Dynamic Bargaining over Redistribution in Legislatures

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Abstract

This paper analyzes the standard Neoclassical growth model where agents are heterogeneous in their initial wealth. Wealth can be taxed in order to finance equal lump-sum transfers. We consider a representative democracy where elected officials select the current capital tax by playing a legislative bargaining game. Specifically, one member of the legislature makes a take-it-or-leave-it proposal and decisions pass by majority rule. In case of rejection of the proposal, the capital tax that was voted in the previous period (the status quo) is kept in place for one more period. A key feature of the bargaining game is that when looking at current payoffs both the agenda setter and the legislature have aligned preferences: their most preferred static policy is full taxation. However, the strength of these preferences differ. We show that the fear of ending in a high taxation equilibrium sustains levels of capital taxes and redistribution that are empirically reasonable. The endogeneity of the status quo is a crucial ingredient which disciplines legislators and reduces commitment problems. We also find that higher wealth inequality does not necessarily increase the size of government (the share of income redistributed).

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1 Introduction

This paper studies a version of the Neoclassical growth model where agents are heterogeneous in their initial wealth. Wealth (capital income) can be taxed in order to finance equal lump-sum transfers. Since taxes are proportional on capital income, capital taxation is a way of redistributing from agents with high wealth to agents with low wealth.

We suppose that public policy choices are determined in a politico-economic equilibrium. Unlike much of the macro political-economy literature, in order to aggregate preferences we do not resort to the median voter theorem.[1] Instead, we consider a representative democracy where elected officials select the current capital tax through legislative bargaining.[2]

Voting is sequential (that is, policy makers cannot commit to a sequence of policies). More in particular, we assume that one member of the legislature is randomly recognized to make a take-it-or-leave-it proposal. In case of acceptance, the tax proposal is implemented. In case of rejection, the capital tax that was voted in the previous period (the status quo) is kept in place for one more period. Once the capital tax is selected, using the government budget constraint (which we assume to be balanced in each period) the lump-sum transfer is residually determined.

Solving our model amounts to solving a non-trivial fixed point problem. Specifically, we require that the law of motion of capital taxes that is behind the determination of the competitive equilibrium must coincide with the policies selected in our legislative bargaining model.

It is important to notice that the status quo is a payoff relevant state because for many legislators rejecting the policy proposal is a credible threat. As a result, the location of the status quo affects the equilibrium proposal

[1] The seminal paper by Meltzer and Richard (1981) investigates the determinants of the size of government using the median voter approach. More recent papers extend this approach to a dynamic setting: see among others, Krusell and Rios-Rull (1999), Azzimonti *et al.* (2006), and Corbae *et al* (2009).

[2] The legislative bargaining approach has been pioneered by Baron and Ferejohn (1989).

and, consequently, the final decision. Moreover, note that in our bargaining model the current policy becomes the default option in case of no agreement in the next legislative session. This creates a dynamic link across periods and introduces an additional state variable besides the standard economic ones. Legislators are assumed to be forward looking: they choose their strategies knowing that current decisions will affect future decisions via the status quo and via their effects on the economic state variables.

In our model, policy preferences over capital tax are not diametrically opposed and the extent of disagreement varies over time. On the one hand, without looking at any effect that current decisions may have on future payoffs, policy makers that represent individuals that are poorer than the average are in favor of full capital taxation. But on the other hand, when looking at future payoffs and considering the distortions on consumption/saving decisions, individuals agree (to different degrees) that in the following periods taxes should be low and zero in the long-run.[3]

In this paper we argue that the endogenous status quo provides a disciplinary role and reduces commitment problems. In particular, we obtain that policy makers may not propose (or accept) high capital taxes (which are beneficial in the short run) because passing a high capital tax, via a change of the status quo, would increase the bargaining power of low wealth agents in future negotiations. Taking this future cost into account, we obtain that high capital taxes are not proposed (or accepted) in the current period. In other terms, by introducing an additional political state variable we avoid the equilibrium where capital income is fully taxed.

Our model yields some predictions about the size of government, which is measured by the share of redistributed income. First, as in the seminal paper by Meltzer and Richard (1981), we obtain that the size of government is increasing in the distance between the mean income and the incomes of

[3]Ideally, policy makers would like to commit to a sequence of taxes that is decreasing over time. The optimal sequence of capital taxes under commitment is characterized in Bassetto and Benhabib (2006).

the decisive players in the legislature. The intuition for this result is simply that a more skewed income distribution makes redistribution more attractive and implies a high equilibrium tax rate. However, there is a second channel through which income inequality affects the size of government in our model. Notice in fact that the size of government is increasing in the severity of time consistency problems: the more severe credibility problems are, the higher the equilibrium capital taxes and the larger the size of government. In the context of our model, we argue that the disciplinary role of the status quo is related to the distribution of wealth in the economy. In particular, more inequality increases the amount of disagreement among legislators concerning the level of future capital taxes. This implies that policy makers are more reluctant to propose policy changes that may decrease their bargaining power in the continuation game. As a result, commitment problems are less severe when income inequality increases. This second effect goes in the opposite direction than the first one. All in all, we obtain that the size of government is affected in a non trivial way by income inequality.

The model is closely related to several recent macro political economy papers. The pioneering work by Krusell *et al.* (1997) assumes that political outcomes are endogenously determined by a median voter who chooses a proportional tax rate that is required to be consistent with a sequential equilibrium of a competitive economy. Krusell and Rios-Rull (1999) argue that a calibrated version of the Solow model, where agents are heterogenous with respect to their income and decisions coincide with the one favored by the median voter, is quite close to the observed size of US government. As in Krusell and Rios-Rull (1999) we assume complete market and homothetic preferences: this implies that for a given stream of policies, private allocations can be expressed as a constant share of aggregate variables and that differences in initial wealth persist indefinitely. One key difference from Krusell and Rios-Rull (1999) is that, as discussed above, we do not use the median model but the political process is modeled as a legislative bargaining process. Furthermore, while they assume that today's vote is on the tax in the next period, we assume that the legislature votes on the current tax, which is non-distortionary.

More recently, Corbae *et al.* (2009) suppose that individuals have uninsurable idiosyncratic labor efficiency shocks and consider a model where policy choices are selected by a median. They consider voter the US in the 80s and 90s and they conclude that the median model would predict counterfactual (excessive) increase of redistribution following the strong increase in wage inequality in that period.

Finally, other recent papers have used a model of legislative bargaining à la Baron and Ferejohn (1989) to study policy making. For instance, Battaglini and Coate (2008) analyze a model of pork barrel politics. However, compared to Battaglini and Coate (2008) we consider a full fledge dynamic economy where individuals make consumptions/saving decisions. Of courses, this complicates solving the fixed point problem.

2 The Economy

Time is infinite and indexed by $t = 0, 1, ...$ There is continuum of consumers of unit measure. Each consumer is initially endowed with θK_0 units of capital, where $\theta \in \Theta$. Let $\mu(\theta)$ be the measure of each agent θ. For simplicity, we assume $E(\theta) = 1$. Therefore, K_0 is the aggregate (and average) initial stock of capital.

Uncertainty is represented by the public observable state $s_t \in S$, where S is finite. It is important to emphasize that in our model the only source of uncertainty is the political process. Specifically, uncertainty concerns the identity of the agenda setter in the legislature and whether or not the agenda setter's proposal is accepted.[4] Let s^t be the history of shocks up to time t and let $\Pr(s^t)$ denote the unconditional probability of event s^t. In choosing

[4]See Section 2.2 for details.

private allocations, consumers take these probabilities as given.[5] Moreover, they also take as given the sequence of public policies $\{T_t(s^t), \tau_t(s^t); \forall s^t\}_{t\geq 0}$, where $T_t(s^t)$ is a lump-sum transfer from the government and $\tau_t(s^t)$ is the tax on capital income, where $\tau_t(s^t) \in [0, \bar{\tau}]$.

In each period t, consumers work and make consumption/savings decisions after observing the state s_t. Agents order stochastic sequences of consumption according to the expected utility that they deliver:

$$E\left(\sum_{t=0}^{\infty} \beta^t u(c_t(s^t))\right), \tag{1}$$

where $E(.)$ denotes the expected value with respect to 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 $u(c_t(s^t)) = \log(c_t(s^t))$.[6] Each consumer is endowed with one unit of labor, which is supplied inelastically.

When choosing allocations consumers are subject to the following budget constrain:

$$c_t(s^t)+k_{t+1}(s^t) = w_t(s^t)+T_t(s^t)+(1-\tau_t(s^t))r_t(s^t)k_t(s^{t-1}), \quad \text{all } \left\{s^t\right\}_{t=0}^{\infty} \tag{2}$$

where $w_t(s^t)$ is the real wage and $r_t(s^t)$ is the interest rate.

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:

$$f(K_t(s^{t-1})) = K_t(s^{t-1})^{\alpha}.$$

To streamline the analysis, we assume that capital fully depreciates. Since there is perfect competition, firms choose capital and labor to satisfy the following conditions:

[5]As explained in Section 2.2, the probability that a proposal passes is endogenous because it depends on the equilibrium proposal.

[6]If taxes were on total income, it is well known (see Lansing, 1999) that under logarithmic utility, the commitment solution is time-consistent. Here, however, taxes are on capital income only.

$$r_t(s^t) = f'(K_t(s^{t-1})),$$

$$w_t(s^t) = f(K_t(s^{t-1})) - r_t(s^t) f'(K_t(s^{t-1})).$$

The government does not issue debt or consume. Thus, the government budget's constraint is

$$\tau_t(s^t)\ r_t(s^t)\ K_t(s^{t-1}) = T_t(s^t) \ \text{ all } \left\{s^t\right\}_{t=0}^{\infty}. \tag{3}$$

We now define the competitive equilibrium of our economy for a given sequence of policies.

Def: *Let a sequence of policies* $\{T_t(s^t), \tau_t(s^t); \forall s^t\}_{t\geq 0}$ *be given. Let also an initial distribution of wealth be given. A Competitive Equilibrium consists of allocations* $\{c_t(s^t;\theta), k_t(s^t;\theta); \forall s^t\}_{t=0}^{\infty}$ *and factor prices* $\{w_t(s^t), r_t(s^t); \forall s^t\}_{t=0}^{\infty}$ *such that:*

1) *At the stated prices, the allocations for every consumer* θ *maximize (1) subject to (2) for all periods and all realizations of shocks.*

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

3) *The government's budget constrain holds for all* $\{s^t\}_{t=0}^{\infty}$

4) *Markets clear. That is,*

$$c_t(s^t) + K_{t+1}(s^t) = f(K_t(s^t)) \quad \textit{all } \left\{s^t\right\}_{t=0}^{\infty}$$

where

$$c_t(s^t) = \int_{\Theta} \mu(\theta) c_t(s^t;\theta) \ \textit{ all } \left\{s^t\right\}_{t=0}^{\infty}$$

and

$$K_{t+1}(s^t) = \int_{\Theta} \mu(\theta) k_{t+1}(s^t;\theta) \quad \textit{all } \left\{s^t\right\}_{t=0}^{\infty}$$

2.1 Legislative Bargaining

Policy is set through legislative bargaining. The set of legislators is assumed to be $\Theta' \subset \Theta$, where $\Theta' = [\underline{\theta}, 1]$.

Legislators are benevolent: they represent the agents in the economy with the same level of wealth. In this paper, we abstract from the selection process of the members of the legislature. Instead, we focus on the post-election bargaining game within the legislature.[7]

The policy choice that is voted upon is the capital tax for the current period. Once the capital tax is selected, using equation (3) the lump-sum transfer is residually determined.

The timing is as follows. At the beginning of each period, a member of the legislature (denoted θ^s) is randomly selected to be the recognized agenda setter. The identity of the agenda setter is distributed according to an exponential distribution. Recognition probabilities are i.i.d. across periods. The recognized agenda setter is able to make a take-it-or-leave-it offer.[8]

In this paper, we assume that the median member of the legislature is also random and distributed according to a normal distribution. Moreover, his identity is not known to the agenda setter before the proposal is made.

Subsequently, the proposal is put to a vote. All members of the legislature simultaneously cast a vote (either "yes" or "no").

If the legislature accepts the proposal, the policy proposal is implemented and becomes the new default option for the next legislative session. If the legislature rejects the proposal, the status quo (the past tax on capital) is implemented and remains the default option in the next legislative session.

Finally, after observing the outcome of the legislative bargaining, individuals make their consumption and savings decisions.

Throughout, we focus on (pure) stationary Markov strategies. The en-

[7] The interaction between elections and legislative bargaining has been analyzed (in a simpler setup) by Chari *et al.* (1997).

[8] In other terms, decisions are made under closed rule (see Baron and Ferejohn, 1989).

dogenous state variables of the economy consist of the aggregate stock of capital, K, and of the status quo policy, denoted τ_s. For the recognized agenda setter θ^s a strategy is a proposal rule $\tau(\theta^s) : \Re_+ \times [0, \bar{\tau}] \to [0, \bar{\tau}]$. For all other legislators a strategy is an approval strategy $\alpha(\theta) : \Re_+ \times [0, \bar{\tau}] \times [0, \bar{\tau}] \to \{yes, no\}$. That is, given the current state and the proposal by the agenda setter, a legislator decides whether to accept or reject.

We let $\Pr(K, \tau, \tau_s)$ denote the endogenous probability that proposal τ is accepted given the current state of the economy. This probability will be defined in equations (7) and (8) below.

Let $V(K, \theta, \tau_s, \theta^s)$ be the maximum present discount value for an individual of type θ when an agenda setter of type θ^s has been recognized. Recall that consumers make private decisions after observing the current capital tax. Given the current share of aggregate capital and given the current capital tax τ, we let $\theta'(\tau)$ denote the individual's share in the next period. Similarly, we let $K'(\tau)$ denote aggregate capital in the next period when the current capital tax is τ.

The proposal rule $\tau(\theta^s)$ for the agenda setter must solve the following Bellman equation:

$$V(K, \theta^s, \tau_s, \theta^s) = \max_{\tau \in [0, \bar{\tau}]} \{Pr(K, \tau, \tau_s)[u(c(\theta^s; \tau)) + \delta \ \mathrm{E}V(K'(\tau), \theta'^s(\tau), \tau, \theta)] +$$

$$(1 - Pr(K, \tau, \tau_s))[u(c(\theta^s; \tau_s)) + \delta \ \mathrm{E}V(K'(\tau_s), \theta'^s(\tau_s), \tau_s, \theta)]\}$$

subject to

$$K'(\tau) = G(K, \tau); \qquad \forall \tau \tag{4}$$

$$\theta'(\tau) = 1 + \beta(1 - \tau)(\theta - 1)\frac{rK}{K'}; \quad \forall \tau, \forall \theta \tag{5}$$

$$c(\theta^s; \tau) = \phi(\theta^s)(K^\alpha - G(K, \tau)); \quad \forall \tau \tag{6}$$

where E(.) denotes expected value with respect to the probability distribution of recognition probabilities, (4) is the law of motion of aggregate capital, (5) is the law of motion of the individual's share of aggregate capital (see Bassetto and Benhabib, 2006, for its derivation), and (6) is consumption.

We now define $Pr(K, \tau, \tau_s)$. As is standard in the voting literature, we assume that legislators do not use weakly dominated strategies when voting for a policy proposal. Specifically, they accept if and only if the utility of implementing the proposal and going to the next period with a new status quo is at least as large as the utility of keeping the status quo and going to the next period with the same status quo. In particular, let $A(K, \tau, \tau_s)$ denote the set of representatives who would accept the offer:

$$
\begin{aligned}
A(K, \tau, \tau_s) = \{\theta \in \Theta' : u(c(\theta; \tau)) + \delta \ \mathrm{E}V(K'(\tau), \theta'(\tau), \tau, \theta) \\
\geq u(c(\theta; \tau_s)) + \delta \ \mathrm{E}V(K'(\tau_S), \theta'(\tau_s), \tau_s, \theta)\}
\end{aligned} \tag{7}
$$

Then

$$
Pr(K, \tau, \tau_s) = \int_{A(K,\tau,\tau_s)} \mu(\theta) d\theta. \tag{8}
$$

We now provide a definition of our Markov Perfect equilibrium. In what follows, we will require that the law of motion of capital taxes that is behind the determination of the competitive equilibrium must coincide with the policies selected in our legislative bargaining model.

Def [to write] *A politico economic equilibrium consists of value functions* $V : \Re_+ \times \Theta \times [0, \bar{\tau}] \to \Re$*, proposal rules* $\tau : \Re \times \Theta \times [0, \bar{\tau}] \to [0, \bar{\tau}]$*, approval rules* $\alpha : \Re_+ \times [0, \bar{\tau}] \times [0, \bar{\tau}] \to \{yes, no\}$ *, law of motion of capital* $K' : \Re \times \Theta \times [0, \bar{\tau}] \to \Re$ *and law of motion of wealth's shares* $\theta : \Re \times \Theta \times [0, \bar{\tau}] \to \Theta$ *such that,*

a) *Given the proposal and acceptance rules, the laws of motion* $K' : \Re \times \Theta \times [0, \bar{\tau}] \to \Re$ *and* $\theta : \Re \times \Theta \times [0, \bar{\tau}] \to \Theta$ *constitute a CE.*

b) *Given* $K' : \Re \times \Theta \times [0, \bar{\tau}] \to \Re$ *and* $\theta : \Re \times \Theta \times [0, \bar{\tau}] \to \Theta$*, the tax function* $\tau : \Re \times \Theta \times [0, \bar{\tau}] \to [0, \bar{\tau}]$ *and value function* $V : \Re \times \Theta \times [0, \bar{\tau}] \to \Re$ *are an equilibrium of the political game.*

3 Preliminary Results

Figures 1-2 illustrate the proposed capital tax (on the vertical axis) as a function of the type (that is, of the relative wealth) of the agenda setter. The scale of the horizontal axis is as follows. A type equal to one corresponds to an agenda setter with wealth equal to average capital. Poorer agenda setters are located to the left of one. Figure 1 (resp. 2) illustrates the proposal rule when aggregate capital is high (resp. low). Each color in the graph corresponds to a proposal for a different status quo policy. Recall that the proposal does not necessarily coincide with the implemented policy since the probability of acceptance is not, in general, equal to one.

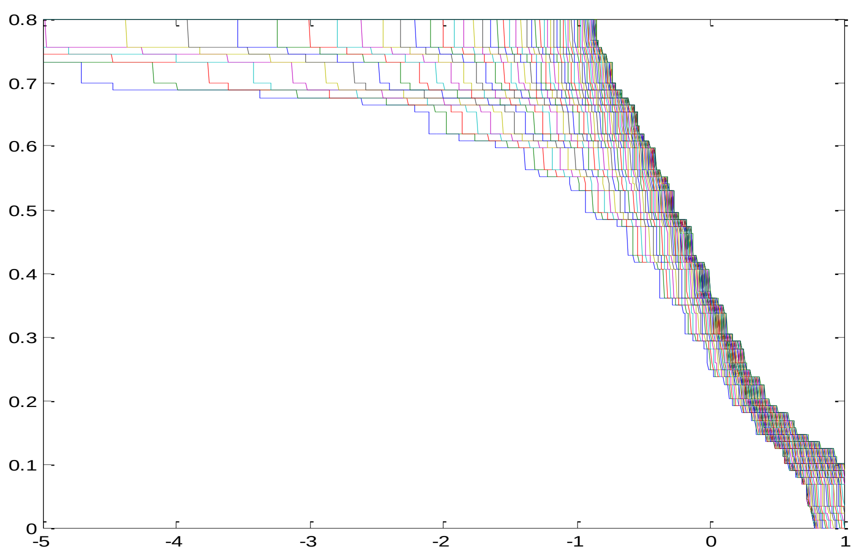

Fig 1: Proposed Capital Tax for each type of Agenda Setter (High Aggregate Capital)

First, notice from Figures 1 and 2 that the location of the status quo matters: that is, it affects the type of policy proposal that is made in equilibrium. Second, not surprisingly, note that regardless of the location of the status quo policy, an agenda setter with wealth close to average capital will propose low capital taxes.

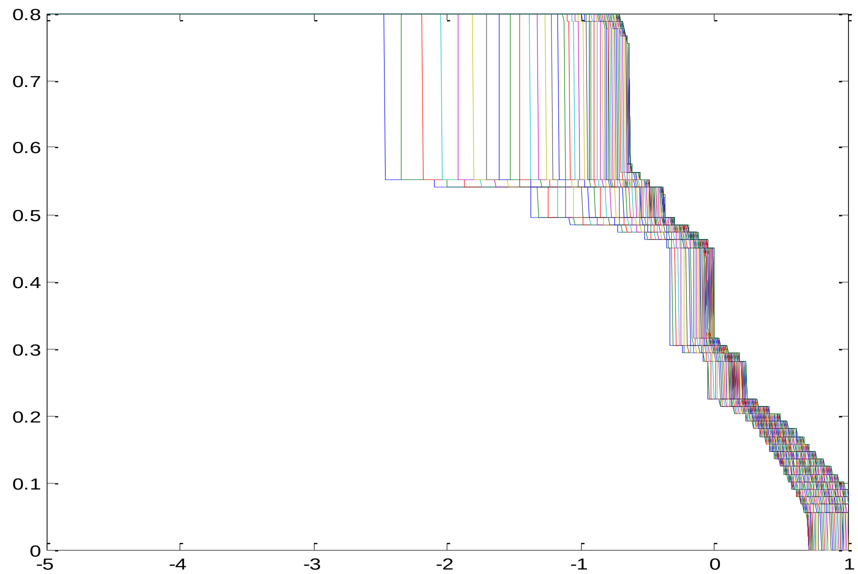

Fig 2: Proposed Capital Tax for each type of Agenda Setter (Low Aggregate Capital)

Figure 3 illustrates the expected proposed capital tax as a function of the status quo. In drawing this figure, we take expectations over all possible types of agenda setter.[9]

[9]Note that 0.8 is the upper bound on the capital tax in our numerical exercice.

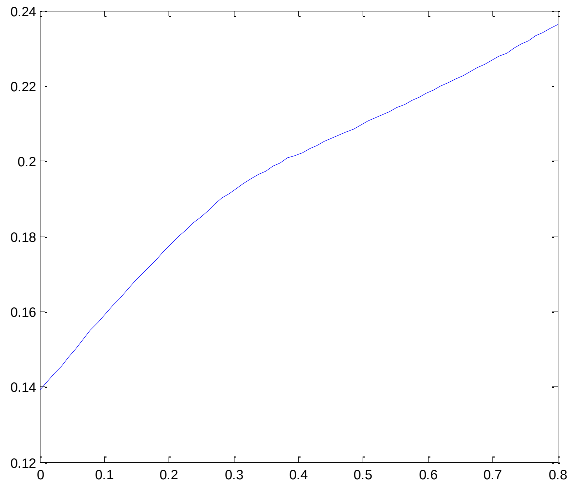

Fig 3: Expected Proposal for each Status Quo Policy (High Aggregate Capital)

It is important to notice that the expected capital tax predicted by our model is quite reasonable (with a range that goes from 0.14 to 0.23). In spite of the fact that legislators have no commitment and of the fact that taxes are on current capital income (hence, there is no implementation lag in our model), we are able to escape the bad policy outcome in which capital taxes are at the upper bound. In other terms, the political mechanism introduced in our model (the endogenous status quo) provides some (limited) commitment.

It is also important to appreciate that the more inefficient the status quo policy, the higher the capital tax (that is, the functions drawn in Figures 3 and 4 have a positive slope). This is simply because a higher status quo policy increases the outside option of legislators with low wealth. As a result, we have that in equilibrium the agenda setter proposes a (relatively) higher capital taxes so as to make it more acceptable to poor legislators and increase the chances of passing her proposal.

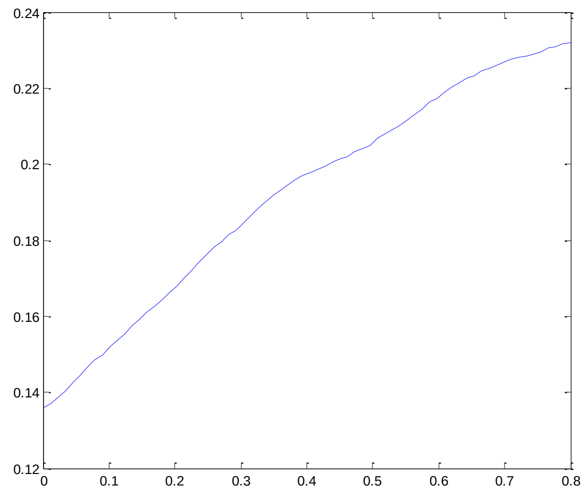

Fig 4: Expected Proposal for each Status Quo Policy (Low Aggregate Capital)

Figure 3 is drawn for the case in which aggregate capital is high. Figure 4 draws the expected capital tax when aggregate capital is low. Comparing Figures 3 and 4, it can be seen that when aggregate capital is low, the expected proposal is (slightly) higher than when aggregate capital is high.

4 Conclusions

[tba]

4.1 Numerical simulations

4.1.1 Algorithm

First, construct grids for capital stock, $\mathcal{K} \in [K_{min}, K_{max}]$, tax, $\tau \in [0, \bar{\tau}]$ and shares of capital $\theta \in [\theta_{min}, 1]$. Where θ_{min} is low enough to make sure that there is a measure zero of θ's below it. Then, choose a initial probability of acceptance function $Pr_0 : \mathcal{K} \times \tau \to [0, 1]$, a collection of initial proposal functions for each possible type of the agenda setter, $\Psi_0 : \mathcal{K} \times \tau \times \theta \to [0, 1]$ and an initial law of motion of capital $\mathcal{G}_0 : \mathcal{K} \times \tau \to \Re$. To allow for the maximal sensitivity of the CE to the actions of the political game we start the simulations with $\Psi_0(K,\tau,\theta)=\tau$, for all K, τ and θ, and $\text{Pr}_0(K,\tau)=1$ for all K and τ. In addition, fix tolerance levels for convergency in CE, $\epsilon_K>0$ and political game, $\epsilon_\tau>0$. Then,

Step 1 Given Ψ_0 and Pr_0 solve for the equilibrium law of motion for capital: $K'=\mathcal{G}_1(K,\tau)$ for $(K,\tau)\in\mathcal{K}\times\tau$. This is done using the endogenous grid method of Carroll (?). 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 matrix $K_0\in\Re^2$ such that $K=\widetilde{\mathcal{G}}_1(K_0,\tau)$ for all $(K,\tau)\in\mathcal{K}\times\tau$. Then, using linear interpolation we obtain the mapping $\mathcal{G}_1:\mathcal{K}\times\tau\to\Re$.

Step 2 Given Ψ_0, Pr_0 and $\mathcal{G}_1(K,\tau)$ compute the value function for the average agent: $V(K,\tau)$. This step is performed using the standard iteration of the value function (starting with $V(K,\tau)=0$) and interpolating for values of K outside the grid.

Step 3 Given $V(K,\tau)$ find the threshold for the committee using equation (**??**) and the probability of acceptance $Pr_1(K,\tau)$ using equation (**??**). Then, for each θ find the optimal choice for the agenda setter: $\Psi_1(K,\tau,\theta)$. This is basically solving the modified problem of section 6.1 for each θ in the grid. Given that we are not certain about the properties of the objective function we use a global method to choose the maximum. That is, evaluate the objective function for all possible combinations of K and τ and choose the maximum value.

Step 4 Check distance between assumed tax function and optimal policy for the agenda setter. If $norm(\Psi_0-\Psi_1)<\epsilon_\tau$ go to Step 5, otherwise go to Step 2 updating $\Psi_0=\Psi_1$ and $Pr_0=Pr_1$

Step 5 Check distance for law of motion of capital. If $norm(\mathcal{G}_0 - \mathcal{G}_1) < \epsilon_K$ stop: solution found. Otherwise set $\mathcal{G}_0 = \mathcal{G}_1$ and go to Step 1.

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