soskice (2006)

2. Literature Review

There are two main approaches to study capital taxation: the traditional normative approach taken by the literature on optimal capital taxation and the positive approach, used in, for example, the recent macro-dynamic-political economy literature. The two approaches lead to different implications. The normative approach prescribes that, in a wide range of environments, the tax on capital should be zero in the long-run.[4] Conversely, the positive literature has shown that, without assuming either ad-hoc constraints or history-dependent strategies, the tax on capital is very close to 100%. For instance, in Klein *et al.* (2008) and Azzimonti *et al.* (2006) the equilibrium capital taxes without commitment are extremely high (81% and 100%, respectively). To avoid this outcome, the typical constraint assumed in the literature is that policymakers can choose the tax for the next period, not the current one.[5]

The positive literature was pioneered by the work of Krusell *et al.* (1997), who propose a notion of politico-economic equilibrium where political outcomes chosen by a forward looking median voter must be consistent with a sequential equilibrium of the competitive economy. Krusell and Rios-Rull (1999) consider a calibrated version of the Solow model. In contrast to this paper, they assume that the median voter theorem holds and agents vote on the tax in the next period. Their findings show that the size of transfers predicted by the model is close to that in the US data. More recently, Corbae *et al.* (2009) consider a setting in which individuals have uninsurable idiosyncratic labor efficiency shocks and conclude that in the US, the median model would predict an excessively large increase of redistribution following the increase in wage inequality in the 80s and 90s. Bachmann and Bai (2011) study the political determination of government purchases when preferences are aggregated using a social welfare function with weights dependent on the wealth of the households. Bassetto (2008) is one of the few papers that incorporates a bargaining process into a standard macro model. He considers an economy where two overlapping generations Nash-bargain over tax rates, transfers, and government spending. Aguiar and Amador (2011) consider a growth model where incumbent governments prefer consumption to occur when they are in power

[4]This is the classical result under commitment of Chamley (1986) and Judd (1985). Positive capital taxes are obtained in Aiyagari (1995), Conesa *et al.* (2009), and Piketty and Saez (2012).

[5] See for instance Persson and Tabellini (1994), Bénabou (1996), Krusell and Rios-Rull (1999), Klein and Rios-Rull (2003), and Corbae *et al.* (2009). One exception is Martin (2010), who allows for endogenous capacity utilization. Alternatively, low capital taxes may be sustained thanks to reputation mechanisms (see Chari and Kehoe, 1990, and Phelan and Stacchetti, 2001).

and, thus, have an incentive to expropriate capital. They focus on self-enforcing equilibria supported by threat of switching to the autarky equilibrium.[6]

Alesina and Tabellini (1990), Persson and Svensson (1989), Amador (2003), and Azzimonti (2011) show that governments affect the policy carried out by future governments by manipulating their successors' constraints via some state variable (e.g., debt or investment). In our setting, the dynamic linkage across periods is created by the status quo. Another key difference from this paper is that they assume that the winning party is a policy dictator and, consequently, there is no need of negotiating. Their main result is that strategic manipulation generates inefficiency (such as, excessive debt or low investment). Notice that in contrast to this literature, political turnover is beneficial in our model: the risk of losing power gives current policymakers the incentive to strategically maintain a low status quo.[7]

Recently, Battaglini and Coate (2007, 2008) and Battaglini *et al.* (2010) have adopted the legislative bargaining approach. They analyze a legislature of representatives making decisions about pork barrel spending, public good, and debt. Besides considering different subject matters, their setting differs from ours along two other dimensions.[8] First, they abstract from capital and they assume that the default option in case of disagreement is exogenous. In their model the dynamic linkage across periods is given by the level of public debt. Second, we study a different source of disagreement between current and future governments. In Battaglini and Coate (2007, 2008) current governments disagree with their successors on how to allocate pork. In our model disagreement between current and future governments arises for two different reasons. First, given that the supply of future capital is elastic, today's government would like future governments to choose lower capital taxes. Second, current and future governments disagree because they represent constituencies with different wealth. Riboni (2010) builds a dynamic agenda setting model in a stylized Barro-Gordon economy in order to study monetary policymaking. As in this paper, the endogenous status quo plays a key disciplinary role. He finds conditions under which monetary policy committees perform better than single central bankers. Persson *et al.* (1997, 2000) analyze alternative legislative-bargaining games in order to study the size and composition of govern-

[6]Other contributions to the recent dynamic political economy literature include the electoral accountability models by Acemoglu *at al.* (2008) and Yared (2010).

[7]The beneficial effect of political turnover has been pointed out in Acemoglu *et al.* (2011).

[8]Their goal is to analyze how policies respond to shocks in public spending needs and to characterize how public debt evolves over time. Azzimonti *et al.* (2011) analyze the impact of a balanced-budget rule.

ment spending under presidential and parliamentary regimes. Their theoretical results help explain the empirical evidence that the size of government in presidential regimes is smaller than in parliamentary regimes.[9]

Finally, this paper is related to the growing literature on legislative bargaining with an endogenous status quo. This literature generally finds that when legislators have concave utilities having an endogenous status quo improves welfare by reducing policy variability. This result was first obtained by Baron (1996), who analyzes a one-dimensional problem and finds that policy converges to the alternative preferred by the median legislator. By means of numerical simulation, Baron and Herron (2003) obtain a similar result in a two-dimensional setting. Duggan and Kalandrakis (2011) also argue that when players are sufficiently patient, the endogeneity of the status quo induces core convergence.[10] Bowen and Zahran (2012) study a divide a dollar game with endogenous default and shows that legislators have an incentive to reach a compromise.[11] Bowen *et al.* (2012) study public good provision and argue that when the status quo public good allocation is endogenous (as, for example, in the Medicare program), current governments are able to insure themselves against power switches. We emphasize that in this paper the endogenous status quo is beneficial for a completely different reason: because it serves a disciplinary role.[12]

3. The Model

3.1. Overview

The model economy includes three types of decision makers: consumers who consume and invest, firms that rent inputs and produce the only good in the economy, and legislators who decide the tax on capital in every period. It is important to keep in mind the general timing of events (see Figure 1). At the beginning of each period t, firms make their production decision, and then legislators meet and bargain over the current tax τ_t. Finally, knowing the

[9] The empirical relation between budgetary institutions and policy outcomes is analyzed, among others, by Alt and Lowry (1994), Persson and Tabellini (2003), and Besley and Case (2003).

[10] Among other papers in the endogenous status-quo literature, Bernheim *et al.* (2006), and Diermeier and Fong (2010), Riboni and Ruge-Murcia (2008), Nunnari (2012), and Dziuda and Loeper (2012).

[11] When legislators are risk-neutral, this result does not hold anymore. Kalandrakis (2004) considers a dynamic a dollar game and shows that in each period the agenda setter extracts all surplus. As a result, he obtains great variance of policies over time.

[12] Concave utilities are not needed for this result. In Piguillem and Riboni (2012) we consider a model with linear utilities and argue that a similar disciplinary role arises.

political outcome, consumers make their consumption and saving decisions.

Throughout, we focus on Markov Perfect equilibria where strategies depend on the payoff-relevant state variable. At time t, the state variable in the political game is given by the predetermined level of capital k_t and the status quo level of taxation q_t, where $q_t = \tau_{t-1}$. Any equilibrium of the political game can be represented by a stochastic Markov process with $\Gamma(\tau_t|q_t, k_t)$ determining the probability of a tax rate τ_t given a capital stock k_t and status quo q_t.

Consumers at time t make savings decisions after observing the political outcome τ_t. Therefore, the state variable in the consumers' problem is given by the current level of taxation (the status quo for next period) and the current level of capital k_t. Given initial capital, any competitive equilibrium can be summarized by the law of motion of aggregate capital, denoted by $G(k_t, \tau_t)$.

In Section 3.2, we describe the competitive equilibrium given an arbitrary stochastic process for policies. In Section 3.3, we describe the political game. In Section 4, we present a simple example to help build intution. In Section 5, we present the numerical solutions. Section 6 concludes.

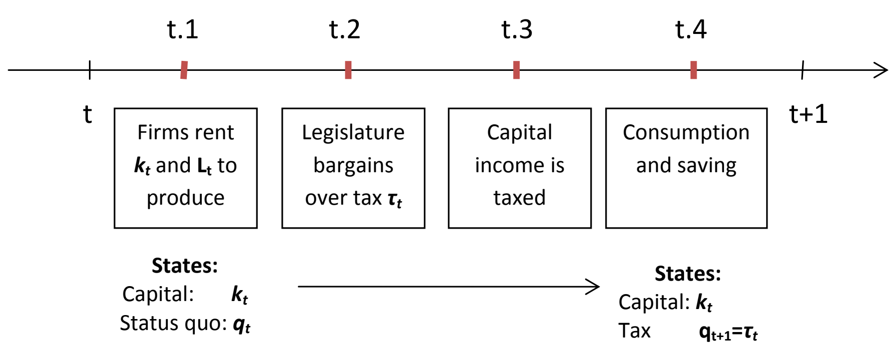

Figure 1: Timing of Events within a Period.

3.2. The Economy

In the economy, time is infinite and indexed by $t = 0, 1, ...$ There is continuum of consumers of measure one. Consumers are heterogenous in their initial wealth and indexed by θ^i; consumers of type θ^i are initially endowed with $\theta^i k_0$ units of capital, where $\theta^i \in \Theta$ and k_0 is the aggregate stock of capital at $t = 0$. Let $\mu(\theta^i)$ be the measure of consumers of type θ^i. For simplicity, we assume $E(\theta^i) = 1$.

Uncertainty is captured by a publicly observable state $s_t \in S$ in period t. Let s^t be the history of shocks up to time t and let $Pr(s^t)$ denote the probability of history s^t. The state s_t is reveled before consumers make their consumption and saving decisions. As will be explained in Section 3.3, the only source of uncertainty in this economy comes from the political process.

Consumers are endowed with one unit of labor, which is inelastically supplied. Their total income is the sum of real wage $w_t(s^t)$, a lump-sum transfer from the government $T_t(s^t)$, and the after tax return on capital holdings.

We assume that markets are complete. We let $a^i(s^t, s_{t+1})$ denote type θ^i's purchases of Arrow securities at time t, history s^t conditional on the realization of event s_{t+1} in the next period; the price of each security is $q(s^t, s_{t+1})$. A tractable way of formulating the market structure is to assume that each security pays one unit of capital upon the realization of s_{t+1}.

Thus, when choosing allocations consumers are subject to the following budget constraints:

$$c_t^i(s^t) + \sum_{s_{t+1}} q(s^t, s_{t+1}) a^i(s^t, s_{t+1}) = w_t(s^t) + T_t(s^t) + R_t(s^t) a^i(s^t), \tag{1}$$

for all$\{s^t\}_{t=0}^{\infty}$. The return on asset holdings is $R_t(s^t) = (1 - \tau_t(s^t)) r_t(s^t)$, where $r_t(s^t)$ is the rental rate of capital and $\tau_t(s^t)$ is the proportional tax on the returns from asset holdings. In order to streamline the analysis of this section we have assumed that capital depreciates fully. However, none of the results shown here depend on this assumption, and we show results with partial depreciation in the numerical solutions.

At time t an agent of type θ^i orders stochastic sequences of consumption according to the expected utility that they deliver:

$$E_t \left(\textstyle\sum_{j=t}^{\infty} \beta^{j-t} u(c_j^i(s^j)) \right), \tag{2}$$

where $E_t(.)$ denotes the expectation conditioned on time t information with respect to the probability distribution of the random variables $\{s^t\}_{t=0}^{\infty}$, $\beta \in [0, 1)$ is the discount factor and per-period utility is given by

$$u(c_t^i(s^t)) = \log(c_t^i(s^t)), \tag{3}$$

where $c_t^i(s^t)$ denotes the time t consumption of an individual of type θ^i.

There is a continuum of firms that rent capital and labor services to produce the unique consumption good. Production combines labor with capital using the following constant-returns-to-scale production function:

$$f(k_t(s^t)) = k_t(s^t)^\alpha. \tag{4}$$

Since there is perfect competition, firms choose capital and labor to satisfy the following conditions:

$$r_t(s^t) = f'(k_t(s^t)), \tag{5}$$

$$w_t(s^t) = f(k_t(s^t)) - r_t(s^t) f'(k_t(s^t)). \tag{6}$$

The government does not issue debt or consume, so the government budget's constraint is for all $\{s^t\}_{t=0}^\infty$

$$\tau_t(s^t)\ r_t(s^t)\ k_t(s^t) = T_t(s^t). \tag{7}$$

Given k_0, a law of motion for aggregate capital $G(k_t, \tau_t)$, and an arbitrary Markov process for taxes, $\Gamma(\tau_t|\tau_{t-1}, k_t)$, it is possible to generate a stochastic path for all τ_t and k_t. We now define the competitive equilibrium of our economy for a given sequence of policies.

Competitive Equilibrium Definition: *Let $\Gamma(\tau_t|\tau_{t-1}, k_t)$ and the initial distribution of wealth be given. A Competitive Equilibrium is a stochastic sequence of fiscal policies $\{T_t(s^t), \tau_t(s^t)\}_{t=0}^\infty$ allocations $\{c_t^i(s^t), \{a^i(s^t, s_{t+1})\}_{s_{t+1}}\}_{t=0}^\infty$ for all θ^i, and prices $\{w_t(s^t), r_t(s^t), \{q(s^t, s_{t+1})\}_{s_{t+1}}\}_{t=0}^\infty$ such that:*

1) *Given prices and the sequence of tax and transfers, the allocation for every consumer θ^i maximizes (2) subject to (1) for all $\{s^t\}_{t=0}^\infty$.*

2) *Factor prices satisfy firms' first order conditions for all $\{s^t\}_{t=0}^\infty$.*

3) *Given prices and aggregate allocations, the sequence of fiscal policies is generated by $\Gamma(\tau_t|\tau_{t-1}, k_t)$ and the government's budget constraint for all $\{s^t\}_{t=0}^\infty$.*

4) *Markets clear:*

$$c_t(s^t) + k_{t+1}(s^t) = f(k_t(s^t)), \quad for\ all \quad \{s^t\}_{t=0}^{\infty}$$

where

$$c_t(s^t) = \int_{\Theta} \mu(\theta^i) c_t^i(s^t) d\theta^i \ for\ all\ \{s^t\}_{t=0}^{\infty}$$

and

$$k_{t+1}(s^t) = \int_{\Theta} \mu(\theta^i) a^i(s^t) d\theta^i,\ for\ all\ \{s^t\}_{t=0}^{\infty}.$$

Suppose that at time $t = 0$ a consumer with share θ^i observes the current tax τ_0 and she expects that in the future policies will be given by $\{T_t(s^t), \tau_t(s^t); \forall s^t\}_{t\geq 1}$. Let $\phi(\theta^i)$ be the equilibrium proportion of consumption of agent θ^i with respect to the average consumer.[13] It can be shown that her maximized present value of utility is given by[14]

$$\widehat{V}(k_0, \tau_0, \theta^i) = \log(\phi(\theta^i, k_0, \tau_0)) + \widehat{V}(k_0, \tau_0, 1) \tag{8}$$

where

$$\phi(\theta^i, k_0, \tau_0) := \left[1 + \frac{(1-\beta)\left(\theta^i - 1\right)\alpha f(k_0)(1-\tau_0)}{c_0}\right] \tag{9}$$

That is, her present discounted value of utility can be decomposed into two additive parts: the first term depends on the consumption share, as defined in (9), while the second term is the present discounted utility of the average consumer for whom θ^i is 1. This result is due to the fact that the utility function is homothetic and markets are complete. Thus, the agents' decisions are proportional to each other, and knowing the decision of one agent is enough to characterize the decisions of all other agents.

As shown by Bassetto and Benhabib (2006), the optimal capital tax under commitment for an agent with $\theta^i \leq 1$ is at the upper bound in the first period and converges to zero in the long run.[15] The intuition for this result is similar to the Chamley's result, even though in

[13]Because markets are complete and the utility function is homothetic this proportion is constant and independent of time and of the state of nature.

[14]Bassetto and Benhabib, (2006) showed this result for economies without uncertainty and where consumers do not value leisure (as here). Piguillem and Schneider (2009) generalize the result to economies with endogenous labor supply, uncertainty and complete markets.

[15]In fact, from (9) we obtain that if $\theta^i < 1$ (respectively $\theta^i > 1$) the first term of expression (8) is always

our economy the government has access to lump sum taxation and there is not an exogenous stream of government spending to be financed. Legislators want to provide redistribution *via* lump sum transfers, while minimizing the distortions caused by capital taxation. Since capital is fully inelastic in the first period and completely elastic in the distant future, it is optimal to raise as much tax revenues as possible at the beginning and avoid future distortions.

Crucially, note that *the optimal plan is time-inconsistent*: legislators who sequentially vote on capital taxes have the temptation to increase capital taxes ex-post. Potentially, in the absence of commitment this may lead to a "bad" policy outcome in which taxes are at the upper bound in all t and savings are low. We stress that all agents with $\theta^i < 1$ share this temptation. The lower θ^i, the higher the temptation to raise taxes ex-post. This is because individuals with low θ^i get a larger amount of redistribution for any given positive value of τ_0.

3.3. Legislative Bargaining

We focus on post-election legislative bargaining and abstract from the election stage. There is a continuum of legislators with different levels of wealth. Each legislator is indexed by her current share of asset wealth $\theta \in \Theta_L$. We assume that legislators act in order to maximize the utility of the consumers with their same level of wealth. Legislators' wealth shares are distributed with density $\mu^l(\theta)$ with support $\Theta_L = [\underline{\theta}, \overline{\theta}]$. In order to make our problem much more tractable we assume that the distribution $\mu^l(\theta)$ is constant over time. In the absence of this assumption, income inequality is a political state variable since the current tax affects the relative wealth of legislators and, consequently, their incentives to tax in the future.[16]

The policy choice that is voted upon is the capital tax for the *current* period. Once the capital tax is selected, the lump-sum transfer is residually determined using equation (7). Let q_t denote the current status quo. At each t, legislative bargaining unfolds as follows.

> *(i) A randomly selected member of the legislature (the agenda setter) makes a take-it-or-leave-it offer τ_t.*

increasing (decreasing) in τ_0.

[16] Azzimonti *et al.* (2006) shows that in the median voter model, it is enough to keep track of the median's assets (that is, "political" aggregation is obtained). In our model, every legislator can be selected to be agenda setter. Therefore, if the distribution $\mu^l(\theta)$ were not constant, we would have to keep track of the entire distribution of wealth within the legislature.

(ii) All legislators simultaneously cast a vote: either "yes" or "no".

(iii) Proposals pass with probability equal to the measure of legislators who vote "yes".

(iv) If τ_t is accepted, it becomes the capital tax for the current period and the default option for next period: $\tau_t = q_{t+1}$.

If τ_t is rejected, q_t is implemented.

As is standard in the legislative bargaining literature, we suppose that some legislators have "agenda-setting powers": they have the ability to determine which bills are considered on the floor.[17] As in other papers in the literature, we assume that in each period only one legislator has the right to propose a tax. The identity of the agenda setter θ^s changes in each period and is a continuous random variable with density function $\mu^s(\theta^s)$ in the interval $[\underline{\theta}, \overline{\theta}]$. Thus, recognition probabilities are *i.i.d.* over time.

Point (iii) deserves some discussion. Note that acceptance is probabilistic: the higher the number of legislators that favor the proposal, the higher the probability of acceptance. This implies that proposals may be rejected even if a simple majority (over 50%) of legislators are in favor of it. In a typical legislature, this may happen when minority legislators have the ability to delay or veto the approval of the bill. Also note that point (iii) implies that a proposal may pass (although with smaller probability) when it is favored by a minority in the legislature. In some other circumstances, this might be the result of vote trading across issues or party discipline. For instance, suppose that there is a party which has a majority of seats and that its policy stance is decided by the median legislator within the party. Then, if there is strict discipline within the party, a policy change may pass with the support of only 25 percent of the legislature. Acceptance is certain only when all legislators prefer the proposal to the status quo, and rejection is certain when all legislators prefer the status quo. We defend the probabilistic acceptance on two grounds. First, the assumption captures the idea that some uncertainty is inherent in the political process. In a richer model, uncertainty as to whether the bill will pass could arise when the agenda setter does not perfectly observe legislators' preferences. Second, probabilistic acceptance introduces an additional source of uncertainty

[17] The chairs of important committees (such as, the Rules Committee in the US House) are usually endowed with agenda-setting powers. Also, legislatures often cede agenda-setting powers to executive offices, such as, the president or premier.

to our model besides the one concerning the agenda setter's identity. The extra noise makes numerical computations much more tractable. Notice that probabilistic acceptance is not essential for our argument: to stress this, in Section 4 we present an example where simple majority rule is assumed.

Finally, point (iv) states that the current policy becomes the default option in case of disagreement in the next legislative session.[18]

We focus on pure Markov strategies. Since strategies are stationary, the problem can be formulated in a recursive way, and in what follows we drop the time index. A proposal strategy for agenda setter θ^s is a function of aggregate capital k, and the status quo q: $\tau(\theta^s) : \Re_+ \times [0, \bar{\tau}] \to [0, \bar{\tau}]$. After observing the proposal, legislator θ votes according to a voting rule $\alpha(\theta) : \Re_+ \times [0, \bar{\tau}] \times [0, \bar{\tau}] \to \{yes, no\}$.

As is commonly assumed in the voting literature, we suppose that legislators vote as if they were pivotal.[19] Legislator θ supports proposal τ against the status quo if and only if τ provides higher utility than q. That is,

$$\alpha(k, q, \tau; \theta) = \begin{cases} \text{“}yes\text{”} & if \quad \widehat{V}(k, \tau, \theta) \geq \widehat{V}(k, q, \theta), \\ \text{“}no\text{”} & otherwise. \end{cases} \tag{10}$$

We let $A(k, q, \tau)$ denote the set of legislators who support the proposal,

$$A(k, q, \tau) = \left\{ \theta \in \Theta_L : \widehat{V}(k, \tau, \theta) \geq \widehat{V}(k, q, \theta) \right\}. \tag{11}$$

We denote the probability that proposal τ is accepted given the pair (k, q) by $Pr^a(k, q, \tau)$. As assumed in point (iii), $Pr^a(k, q, \tau)$ is equal to the measure of set $A(k, q, \tau)$.

$$Pr^a(k, q, \tau) = \begin{cases} \int_{A(k,q,\tau)} \mu^l(\theta) d\theta & if \ \tau \neq q \\ 1 & if \ \tau = q \end{cases} \tag{12}$$

Note that when $\tau = q$ the probability of acceptance is one. In fact, rejecting the proposal would not make any difference: policy q would be adopted regardless of the vote.

[18] As argued by Tsebelis (2002, p. 8), the status quo is often the explicit or *de facto* outside option in actual budget negotiations. Rasch (2000) identifies the countries where this provision is part of the formal rules.

[19] This rules out Nash equilibria where all legislators accept a proposal they do not like because a single rejection would not change the voting outcome.

Since consumers make decisions after the legislature votes, saving decisions depend on current capital and on the current capital tax τ. Note, however, that τ does not change the current income of the average agent. Thus, τ affects aggregate savings only because it constitutes the default option in the next legislative session.

If legislator θ^s is randomly chosen as the agenda setter, her optimal proposal maximizes the expected present value of utility given the current stock of capital and the current status quo:

$$\tau(k,q;\theta^s) = \arg\max_{\tau\in[0,\bar{\tau}]} Pr^a(k,q,\tau)\widehat{V}(k,\tau,\theta^s) + (1 - Pr^a(k,q,\tau))\widehat{V}(k,q,\theta^s) \tag{13}$$

subject to

$$k' = G(k,\tau); \qquad \forall\tau \tag{14}$$

The first term of the objective function is the utility of implementing τ from expression (8) multiplied by the probability that τ is accepted. The second term is the utility of keeping the status quo, multiplied by the probability that τ is rejected. Note that this is a non-trivial problem since the agenda setter must realize the consequences of her proposal on the current and future probabilities of acceptance, on proposal rules of future agenda setters and on savings decisions.

Using the proposal rule and the probability of acceptance, the probability that each τ is implemented given a state is:

$$\Gamma(\tau|q,k) = \begin{cases} Pr^a(k,q,\tau)\int_{\tau=\tau(k,q;\theta^s)} \mu^s(\theta^s)d\theta^s & if\ \tau \neq q \\ \int_{q=\tau(k,q;\theta^s)} \mu^s(\theta^s)d\theta^s + \int_0^{\bar{\tau}} \left(\int_{\tau'=\tau(k,q;\theta^s)}(1 - Pr^a(k,q,\tau'))\mu^s(\theta^s)d\theta^s\right) d\tau' & if\ \tau = q \end{cases} \tag{15}$$

Expression (15) has a simple interpretation. From the first line, the probability of making a policy change to τ is equal to the measure of agenda setters that would propose τ multiplied by the probability that the proposal is accepted. The second line is the probability of maintaining the status quo. This can happen when q is proposed, the first term, and when other proposals are rejected, the second term. Notice that the latter term is what explains endogenous policy persistence in the model.

We now proceed to define the *Politico-Economic Equilibrium.* We require the Markov process for taxes implied by the political game to be optimal given the law of motion of aggregate capital implied by the competitive equilibrium, and vice versa.

Politico-Economic Equilibrium Definition: *A politico economic equilibrium is: value functions for all legislators* $\widehat{V} : \Re_+ \times [0, \bar{\tau}] \times \Theta \to \Re$, *proposal rules for all legislators* $\tau(\theta^s)$ $: \Re \times [0, \bar{\tau}] \to [0, \bar{\tau}]$, *approval rules for all legislators* $\alpha(\theta) : \Re_+ \times [0, \bar{\tau}] \times [0, \bar{\tau}] \to \{yes, no\}$, *a Markov process for taxes characterized by* $\Gamma(\tau|q, k)$, *and the law of motion of aggregate capital* $G : \Re_+ \times [0, \bar{\tau}] \to \Re_+$ *such that*

a) Given $\Gamma(\tau|q, k)$, *the law of motion of aggregate capital is generated in the competitive equilibrium and* $\widehat{V}$ *is given by (8).*

b) Given $G(k, \tau)$ *and* $\widehat{V}$,

b.1) Approval rules satisfy (10).

b.2) The tax proposal solves problem (13).

b.3) $\Gamma(\tau|q, k)$ *is generated by equation (15).*

For more details about the algorithm used in the computations see Section 5.1 and Appendix A.1.

4. Example

In this section we present a simple example to explain the mechanism behind the full dynamic model presented in Section 3. While the underlying economy is identical to the one described in Section 3.2, legislative bargaining in this example is simplified along three dimensions. First, we assume that the legislature chooses taxes only in periods 0 and 1: the tax that is chosen in period 0 is implemented at time 0, while the tax that is chosen at time 1 stays in place at all $t \geq 1$. That is, in this example policy persistence is assumed; in the full model policy persistence will arise in equilibrium. Second, the legislature includes only two types of legislators with shares θ^m and θ^p. We assume that both types are poorer than the average and that $\theta^p < \theta^m < 1$. Concerning the distribution of seats in the legislature, we suppose that legislators of type θ^m have a majority. The probabilities of becoming agenda setters for legislators of type θ^m and θ^p are equal to $1-\gamma$ and γ, respectively. The third simplification that we make in the example is to assume that a proposal passes by simple majority rule. This implies that a proposal passes if and only if legislators of type θ^m are in favor.

We proceed backwards. First, we solve the bargaining game at time $t=1$ for any given possible state. Then we move backward to time $t=0$.

4.1. Legislative Bargaining at $t=1$

Recalling that the tax chosen at $t=1$ stays in place for all $t \geq 1$, using standard guess-and-verify methods we obtain that for all $t \geq 1$ we have $k_{t+1} = (1-\tau_1)\alpha\beta k_t$. Using (8), (9), and the law of motion of aggregate capital we compute the value functions of the two legislators, denoted by $\widehat{V}(\tau_1, k_1, \theta^m)$ and $\widehat{V}(\tau_1, k_1, \theta^p)$. Figure 2 illustrates that both utilities are single peaked in the constant tax τ_1. Moreover, it can be shown that the optimal constant tax of legislator θ_i, denoted by $\tau^*(\theta^i)$, solves the following first order condition:

$$\frac{1}{\phi(\tau_1,\theta^i)}\frac{-(\theta^i-1)}{1-(1-\tau_1)\beta\alpha} - \frac{\tau_1\beta}{(1-\tau_1)(1-\beta\alpha)} = 0, \tag{16}$$

where $\phi(\tau_1, \theta^i)$ was defined in equation (9). The first term is increasing in τ_1 for both legislators and reflects the current gain from redistribution. The second term is the efficiency cost, due to distorted savings decisions, of setting a high capital tax.[20] Figure 2 shows that $\tau^*(\theta^p) > \tau^*(\theta^m)$. Not surprisingly, the preferred constant tax for the poorer legislator is above the peak of the relatively richer legislator.

[20]Note that the optimal tax that solves equation (16) does not depend on the current level of capital. This is because we assumed logarithmic utility and full depreciation.

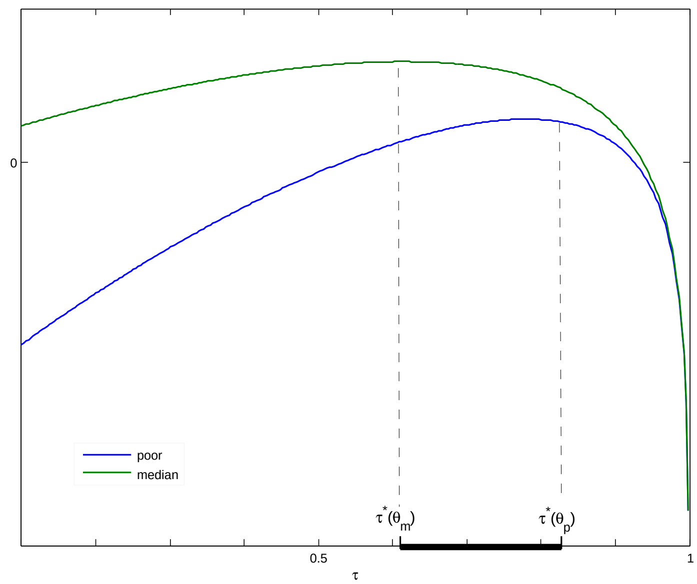

Figure 2: Indirect Utilities of Legislators θ^p and θ^m.

We now describe the political outcome at $t = 1$. Because the recognized agenda setter has a monopoly power over the agenda, the political outcome depends on the agenda setter's type. Two cases must be considered. The first possibility is that the recognized agenda setter at $t = 1$ is a legislator of type θ^m. The second possibility is that the recognized agenda setter is a legislator of type θ^p.

The first case is immediate to solve: when the majority legislator is also the agenda setter, $\tau^*(\theta^m)$ is obviously proposed and the proposal passes. The second case is that the agenda setter is of type θ^p. Since legislators of type θ^p constitute a minority, a proposal by θ^p will pass if and only if legislators of type θ^m prefer the proposal to the status quo. We define the acceptance set $\Upsilon_m(q_1, k_1)$ as the set of policy proposal that θ^m finds weakly preferable to the status quo q_1 (for a given capital level k_1): $\Upsilon_m(q_1, k_1) = \{\tau_1 \in [0, 1] : \widehat{V}(\tau_1, k_1, \theta^m) \geq \widehat{V}(q_1, k_1, \theta^m)\}$.

After computing $\Upsilon_m(q_1, k_1)$, the maximization problem of the agenda setter θ^p is straightforward to solve. Recalling that θ^p favors higher taxes than θ^m, it is easy to see that when the acceptance constraint is not binding, θ^p proposes the unconstrained optimum, $\tau^*(\theta^p)$. Instead, if the acceptance constraint is binding, θ^p proposes the maximum alternative in the acceptance set. An instance in which the acceptance constraint is binding is when the status quo q_1 lies between $\tau^*(\theta^p)$ and $\tau^*(\theta^m)$ (see the shaded interval in Figure 2). In this case, no policy change is possible: it is impossible to increase the utility of legislators θ^p without decreasing the utility of legislators θ^m. When instead the status quo lies outside the shaded interval, a policy change is possible. For instance, if $q > \tau^*(\theta^p)$, both legislators want lower taxation. It is immediate to verify that when $q > \tau^*(\theta^p)$ the agenda setter θ^p is able to pass $\tau^*(\theta^p)$. Finally if $q < \tau^*(\theta^m)$ both legislators want higher taxes. Agenda setter θ^p uses her monopoly power over the agenda to threaten the legislature with facing the consequences of keeping a low status quo policy. This allows θ^p to pass a higher policy than $\tau^*(\theta^m)$. In particular, when the status quo is sufficiently low (below a threshold denoted by $\underline{\tau}$), θ^p is able to pass her preferred policy.[21] When instead q_1 is between $\underline{\tau}$ and $\tau^*(\theta^m)$, θ^p chooses a policy that leaves θ^m indifferent between accepting and rejecting: we denote this policy by $\tau^i_m(q_1)$.

It is now immediate to compute the expected tax at $t = 1$:

$$E(\tau_1) = \begin{cases} \gamma\tau^*(\theta^p) + (1-\gamma)\tau^*(\theta^m) & if\ 1 \geq q_1 > \tau^*(\theta^p) \\ \gamma q_1 + (1-\gamma)\tau^*(\theta^m) & if\ \tau^*(\theta^m) \leq q_1 \leq \tau^*(\theta^p) \\ \gamma\tau^i_m(q_1) + (1-\gamma)\tau^*(\theta^m) & if\ \ \underline{\tau} \leq q_1 < \tau^*(\theta^m) \\ \gamma\tau^*(\theta^p) + (1-\gamma)\tau^*(\theta^m) & if\ \ 0 \leq q_1 < \underline{\tau} \end{cases} \tag{17}$$

Expression (17) makes clear that when θ^p is the agenda setter (an event occurring with probability γ), the chosen tax depends on the initial status quo. In particular, notice that when q_1 is close to 1, the bargaining power of θ^p is so high that she is able to pass her preferred policy $\tau^*(\theta^p)$. When instead the agenda setter is of type θ^m, the implemented policy is $\tau^*(\theta^m)$, regardless of the location of the status quo.

4.2. Time $t = 0$.

The tax policy that is negotiated at time 0 only applies to the current period. However, legislators must internalize the consequences, via the status quo, of the current choice on legislative bargaining at time 1.

We analyze the trade-off faced by legislator θ^m at time 0. On the one hand, when looking at the current payoff, θ^m wants maximum taxes. On the other hand, θ^m realizes –see expression (17)– that a high capital tax at $t = 0$ will become the default in the next period and lower

[21] We define $\underline{\tau}$ as the status quo policy that makes θ^m indifferent between rejecting and accepting $\tau^*(\theta^p)$.

her bargaining power in case the agenda setter at $t = 1$ is of type θ^p. Taking this political cost into account, θ^m generally chooses a capital tax lower than 100%.

It is important to notice that the strength of the political cost of rasing taxes at $t = 0$ depends on the political and institutional environment. In particular, there are three instances in which the political cost is zero and, consequently, θ^m chooses maximum taxes at $t = 0$.

RESULT : *At $t = 0$ agenda setters of type θ^m choose maximum taxes if one (or more) of the following conditions is met: (i) $\gamma = 0$; (ii) $\theta^p = \theta^m$; (iii) the status quo is exogenous.*

The intuition for condition (i) is the following. When γ is zero, there is no political turnover: θ^m knows that she will be the agenda setter at $t = 1$. As a result, she does not need to keep taxes low in order to constrain future agenda setters. As γ increases, legislators of type θ^m have stronger incentives to be more disciplined (propose lower taxes) at time 0. Does it necessarily follow that a higher γ lowers equilibrium taxes? The answer is not straightforward since an increase of γ also implies that poorer legislators, who favor high taxes, are recognized more often as agenda setters. This second effect goes in the opposite direction of the disciplinary effect discussed above and explains why an increase of γ may have an ambiguous effect on equilibrium tax levels (for a quantitative exercise see Section 5.2.6). Condition (ii) concerns income inequality within the legislature. To understand the role of this condition, note that when θ^p and θ^m are close, legislators have similar wealth and, consequently, do not disagree much on the policy that should be chosen at time 1. In the absence of disagreement, θ^m would not care about lowering her bargaining power. Eventually, when $\theta^p - \theta^m$ goes to zero, maximum taxes are chosen at $t = 0$. Finally, it is important that the default in the legislative bargaining is endogenous. If the default is fixed, the political cost of raising taxes at $t = 0$ is null: bargaining at time 1 would depend on the fixed status quo, not on the previously decided policy.

5. Quantitative Exercise

5.1. Computational Strategy

The numerical problem consists of solving one fixed point, the *Politico-Economic Equilibrium* (PEE) characterized by $\Gamma(\tau|q, k)$, which depends on another fixed point, the *Competitive Equilibrium* (CE), characterized by the law of motion of aggregate capital $G(k, \tau)$. Loosely speaking our strategy amounts to first solving the CE given $\Gamma(\tau|q,k)$. This generates an aggregate decision rule and new value functions. Then, we use the outputs from the CE to generate a new $\Gamma(\tau|q,k)$ and we repeat this procedure until convergence. In Appendix A.1, we describe the algorithm, but some details are worth mentioning.

We solve the CE using a variant of Carroll (2006)'s endogenous grid method. Since the CE exhibits aggregation, it is enough to solve the problem of the mean agent. Thus, we start the iterations assuming a $G(k,\tau)$ and then apply the Carroll (2006) method to the saving problem of the mean agent. Then, we set $G(k,\tau)$ equal to the saving policy function of the mean agent and repeat the procedure until the aggregate saving rule is consistent with the saving rule of the mean agent. The main difference from the solution of a standard CE problem is that fiscal policies are endogenous, thus implying that the future tax depends on the future stock of capital. This can create problems for equilibrium existence and convergence of numerical algorithms (when the equilibrium exists). However, as shown by Coleman (1991) and Greenwood and Huffman (1995), when the tax function is monotone increasing in the level of capital the problem disappears. We confirm in the numerical solutions that the tax function is indeed monotone increasing in the capital stock.[22]

We stress that at least one PEE always exists; in particular, the "bad equilibrium" where the legislature sets the tax at the upper bound in every period, and agents invest foreseing this strategy. Intuitively what happens here is that when the aggregate law of motion of capital is completely inelastic to the current tax policy, it is optimal for the agenda setter to propose the highest possible tax and for the legislature to approve it. Since we are interested in equilibria in which aggregate savings react to the tax policies, we start the iteration of the PEE assuming that $\Gamma(\tau|k,\tau)=1$. That is, it is initially assumed that taxes always remain at the same level. This allows us to search for the equilibrium where savings actually react to current taxes.

Finally, one important step in solving for the PEE is the computation of the acceptance probability. Again, the aggregation result greatly simplifies this task. We use the fact that $\widehat{V}(k,q,\theta)$ satisfies the single crossing property to compute $Pr^a(k,q,\tau)$.[23] That is, the differ-

[22]See Figure 7. See Santos, (2002) for an extensive discussion of existence of Markov Equilibria in non-optimal economies. The main difference between our economy and the ones in those papers is the inclusion of the past tax as a state variable. For this reason, we cannot apply those results directly to our model.

[23]See Piguillem and Schneider (2009) for a formal proof.

ence between $\widehat{V}(k,\tau,\theta)$ and $\widehat{V}(k,q,\theta)$ is monotone in θ. This implies that there is at most one legislator, denoted by $\theta^*(k,q,\tau)$, who is indifferent between τ and q. That is, using (8) and (9) we obtain

$$\theta^*(k,q,\tau) = \frac{[f(k)-G(k,q)]\,\Xi(k,q,\tau)-[f(k)-G(k,\tau)]}{(1-\beta)rk[1-\tau-\Xi(k,q,\tau)(1-q)]}+1, \tag{18}$$

where

$$\Xi(k,q,\tau) := e^{\left[\widehat{V}(k,q,1)-\widehat{V}(k,\tau,1)\right]}.$$

Notice that if $\Xi(k,q,\tau)>1$ the average individual is better off with the status quo. In this case, because of the single crossing property, we have that the proposal passes with probability equal to the measure of legislators with share of wealth below the cutoff θ^*. Then,

$$Pr^a(k,q,\tau) = \begin{cases} \int_{\underline{\theta}}^{\theta^*(k,q,\tau)} \mu^l(\theta)d\theta & if\ \ \Xi(k,q,\tau)\geq 1, \\ 1-\int_{\underline{\theta}}^{\theta^*(k,q,\tau)} \mu^l(\theta)d\theta & otherwise. \end{cases} \tag{19}$$

5.2. *Results*

5.2.1. Calibration. Throughout the numerical simulations we set $\beta=0.96$ and $\alpha=0.3$. Concerning the depreciation rate, we assume that $\delta=0.08$, with the exception of Section 5.2.5, where we suppose $\delta=1$. The upper bound for taxes is $\bar{\tau}=0.95$.[24] These parameters are standard in the literature. However, calibrating the distribution of wealth within the legislature, $\mu^l(\theta)$, requires making a stance on legislators' objectives. If we think that legislators are benevolent, or closely represent the population that elects them, the appropriate distribution of wealth would be the distribution of net worth in the whole population. Instead, if we think that politicians are self-interested, we should pick the distribution of wealth of the actual representatives. In what follows, we present results under two alternative calibrations.

First, we calibrate μ^l with the distribution of net worth in the U.S. economy using the *Survey of Consumer Finances* (SCF) for 2007. Since computing the acceptance probabilities requires a continuous function, we approximate the observed distribution of net worth with

[24]The reason why we assume $\bar{\tau}<1$ is the following. In the simulations with $\delta=1$, assuming $\bar{\tau}=1$ would imply that policymakers, by choosing the upper bound, could eliminate all inequality in the first period and thus all future temptations to rise taxes ex-post. Having $\bar{\tau}<1$ is a reduced form way of capturing a richer environment where agents have exogenous labor skills that regenerate inequality in every period.

a *Frechet* distribution. Under this calibration we obtain that the median share is equal to 0.25 and $Prob(\theta > 1) = 0.20$. See Figure A.1 in the appendix for more details.

Second, we collect data from opensecrets.org and we compute the distribution of net worth for the U.S. representatives (see Appendix A.2 for more details). This data revels that members of Congress are much richer than the population that they represent: in particular, more than 60% of the legislators are richer than the average citizen. In our second calibration we repeat the approximating procedure discussed above using this database instead of the SCF.

Concerning the distribution of agenda setting power, $\mu^s(\theta^s)$, in most of our simulations (with the exception of Sections 5.2.5 and 5.2.6), we assume that it coincides with $\mu^l(\theta)$.

Before presenting the equilibrium average taxes it is informative to analyze the computed proposal and acceptance probabilities.

5.2.2. Proposal and Acceptance Strategies. The most important outputs of the numerical simulations are the proposal strategies and the acceptance probabilities. In Figure 3, we fix the level of capital and illustrate the proposed capital tax (on the vertical axis) as a function of the status quo for different values of θ^s, the share of wealth of the recognized agenda setter.

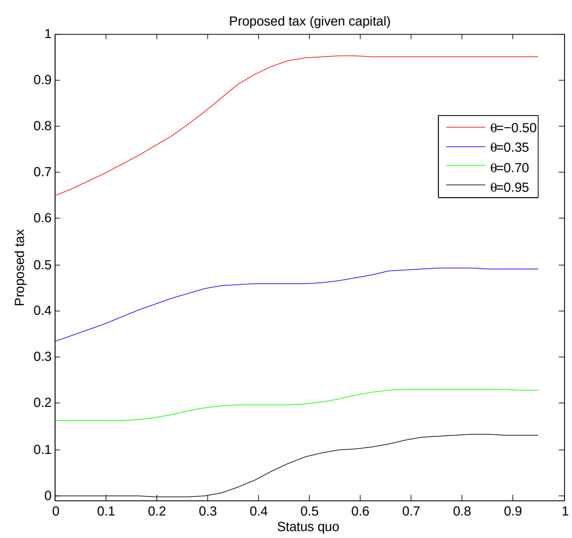

Figure 3: Proposal Strategies

Two features of the proposal rules are worth noting. First, the poorer the legislator (that is, the lower her θ^s) the higher the proposed tax for any given status quo. This is because poor legislators gain more from redistribution and consequently are more willing to accept the long run distortions associated with an increase of the status quo. For instance note that a poor agenda setter ($\theta^s = -0.5$) proposes $\bar{\tau}$ for most status quos, while a relatively richer agenda setter ($\theta^s = 0.95$) proposes zero for most status quo policies. Second, proposal rules are monotone increasing in the status quo. For example, the upper curve in Figure 3 shows that a poor agenda setter proposes taxes lower than $\bar{\tau}$ when the initial status quo is around zero and that her proposal approaches $\bar{\tau}$ as q increases.

The positive slope of the proposal rule is an important element of our disciplinary mechanism. It provides the channel for strategic manipulation of future agenda setters: by passing low taxes current policymakers reduce the expected proposals of future agenda setters.

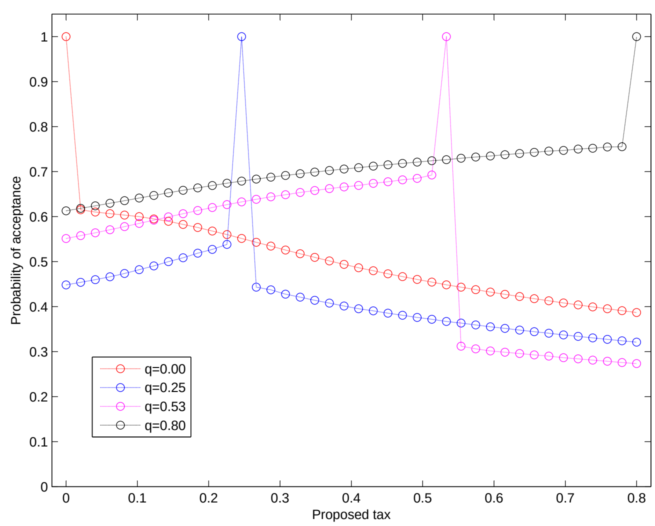

Figure 4: Acceptance Probabilities

Figure 4 illustrates the acceptance probabilities as a function of all possible proposals. Thus, the vertical axis measures the probability of acceptance and the horizontal axis the proposal τ. Again we compute the probability for a given level of capital. Each line in Figure 4 corresponds to a different status quo policy. Note that acceptance probabilities are below one unless the proposal coincides with the status quo, as shown in equation (19). When the proposal coincides with the status quo, legislators have no other choice than accepting the proposal. When the proposal differs from the status quo, some legislators oppose the change, which makes the probability of rejection strictly positive and generates the jump discontinuity at $\tau = q$. The fact that rejection occurs with positive probability creates policy persistence. Since policymakers gain from high taxes today but they would like to commit to low taxes in the future, policy persistence attenuates the temptation rise taxes.

Another feature worth noting is that the probability of acceptance is decreasing in the distance between the status quo and the proposal. Large policy changes are less likely to be accepted because an increasing number of people are made worse off. To understand this, consider first a proposal to infinitesimally cut taxes. In this case, the legislators who oppose the change would be those who prefer a tax increase. Consider now a large tax cut and notice that the group of legislators opposing this change are not only those who prefer a tax increase, as before, but also some legislators who prefer a smaller tax cut.

Finally, note that in general there is an asymmetry between the left and the right jump from the status quo. For instance, when the status quo is 0.53 the probability of accepting a tax increase is smaller than the probability of accepting a tax cut. This is because a tax rate of 0.53 is too high from the perspective of the majority of legislators. When instead the status quo is relatively low, the asymmetry is in the opposite direction.

5.2.3. Average taxes. Table 1 presents summary statistics for 10000 simulated legislative sessions. Each row corresponds to a different calibration of wealth within the legislature. We present in Column 2 the share of the median legislator. In Columns 3 and 4, we show the average capital tax and the autocorrelation of the tax. In Columns 5 and 6 we report, respectively, the standard deviation of the tax and average consumption. The first row shows that average taxes are equal to 50% when the distribution of wealth in the legislature coincides with the one in the population. Notice that tax levels are well below the upper bound, even though most legislators are poorer than the average.

Table 1. Summary Statistics

Calibration	θ^m	$E(\tau)$	$corr(\tau, \tau_{-1})$	$std(\tau)$	consumption
Benevolent Legislators	0.25	0.50	0.53	0.27	0.98
Self-interested Legislators	1.76	0.18	0.50	0.39	1.14

When we assume that legislators are self-interested (that is, when we use the actual distribution of wealth within the US Congress) most of the legislators are richer than the average agent in the economy. As a result, taxes are considerably lower and average consumption higher under this calibration. This may explain why voters elect politicians richer than themselves. Persson and Tabellini, (1994b) have shown that electing conservative (rich) representatives could be welfare improving. As we show in Section 5.2.5, our mechanism does not require legislators richer than the average to work.

5.2.4. Bicameralism. We now suppose that in order to pass, a proposal must be approved by two chambers. For simplicity, assume that in the two chambers, legislators' wealth shares are distributed according to the same density. As before, in each chamber the probability of approval is equal to the measure of legislators who prefer the policy change. Since we assume that the two votes are independent, the overall probability that the proposal passes is simply the square of expression (12).

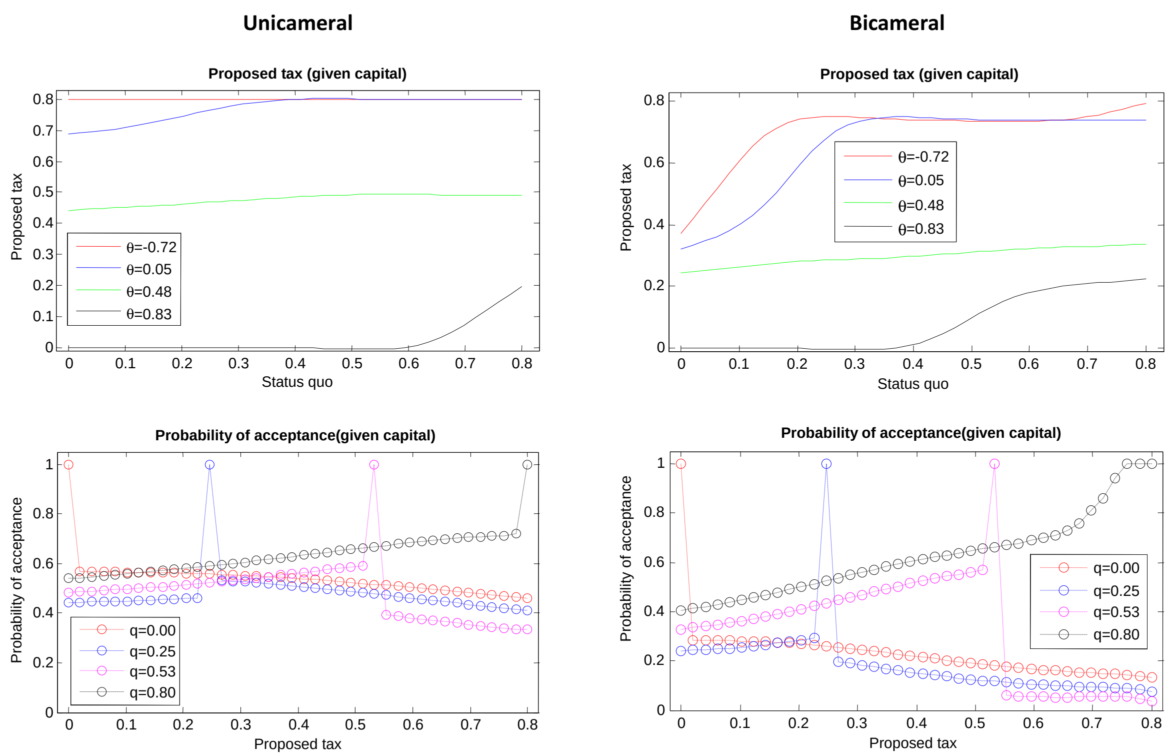

Figure 5: Unicameralism (Left Panels) vs Bicameralism (Right Panels)

Figure 5 illustrates the proposal rules (upper panels) and acceptance probabilities (lower panels) in the two systems. Equilibrium behavior under bicameralism (unicameralism) is shown at the right (left). As expected, we find that the constitutional change induces more status quo bias: policy changes less likely pass in a bicameral system.[25] Moreover, it affects the slope of equilibrium proposal rules. In the bicameral legislature, proposals are closer to the 45 degrees line. This is because legislators propose taxes closer to the status quo in order to increase the probability of acceptance. For instance, note that tax increases proposed by poor agenda setters are more moderate in the bicameral case when the status quo is close to zero. Finally, by increasing policy persistence, bicameralism makes it more costly to go to the next period with a high status quo. As a result, proposal rules are in general lower. By comparing results in Tables 1 and 2, note that in our stylized bicameral system taxes are lower, autocorrelation increases and public policies are slightly less volatile.

Table 2. Bicameralism.

Calibration	θ^m	$E(\tau)$	$corr(\tau, \tau_{-1})$	$std(\tau)$	consumption
Benevolent Legislators	0.25	0.35	0.76	0.26	1.07
Self-interested Legislators	1.76	0.08	0.66	0.37	1.16

The high policy persistence associated to the bicameral system has important consequences for the predicted path of aggregate capital (and GDP) and taxes. Figure 6 (upper panel) illustrates a sample path for capital taxes, starting with a high status quo. Interestingly, the lower panel of Figure 6 indicates that capital evolves according to a cyclical pattern and that the period cycle lasts several decades.

The key explanation underlying these “political growth cycles” is provided in Figure 7, where we show that expected taxes are monotonically increasing in current capital (represented on the horizontal axis). This feature arises because a high capital stock increases the tax base, strengthening the temptation to raise capital taxes for redistribution purposes. Then, when capital is low, low taxes are more likely to be proposed (and pass) than high taxes. Since taxes are expected to persist (see the high autocorrelation in Table 2), we obtain that consumers foresee several periods with low taxes and accumulate more capital. However, as the economy grows legislators become increasingly tempted to rise taxes. Eventually, high

[25]Notice that the probabilities of acceptance in the bicameral system are not not exactly equal to the square of the ones under unicameralism. This is because voting rules, as described in (10), are themselves affected by the constitutional change.

taxes pass in the legislature, leading to negative savings, so that the cycle begins again.[26]

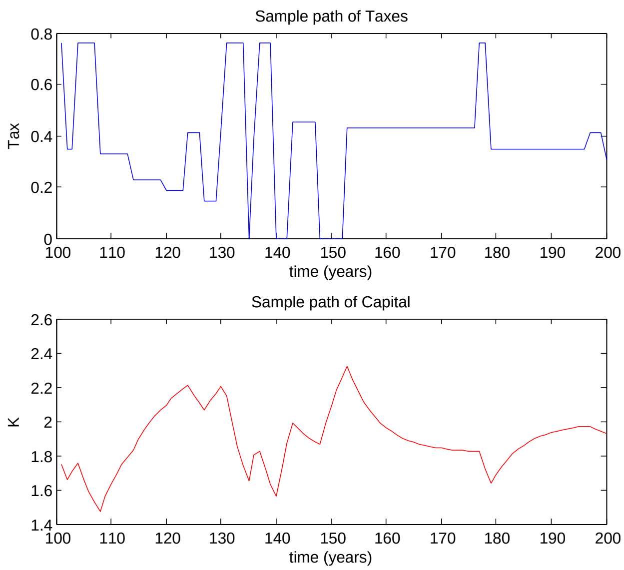

Figure 6: Sample path taxes and aggregate capital

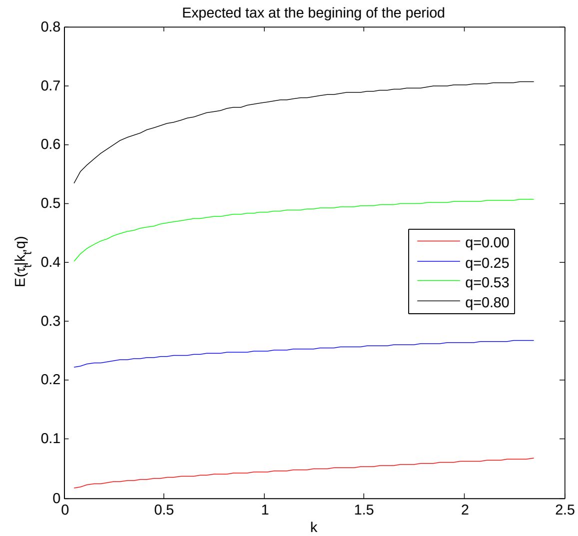

Figure 7: Expected tax at the beginning of the period

5.2.5. How important rich legislators are?. The reader may wonder if the results of Table 1 and 2 depend on having a large proportion of legislators with pretax income above the mean. As shown below, this is absolutely irrelevant for our qualitative results. To make clear this point, we consider alternative distributions whose supports are truncated above at 1, so that the richest legislator has wealth share equal to the average consumer in the economy. In particular, we assume that the share of wealth in the legislature is distributed according to a truncated exponential in the interval $[-5, 1]$. The share θ^s of the selected agenda setter is distributed according to a truncated normal, again in the interval $[-5, 1]$. Moreover, we assume here that $\delta = 1$ so that capital income taxation gives *de facto* full confiscatory powers to the legislators.

Table 3 presents summary statistics for 10000 simulated legislative sessions. In order to understand the consequences of changes in the political and institutional environments, we compute average taxes corresponding to different combinations of recognition probabilities and wealth distribution in the legislature. We present in Columns 1 and 2 the first moments

[26]Policy persistence is key to generate these cycles. In unreported results we obtained that in the unicameral system (where persistence is lower) political cycles are less pronounced.

of both distribution: that is, $E(\theta^s)$, the expected share of the agenda setter, and $E(\theta)$, the expected share of wealth in the legislature. The remaining columns show the computed statistics for capital taxes. While rows 1 to 5 present results when $\delta = 1$, in the final row we compute summary statistics when $\delta = 0.08$.

Table 3. Changes in the Distribution.

$E(\theta^s)$	$E(\theta)$	$E(\tau)$	$corr(\tau, \tau_{-1})$	$std(\tau)$	$min(\tau)$	$max(\tau)$
0.410	0.020	0.178	0.475	0.092	0	0.552
0.410	0.500	0.134	0.489	0.120	0	0.676
0.600	0.020	0.138	0.528	0.078	0	0.507
0.600	0.500	0.115	0.490	0.110	0	0.642
0.600	0.602	0.104	0.480	0.085	0	0.630
0.640	0.720	0.347*	0.522	0.281	0	0.690

* This row has been computed with $\delta = 0.08$

In spite of the fact that all members of the legislature gain from redistribution, we find that average taxes are still well below the upper bound tax rate. Note that we obtain low taxes even when the average wealth share in the legislature is close to zero (see the first row). As expected, if both the average legislator and the average agenda setter become richer, average taxes decrease. In all simulations the implemented tax for some sessions is zero and the approved tax is always below the upper bound. The standard deviation of policy decisions is decreasing in the distance between the average share of the legislators and of the agenda setter. Intuitively, larger distances imply stronger disagreement within the legislature, and more disagreement leads to fewer policy changes and more status-quo bias. A similar argument can explain why we obtain high autocorrelation when the difference between $E(\theta^s)$ and $E(\theta)$ is high.

An interesting observation from this table is that expected taxes do not vary much after significant changes of either $E(\theta^s)$ or $E(\theta)$. In Section 5.2.6 we describe equilibrium decisions under the configuration of parameters of rows 2 and 4, and explain why a sizeable decrease of $E(\theta^s)$ has small effect on average taxes.

Finally, the last row of Table 3 presents results under partial depreciation ($\delta = 0.08$), as we did in Section 5.2.3. We find that with partial depreciation average taxes are three times larger than with full depreciation. The underlying reason is intuitive. With full depreciation the stock of capital in the next period coincides with current savings. This implies that expectations of high taxes drive capital to low levels (possibly zero) in only one period. In other words, full depreciation makes future capital extremely elastic. This explains why legislators find it politically more costly to set high taxes when capital fully depreciates. When instead the depreciation rate δ is less than one, low savings have a weaker impact on the stock of capital available in the next period. This diminishes the political cost of going to the next period with a high status quo tax and increases legislators' temptation to choose high taxes.

5.2.6. Shift of Agenda Setting Power. In this section we conduct the following experiment: we increase the probability that poor legislators are selected to make policy proposals by decreasing the expected wealth share of the agenda setter. As already shown in Table 3, this change does not have drastic consequences for equilibrium outcomes.

We argue below that this is because it generates two opposite effects that balance each other. On the one hand, poorer legislators, who prefer higher taxes, are recognized more often. On the other hand, the fact that future agenda setters will likely be poorer increases the incentive of current agenda setters to propose low taxes by increasing the cost of moving into the next period with a higher status quo.

In order to understand the latter effect, we look in detail at the equilibrium proposals and acceptance probabilities when the distribution of agenda setting power within the legislature changes. We fix the average wealth share in the legislature (throughout $E(\theta) = 0.5$) and decrease the average wealth share of the recognized agenda setter from 0.6 to 0.41. Figure 8 compares the proposal rules (upper row) and the probability of acceptance (lower row), respectively, after (left panel) and before (right panel) the power shift.

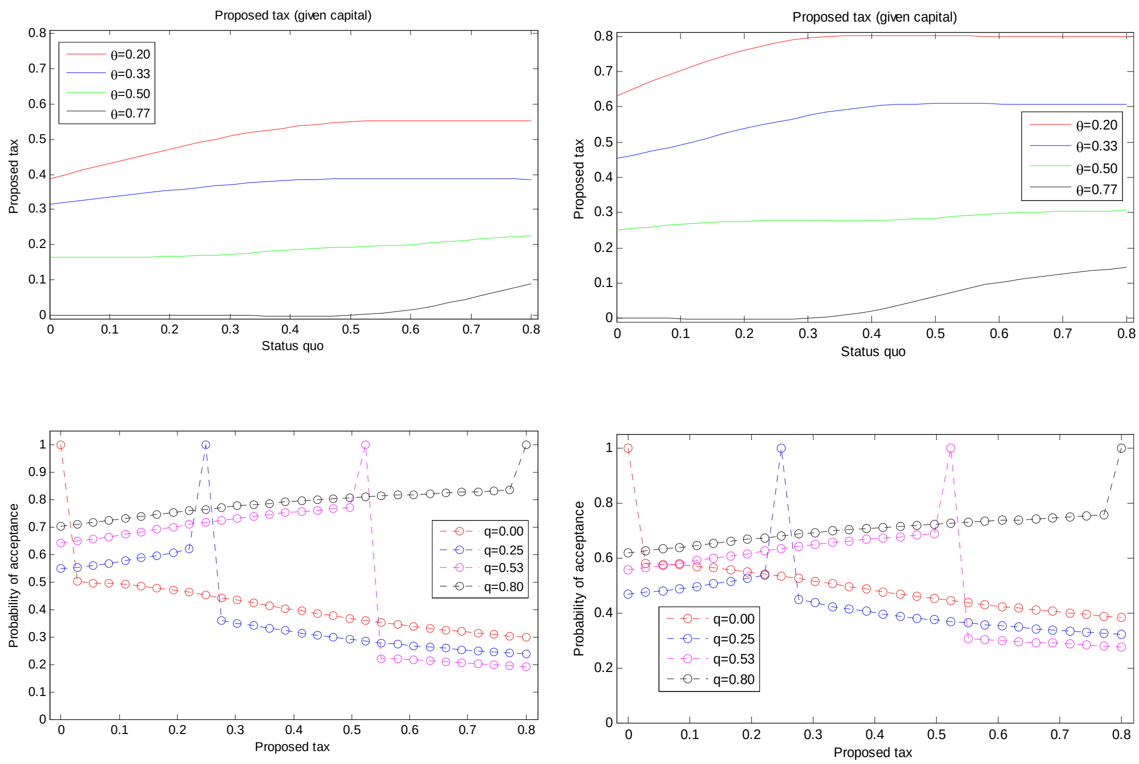

Figure 8: $E(\theta^s) = 0.41$ (Left Panels) vs $E(\theta^s) = 0.6$ (Right Panels)

The upper row of Figure 8 illustrates that the proposals made by an agenda setter of any given wealth share are lower when future agenda setters are expected to be poor compared to the proposals made when future agenda setters are expected to be rich. This is why the proposal rules in the upper-left panel of Figure 8 are below those in the upper-right panel.

For instance, consider the tax proposed by a very poor agenda setter ($\theta^s = 0.2$). When the expected share of future agenda setters is 0.41, her proposal is consistently below the upper bound tax rate for all status quo policies. When instead rich legislators are more likely to be recognized, the proposal rule starts at a higher level and reaches $\bar{\tau}$ when the status quo is above 0.4. The intuition behind this result is that a shift of agenda setting power toward the poor has a *disciplinary effect*. Since a larger number of future agenda setters are expected to be fiscally irresponsible (propose tax increases), it is more valuable to strategically use the status quo to manipulate them.

Notice that we observe the same disciplinary effects on acceptance probabilities. As shown in the lower panels of Figure 8, when the expected agenda setter becomes poorer, the legislature is less likely to accept tax increases and reject tax cuts.

However, as mentioned before, a power shift towards the poor also induces a standard *composition* effect on the pool of realized agenda setters. Since rich legislators propose on average lower taxes, if they are less likely to be recognized, equilibrium taxes tend to increase. Comparing row 2 with row 4 in Table 3, note that the overall effect of a sizeable power shift toward poor legislators is positive, but quite small.

6. Conclusions

We have studied a macroeconomic model where redistribution is decided in a post-election bargaining process rather than by the median voter. This point of departure from the literature is key to generate a rich set of predictions.

Since current capital is sunk, legislators with pretax income below the average have time-inconsistent indirect preferences over redistribution and taxation: they have incentives to choose maximum taxes in every period. In spite of this temptation, we find that policymakers may not propose (or accept) high capital taxes because this increases the status quo, and thus, the bargaining power of low wealth agents in future negotiations. This future political cost is enough to generate time consistent levels of capital taxation that are reasonably low. It is worth mentioning that we obtain these results without resorting to reputational arguments or introducing ad-hoc constraints on the governments' set of choices.

The political environment and the number of checks and balances specified in the constitution are key determinants of government size. Among other experiments, we consider a shift of proposal power toward representatives of poor constituencies. We show that on the one hand, since poor policymakers gain more from redistribution, higher capital taxes are more likely to be proposed. However, we also show that poor legislators having more agenda-setting power increases the political cost of going to the next period with a high status quo. As a result, we find that legislators behave in a more fiscally responsible way. All in all, these two opposite effects imply that taxes and transfers do not increase much when the poor have more power. Since a power shift towards poor legislators might be related to increased inequality, our results could explain why the empirical relationship between inequality and government size is weaker than what is predicted by macro models adopting the median-voter approach.

Finally, we show that endogeneizing policy making may induce political cycles: periods with low taxes and growing capital are followed by periods with high taxes and decreasing capital (and vice versa).

The economic consequences of political institutions have been studied by several authors using stylized models, often in a partial equilibrium and static settings. Our paper is a first step toward understanding the effects of constitutional rules on economic outcomes in the context of a standard macroeconomic model. However, much remains to be done in order to capture more realistic features of policymaking. This constitutes an important direction for future research.

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Appendix

A.1. Algorithm

Given measure μ^s of agenda setters and μ^l of median legislators, construct grids $\mathcal{K}$, $\mathcal{T}$, and Θ for, respectively:

1. Capital stock $k \in [k_{min}, k_{max}]$.
2. Tax $\tau \in [0, \bar{\tau}]$.
3. Share of average capital $\theta \in [\theta_{min}, \theta_{max}]$.

We choose θ_{min} low enough to make sure that there is a measure zero of θ's below it.

Guess an initial Markov process for taxes $\Gamma_0(\tau|q, k) : \mathcal{T} \times \mathcal{T} \times \mathcal{K} \rightarrow [0, 1]$. To allow for sensitivity of the competitive equilibrium to the actions of the political game we start the simulations with $\Gamma_0(\tau|\tau, k) = 1$ for all k, τ.

Finally, we fix the tolerance level for the political game, $\epsilon > 0$.

Step 1 (*Solve Competitive Equilibrium*) Given Γ_0 solve for the equilibrium law of motion for capital: $k' = G_1(k, \tau)$ for $(k, \tau) \in \mathcal{K} \times \mathcal{T}$, using the endogenous grid method of Carroll (2005).

The key observation is that under complete markets the aggregation theorem holds, and we only need to solve for the optimal decision of the average agent. Since the fixed grid is $\mathcal{K}$, the output from this step would be the matrix $k_0 \in \Re^2$ such that $k = \widetilde{G}_1(k_0, \tau)$ for all $(k, \tau) \in \mathcal{K} \times \mathcal{T}$. Then, using linear interpolation we obtain the mapping $G_1 : \mathcal{K} \times \mathcal{T} \rightarrow \Re$.

Step 2 (*Compute value functions*) Given Γ_0 and $G_1(k, \tau)$ compute the value function for the average agent, $\widehat{V}(k, \tau, 1)$, using the standard iteration of the value function (starting with $\widehat{V}(k, \tau, 1) = 0$) and interpolating for values of k outside the grid. Further, again because of the aggregation theorem, the value function for each agent θ can easily be computed as $\widehat{V}(k, \tau, \theta) = \log(\phi(\theta)) + \widehat{V}(k, \tau, 1)$ for all θ, using expression (9).

Step 3 (*Update Markov process for taxes*) Using equation (18) compute, for each k, the legislator $\theta^*(k, \tau, q)$ who is indifferent between the status quo q and a new policy τ. Then, the probability of acceptance of a tax τ given status quo q and capital stock k, is given by (19). In addition, given the acceptance probability, $\widehat{V}(k, \tau, \theta)$ and $G_1(k, \tau)$ we can compute the optimal choice for each agenda setter using equation (13): $\tau(k, \tau, \theta)$. Since we are not certain about the properties of the objective function we use a global method to choose the maximum. That is, we evaluate the objective function for all possible combinations of k and τ and choose the maximum value.

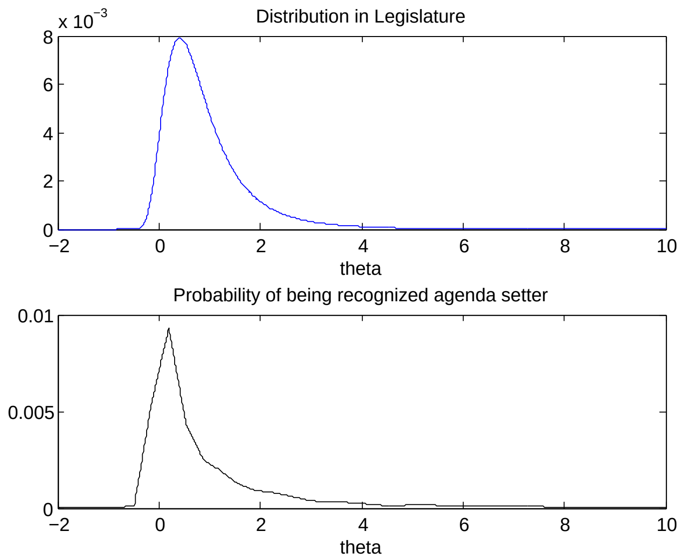
Both $Pr^a(k, q, \tau)$ and $\tau(k, \tau, \theta)$ then imply a new Markov process for taxes using (15).

Step 4 (*Updating*) Check the distance between the assumed process for taxes and that implied by the policy game. If $norm(\Gamma_0 - \Gamma_1) < \epsilon$ stop: the equilibrium is found. Otherwise go to Step 1, updating Γ_0 with $\alpha\Gamma_1 + (1-\alpha)\Gamma_0$ for some $\alpha \in (0, 1)$.

A.2. Distribution of net worth

Distribution of Net worth in the population

Figure A.1: Kernel Density and Frechet approximation. Distribution of Net worth SCF 2007



Distribution of Legislators' net worth

Figure A.2: kernel density distribution of Net worth. Members of US Congress

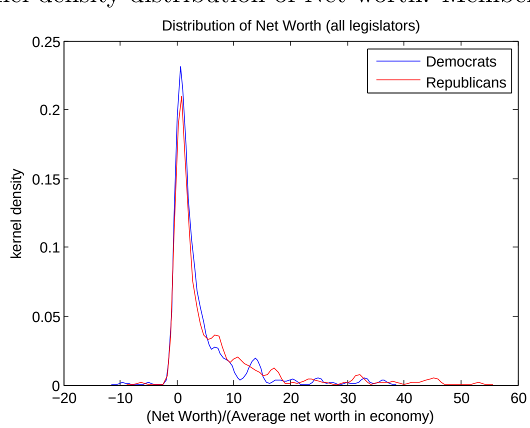


Table A.1: net worth for the U.S. members of Congress

	Summary		
	Democrats	**Republicans**	**Difference (%)**
House			
Average	4,488,893	7,561,302	68%
Median	654,006	848,035	30%
Prop richer than average	0.58	0.61	
Senate			
Average	19,383,524	7,153,985	-63%
Median	2,579,507	3,025,002	17%
Prop richer than average	0.85	0.83	
Boths Chambers together			
Average	7,209,600	7,491,000	4%
Median	891,506	1,075,002	21%
Prop richer than average	0.63	0.65	