Politically Feasible Public Bailouts

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Abstract

Two key features of the government bailout programs implemented in the 2008-2009 financial crisis were: first, the general opposition of voters to these programs and second, the implementation of a variety of interventions, ranging from targeted transfers meant to inject capital in particular institutions to untargeted transfers aimed at helping entire sectors. This paper argues that the observed shift in the balance between targeted and untargeted transfers emerges in a political economy environment, when voters posses less information than the government about the shocks hitting the economy, and when firms can lobby the government for socially inefficient transfers. The model shows that the optimal incentives voters can give to an elected politician can lead to persistent effects of government interventions, which triggers a shift towards more untargeted interventions following a crisis.

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1 Introduction

The amount of public funds and the variety of programs used by governments to support the financial sector during the 2008-2009 crisis have been unprecedented.[1] Governments intervened through programs ranging from specific, targeted transfers meant to inject capital in particular institutions, to broader, untargeted interventions aimed at supporting struggling industries and lowering the rates at which firms can borrow in the market.[2] Two key characteristics stand out when examining these policy choices.

First, the bailouts of struggling financial institutions at the beginning of the crisis faced significant voter disapproval.[3] Part of the negative public opinion involved the question of whether these bailout packages were a necessary response to the crisis or too large a rescue offered to lobbying banks.[4] Voter backlash to these measures was reflected, for example, in the difficulty of passing another bailout program through the US Congress later on the crisis, in order to rescue troubled car makers.[5]

The second key feature that stands out is that, in spite of voter opposition, governments continued to intervene in the economy in order to avoid a systemic collapse, and they used a combination of targeted and untargeted interventions, along with a fragmentation of interventions among different "on-budget" and "off-budget" institutions, such that only part of the bailout programs counted as government spending.[6] In the United States, the Treasury implemented capital assistance programs in conjunction with the Fed,[7] it also developed several programs that were aimed at supporting struggling sectors rather than being tar-

[1] See Block (2010) for a description of the different programs and the estimated costs associated with them.

[2] For example, permitting discount window loans to be collateralized by high grade private securities, opening the window for non-bank financial institutions, actions which essentially reduce the interest rate faced by borrowers.

[3] These interventions included, in the US, taking Freddie Mac and Fannie Mae into government conservatorship or the capital injections into the largest private U.S. banks under the Troubled Asset Relief Program (TARP), passed in October 2008.

[4] See, for example, Neil Barowsky, "Where the Bailout Went Wrong," The New York Times, March 30, 2011, page A27; Block (2010) provides referrences to from Jackie Calmes, "Democrats Seize on Oversight," Washington Post, April 19, 2010, at A1, and Jim Puzzanghera, "Debate Begins on Final Overhaul Reform," Chicago Tribune, June 11, 2010, at C31.

[5] A proposed bailout of the auto makers failed to pass a Senate vote in December, 2008. Afterwards, the President redirected funds meant for financial institutions from the TARP, in order to bail out the auto makers. For more details, see Stephen Labaton and David M. Herszenhorn, "White House Ready to Offer Aid to Auto Industry," The New York Times, December 12,2008, page A1.

[6] For more details on these programs and accounting methods, see Block (2010).

[7] The most significant is the Term Asset-Backed Securities Loan Facility (TALF) set up in November 2008 to offer capital assitance to struggling firms; it was amended in December 2008 to extend loans with longer maturities and to accept a broader range of collateral.

geted at particular firms,[8] and it provided indirect assistance through special tax breaks.[9] A similar pattern was also observed in Europe. For example, Germany began by directly rescuing its struggling banks using public funds.[10] The government introduced a program to guarantee loans and help shore up equity in troubled banks in October 2008, followed by untargeted programs passed through the parliament in November 2008 and February 2009, both of which included a combination of untargeted support measures such as tax breaks, provisions for underwriting credit to struggling firms, and subsidies to industries.[11]

Given the above two features of the crisis response, the question that emerges is whether the observed government policies were a result of voter backlash followed by political stalemate,[12] or something to be expected even in the absence of political stalemates. This paper argues that these two features of the crisis are an outcome that emerges in the absence of any political stalemate, given voters' available instruments for providing incentives to their elected officials. Such instruments are generally restricted to removal from office through elections, based on the information that voters posses about how appropriate the actions of the government are relative to the gravity of the crisis. Using the information available to them, voters evaluate whether their representatives are using the public funds in their constituents' interest, and they decide whether to reelect the incumbents. This paper builds a model that sheds light on why a shift over time from targeted to untargeted interventions can be in the best interest of voters.

The paper presents a principal-agent model in which government intervention is decided by an elected politician, who cares about maximizing a weighted sum of the economy-wide output. The output in the economy is produced by firms, and each period a fraction of firms is hit by a shock that causes a loss in their investment projects. After this shock hits, firms can reinvest funds in their projects; however, only the funds reinvested in projects that suffered losses give positive net returns, while investing additional funds in the healthy projects would be not be cost effective. The funds for reinvestment can come from the firm's own reserves

[8] For instance, the Car Allowance Rebate System to help car dealerships and car makers, and the Loan Modification Program for Homeowners, aimed at helping indebted households, both passed in 2009.

[9] For more details on these programs, see Block (2010) and the summary document prepared by the Congressional Research Service, available at http://www.fas.org/sgp/crs/misc/R41073.pdf (accessed March 5, 2014).

[10] Starting with Hypo Real Estate and BayernLB in October 2008, followed by Commerzbank, Germany's second largest bank in January 2009 (source: the New York Fed's International Responses to the Crisis Timeline)

[11] Source: The Library of Congress Research Reports: Financial Stimulus Plans: Recent Developments in Selected Countries (http://www.loc.gov/law/help/financial_stimulus_plan.php).

[12] Mian et al. (2012) provide evidence about increased polarization and fractionalization following crises, which may explain the difficulties in reaching compromise.

or from public funds, through the government. The firms hold identical projects ex-ante, but they differ based on whether or not they are connected to the government. Connected firms can lobby the politician for public transfers, and this leads to the politician placing more weight on the output of connected firms. It also results in a difference in objectives between the politician and voters, since voters do not benefit from the firms' lobbying activities. The government can choose to make public funds available to firms either through targeted transfers that are directed at a specific firm or through untargeted transfers that are given to all firms. The politician is biased towards using targeted transfers, which can be directed at connected firms. Finally, at the end of each period, elections are held, and voters can decide to remove the politician from office. They make this decision based on the information available to them about the size of the shocks hitting the economy and about the size of targeted versus untargeted transfers. Therefore, private information plays a key role in the model. Voters cannot directly observe the size of the shocks that hit the economy, or the fraction of connected firms that are not distressed but lobby the government, and they must rely on reports from the politician.

The main result of the paper is that, in equilibrium, voters provide dynamic incentives for the politician to limit the transfers made to firms who engage in lobbying activities, and for which the public transfers would be socially inefficient. Following a crisis period that requires a large government intervention, the politician is more restricted from using targeted transfers in the future. Voters implement the restriction by conditioning reelection on the politician reducing the funds allocated to targeted transfers. The voters' restrictions are then relaxed after periods with low government transfers. The intuition for this result is that a politician who reports a high need for government intervention will initially be allowed to engage in public bailouts, even if voters know that some of these funds will be used for inefficient transfers to lobbying firms. This would be acceptable to voters given the severe decrease in household consumption in the absence of bailouts. Yet, if the same need for government transfers is reported next period as well, then voters are more likely to infer that the public funds will be used by the politician for inefficient transfers to lobbying firms rather than needed bailouts. Therefore, they will be less willing to keep the politician in power. Faced with a tougher condition for reelection, if the crisis indeed requires government intervention, then the politician will be forced to intervene in the economy through other types of transfers. This optimal incentives scheme shows why voters would prefer to make it more difficult for successive targeted bailout programs to be implemented, determining a switch towards untargeted transfers.

A second result of the paper is that the persistence effects of current policies on future reelection conditions can continue into the long run. Dynamic incentives continue to be provided over a long time horizon, leading to variation in the balance of targeted and untargeted transfers used by the government over time. In the long run, if the politician and voters are equally patient – they discount the future at the same rate – then the equilibrium policies chosen by the politician will converge to either using only targeted transfers or only untargeted transfers. This result mirrors the immiseration result obtained in Thomas and Worrall (1990) or Atkeson and Lucas (1992), and reflects the need for voters to commit to increasing rewards and punishments over time in order to offer incentives to the politician. Yet, if the politician is more impatient than the voters, then the need for increasing rewards and punishments is reduced, since the politician places a lower relative value placed on payoffs far in the future. Then the voters allow both types of transfers in the long run and there will not be convergence towards one type of intervention.

The model also considers the role of public debt in affecting the politician's policy choices. The politician's ability to take on debt makes incentive provision more costly to voters, because it gives the politician more flexibility in determining the government intervention budget, while voters only have limited means of punishing inefficient transfers. The main result of this part is that debt limits the extent to which removal from office can be used as an effective instrument to influence politician behavior. High outstanding debt also creates a force for lower restrictions on targeted transfers. As the government has fewer overall resources in the current period, there are higher costs to using less efficient transfers in order to limit inefficient transfers. Yet, the overall effect of public debt on voter welfare is ambiguous. Public debt allows the politician to smooth the cost of government interventions over time, which is beneficial to voters. Yet, the cost of providing incentives to the politician is higher. The implication is that debt limits or budget balance requirements can be preferred by voters in high rent-seeking environments, in which inefficient transfers are very costly to voters. Otherwise, public debt is welfare increasing for both voters and the politician because it facilitates smoothing the cost of interventions over time.

Finally, an extension of the basic model considers the case in which the government can also provide a non-financial public good along with the transfers to firms. This non-financial public good is valued equally by both households and the politician. The presence of the non-financial public good makes the trade-off between the different types of transfers more complex. If voters decide to increase the restrictions on targeted transfers in order to provide incentives for the politician, then this might no longer have the effect of increasing untargeted transfers. In fact, voter restrictions on targeted transfers to financial firms result in higher provision of the non-financial public good, possibly without any increase in untargeted transfers to firms. Voters therefore have more control over the size of financial interventions. At the same time, however, it becomes harder to reduce inefficient transfers without reducing total support for the financial sector.

Related literature. The analysis of optimal government intervention in financial markets has in most cases assumed that decision-making is done by a benevolent government that maximizes social welfare (Holmstrom and Tirole, 1998; Gertler and Kiyotaki, 2010; Gertler and Karadi, 2011; Farhi and Tirole, 2012; Diamond and Rajan, 2012). Papers in this literature have focused on the responses of private agents to an expected government intervention in financial markets. Farhi and Tirole (2012) highlight the moral hazard and strategic complementarities induced in the market by a time inconsistent government intervention policy. Philippon and Skreta (2012) also study the optimal government intervention in a market with adverse selection over private assets. They show that minimum cost public interventions can be achieved through targeted means, using debt contracts or debt guarantees. Similarly, Philippon and Schnabl (2013) study the optimal government intervention when the financial sector suffers from debt overhang. This paper also studies optimal government intervention, but it focuses on the incentive problems that emerge at the level of the government.

Several recent studies have provided substantial evidence that political economy considerations affect the decision making process of the government regarding interventions in financial markets. Lobbying and political rent-seeking have been shown to influence what type of intervention the government engages in (Mian et al., 2010), or which firms receive public bailouts (Faccio et al., 2006). Moreover, 'pork-barrel' expenses played an essential role in the passing of legislation regarding public purchases of private financial assets(Drazen and Ilzetzki, 2011). I contribute to this literature by studying the incentives problem that emerges when elected officials can derive political rents by making transfers to connected firms.

This paper builds a principal-agent model similar to Acemoglu et al. (2008). They study the dynamic incentives problem with a rent-seeking politician, in a standard neoclassical growth model. This paper studies a problem with similar constraints, but the analysis abstracts away from capital and taxation distortions. Instead, it focuses on the distortions due to the type of firms who receive transfers from the government as a result of lobbying. Moreover, it considers the existence of private information regarding the shocks affecting the economy.

The private information environment used in the paper is an extension of the models of

Atkeson and Lucas (1992) and Thomas and Worrall (1990). If features two different shocks which are privately observed by the government each period. The two shocks capture the fraction of distressed firms and the fraction of connected firms which are distressed. While the total effect of the shocks on aggregate output can be observed at the end of each period, the combination of shocks that led to this outcome cannot be perfectly inferred, resulting in a model with properties similar to Atkeson and Lucas (1992).

The paper is related methodologically to Farhi and Werning (2007), who study an optimal incentives provision problem in the presence of private information and different discount rates between principal and agent. Also, Sleet and Yeltekin (2008) consider the credibility of allocations in dynamic games with private information, and show that optimal politically credible allocations can be solved as virtual planning problems with social discount factors in excess of the private one. Another related paper is Ales et al. (2012), which adds private information to a mechanism similar to the one in Acemoglu et al. (2008). They focus on the issue of politician replacement on the equilibrium path. In this paper, the focus is on the variation in the incentives provided by voters to the elected politician, and not on the question of endogenous replacement.

Finally, there is a vast empirical literature studying the effects of lobbying, rent-seeking and electoral constraints on government policy. Mian et al. (2010) provide empirical evidence related to the role of lobbying and political influence in the policies adopted in the United States in the lead up to the recent financial crisis. They show that campaign contributions from the financial services industry were associated with a higher likelihood of congressional voting in favor of legislation that encouraged the subprime mortgage credit expansion. Duchin and Sosyura (2012) investigate the link between corporate political connections and government investment under the TARP. They find that politically connected firms are more likely to be funded, yet investments in politically connected firms underperform those in unconnected firms, which suggests that political connections lead to distortions in investment efficiency. Igan et al. (2011) study lobbying activities before the 2008 financial crisis, and they find that lobbying lenders faced higher probability of receiving a public bailout during the crisis, which again suggests that lobbying and political connections play an important role in government policy choices. Also, Cohen and Malloy (2010) show that personal connections amongst politicians have a significant impact on the voting behavior of U.S. politicians. The effects are significant when considering voting over bills that do not affect the representative's constituents. This provides further evidence on the inefficiencies that can emerge when the interests of politicians differ from those of their voters. For the European case, in a comparative study of four different government responses to the recent financial crisis, Grossman and Woll (2013) argue that the type of institutional business-government relationship existing in each country, more specifically whether banks negotiate with governments one-on-one or collectively, determines the composition of the bailout packages between direct government bailouts and other forms of indirect government support.

The rest of the paper is organized as follows. Section 2 outlines model. Section 3 provides the analysis of the model and the equilibrium. Section 4 considers the equilibrium policies when the government has access to public debt. Section 5 describes an extension that allows the government to also provide a non-financial public good along with the targeted and untargeted transfers. Section 6 concludes.

2 Model

2.1 Environment

The economy consists of a continuum of firms, a continuum of households and an elected politician selected from a pool of identical politicians.

Firms. Each firm holds a production technology $f(k_t)$ that converts capital into consumption goods. The production function $f(k)$ is concave, increasing and continuously differentiable in k, with partial derivative denoted by f_k, and $\lim_{k\to 0} f_k > 1$, $\lim_{k\to\infty} f_k = 0$, and $f(0) = 0$.Capital fully depreciates at the end of each period. Firms are owned by households and are supplied with capital k_t each period. I assume that firms cannot enter into debt contracts with other parties (or with each other), so their only possible sources of funding are capital supplied by the owners and public funds from the government. While this is a strong assumption, it is made in order to isolate the inefficiencies emerging at the level of the government from the inefficiencies due to the capital market.

Each period t, a fraction θ_t of the projects become distressed. The fraction of distressed projects, θ_t, is an i.i.d. random variable whose distribution is discrete over $\Theta = \{\theta^1, \theta^2, ..., \theta^N\}$ with probability $\pi(\theta^n)$, $n = 1, ..., N$. If distressed, a project suffers a loss of x of its initial capital, where $0 < x < \overline{k}$. If not distressed, the project pays off $f(k_t)$ consumption units.

The key ingredient of the model is that the firms also differ in terms of their ability to lobby the government. A fraction ν of firms are connected to the elected politician and therefore can lobby the politician for transfers. The politician derives political rents from any transfers that will be made to the connected firms who engage in lobbying, as described below. Each period, a fraction of the connected firms will be distressed, while the others will not suffer any distress. While the total share of distressed firms in period t is θ_t, the share of connected firms that become distressed can be different from $\theta_t \nu$.[13] Denote the fraction of firms that are connected and not distressed in period t by γ_t, and let γ be distributed with $g(\gamma)$.

Households. Each household receives an endowment $\overline{k}$ of capital goods each period, and each household owns a firm. The endowment $\overline{k}$ is assumed to satisfy $f_k(\overline{k}) = 1$. Therefore, any investment above $\overline{k}$ would produce a return less than 1. Households cannot sell shares in their projects to other households. This assumption shuts down the channel for risk-sharing between households. The analysis would be identical if we allowed each household to build a perfectly diversified portfolio of shares in each project. Yet, by having the ownership of each firm differ, we can obtain the setup for the key assumption of this model – that some firms are connected to the government while others are not. This assumption has in the background the idea that some households are connected to the elected politician, while others not, and therefore the connected firms must be owned by the connected households.

Households do not have access to any storage technology that allows the transfer of resources between periods, so all output must be consumed in each period. At the end of each period, households receive consumption goods c_t given the output of its firm. Each household cannot, however, observe the values of θ_t, the fraction of firms that were distressed. The assumption that θ_t is not observable to households captures the idea that households cannot observe the total fraction of firms that are considered in need of funds. They can observe whether their firm is in need of funds, but not the needs of all other firms.[14]

Households are risk-neutral, and each household j receives instantaneous utility from consumption each period,

$$u_{t,j} = c_{t,j}.$$

They are infinitely-lived and discount the future at rate β. Therefore, their expected lifetime

[13] Although in expectation it is $\mathbb{E}[\theta]\,\nu$.

[14] In the current version of the model, distressed firms can only get additional funding from public sources, so by construction all distressed firms are in need of public liquidity. Yet, the model could easily be modified to include private borrowing, so that some distressed firms can borrow additional funds in the market, while others are constrained and cannot borrow in the market, requiring public liquidity. Then, households would observe which firms are distressed and which are not, but they would not observe who is in need of public liquidity versus who is able to borrow in the private market. Therefore, θ_t would capture the fraction of firms which cannot borrow in the private market and need public liquidity.

utility of each household j is given by:

$$U_j = \mathbb{E} \sum_t \beta^t u_{t,j}.$$

Elected politician. The allocation of resources is delegated to an elected politician. The politician maximizes a weighted sum of household utilities (or firms' output), where households receive different weights depending on whether their firms are connected to the politician or not. Connected firms can lobby the government, which provides the politician with rents. The result of the lobbying process can be summed up in reduced form as the politician placing a higher relative weight on the output of connected firms. This reduced form outcome can be obtained from the standard Grossman and Helpman (1994) model. To simplify the analysis, we consider the case in which distressed firms lack the funds to engage in lobbying activities, so that only firms that are connected and not distressed can lobby the politician. The political rents that result from this process are reflected in higher weight being placed on the output of firms that lobby the politician. Let this relative weight be denoted by $R > 1$.

The role of lobbying in political decision-making, and the political rents it generates have been the subject of a large empirical literature, as described in the introduction. In the recent financial crisis, campaign contributions were shown to have played a significant role in the passing of legislation regarding public intervention in the financial sector.[15] Also, targeted government interventions involve the purchase of assets from selected firms. Recent evidence from the government purchase programs during financial crisis shows that a significant portion of the private assets were overvalued, and that politically connected firms benefited more from targeted government purchases.[16] Therefore, both campaign contributions as well as targeted purchases of private assets can generate political rents, and this model captures this aspect of the political process through the weighting of the output from different firms in the utility function of the politician.

Each period, the elected politician receives government endowment τ, which for now is taken as exogenous (tax distortions are ignored). The politician observes the aggregate shock θ_t, the fraction of distressed firms, as well as γ_t, how many connected firms are not distressed and can therefore lobby.

[15] Mian et al. (2010) show that campaign contributions from the financial services industry were associated with a higher likelihood of congressional voting in favor of legislation supporting the subprime mortgage credit expansion.

[16] Duchin and Sosyura (2012) estimate empirically the effects of political connections on the funding made available to private firms though the TARP program.

The politician can transfer funds to firms in period 1. Funds can be transferred directly – targeted to specific firms – or indirectly through untargeted transfers to all firms. Denote the targeted transfers to a firm j by $g_{t,j}$ and the untargeted transfers to all firms by g_t^i. Since firms only differ in whether they are distressed or not, and whether they are connected to the government or not, the targeted transfers will only differ along these dimensions as well. Therefore, let g_t^d be the targeted transfer received by a distressed firm, and g_t^c the targeted transfer received by a connected firm that is not distressed. Finally, for completeness, we can denote by g_t^{nd} the targeted transfer received by a firm that is not connected and not distressed. Yet, under the assumptions made below about the size of the government budget, the firms that are not distressed and not connected will not receive any targeted transfers since these transfers would be inefficient, and so $g_t^{nd} = 0$.

The model embeds the following political economy friction: the politician can derive political rents by transferring funds to politically connected firms, through either targeted transfers or through untargeted transfers; however, untargeted transfers cannot be restricted to only a subset of firms, which makes them more expensive. The targeted transfers can bring political rents at a lower cost, since they can be directed at the firms that are connected to the politician. This setup is motivated by the fact that targeted interventions capture bailout programs under which the government can choose the beneficiaries and overpay for the assets it buys. Untargeted transfers, on the other hand, are meant to capture the type of programs implemented by the Treasury in conjunction with the Fed, aimed at providing easier access to funds for all firms. The politician's budget constraint each period is then given by:

$$\theta_t g_t^d + \gamma_t g_t^c + (1 - \theta_t - \gamma_t) g_t^{nd} + g_t^i \leq \tau, \tag{1}$$

or, incorporating $g_t^{nd} = 0$,

$$\theta_t g_t^d + \gamma_t g_t^c + g_t^i \leq \tau. \tag{2}$$

The politician's instantaneous utility is then expressed as:

$$v_t \equiv \left[\theta_t f(\overline{k} - x_t + g_t^d + g_t^i) + (1 - \theta_t - \gamma_t) f(\overline{k} + g_t^i) + R\gamma_t f(\overline{k} + g_t^c + g_t^i) \right]. \tag{3}$$

The politician discounts the future at rate $\widehat{\beta} \leq \beta$. The different discount rate captures the fact that, compared to the voters, the politician may care more about the present outcome than about the future.[17] Therefore, the politician maximizes the following utility:

$$V = \sum_t \widehat{\beta}^t v_t, \tag{4}$$

or written in recursive form:

$$V_t = v_t + \widehat{\beta}\mathbb{E}\left[V_{t+1}\right] \tag{5}$$

Private Information and the electoral process. The politician is subject to the following form of electoral control. The households have the power to vote the incumbent politician out of office at the end of each period. We assume that the households have solved all collective action problems, and as voters, they maximize the sum of utilities of all households, with equal weight on each household's consumption:

$$u_t = \mathbb{E}_{\theta_t,\gamma_t}\left[\theta_t f(\overline{k} - x_t + g_t^d + g_t^i) + (1-\theta_t-\gamma_t) f(\overline{k} + g_t^i) + \gamma_t f(\overline{k} + g_t^c + g_t^i)\right]. \tag{6}$$

The ability of the voters to punish the incumbent politician is limited by the information available to them each period. They cannot observe the values of shocks θ_t, the fraction of distressed firms, and γ_t, the share of connected firms that are not distressed and therefore have the ability to lobby for funds. They can only observe the total tax revenue τ and the total amount of funds disbursed towards targeted interventions – $\left(\theta_t g_t^d + \gamma_t g_t^c\right)$– versus untargeted transfers (g_t^i).

The politician can observe the shock θ_t each period and send a message $\widehat{\theta}_t$ to voters about its value. After sending this message, the shock γ_t is observed by the politician, but it cannot be transmitted to voters, i.e., it is not observable or verifiable to voters. The assumption that γ_t is observed after the message $\widehat{\theta}_t$ is sent is meant to capture the fact that γ_t cannot be transmitted to voters, and also that the rents derived from connected firms are not known before the direct intervention is approved. Once the direct interventions are possible, firms will have an incentive to lobby for funds.

Voters set a replacement strategy at the beginning of the period and any replacement is done at the end of the period, after the report $\widehat{\theta}$ is sent, the total targeted intervention $(\gamma_t g_t^c + \theta_t g_t^d)$ and the untargeted transfers (g_t^i) are observed.[18] If replaced, the politician receives the

[17] The justification for the difference in discount factors is also discussed in Farhi and Werning (2007), Acemoglu et al. (2008), and Sleet and Yeltekin (2008).

[18] An equivalent system would give voters the opportunity to replace the politician at the beginning of each period. The main characteristic of this electoral system is that it allows voters to condition their replacement decision on the message $\widehat{\theta}_t$ and the government policies in period t.

exogenous utility $\underline{V}$. The value $\underline{V}$ is assumed to be low enough such that incentives can be offered to the politician, but also sufficiently high such that the voters' preferred policy cannot be implemented. Denote by $\rho_t \in \{0, 1\}$ voters' replacement decision, where $\rho_t = 0$ stands for replacement.

2.2 Timing

Consider the following game. Each period, the economy starts with a politician in power and the following sequence of events happens:

1. Nature chooses shocks θ_t and γ_t;
2. Voters choose a strategy Υ_t for politician replacement given the history of all reports $\widehat{\theta}_j$, $j = 0, ..., t$;
3. The politician observes θ_t and sends message $\widehat{\theta}_t$ about the current shock θ_t;
4. The politician observes γ_t and decides transfers $\left\{g_t^d, g_t^c, g_t^i\right\}$;
5. If $\Upsilon_t = 1$, the incumbent is replaced with an identical politician;
6. Each household h receives consumption goods c_t^h according to the output of its firm.

3 Analysis

3.1 Equilibrium Concept

Let $h_t^0 \equiv \{g_0^i, \widehat{\theta}_0, ..., g_t^i, \widehat{\theta}_t\}$ be the public history of the game up to and including period t. Let $h_t^1 \equiv h_t^0 \cup \{\theta_0, \gamma_0, g_0^d ..., \theta_t, \gamma_t, g_t^d\}$ be the history of outcomes observed by the politician up to period t. Let $\Upsilon|_{h_t^0}$ be the continuation strategy of the representative voter, and let $\digamma|_{h_t^1}$ be the continuation strategy for the incumbent politician. We consider sustainable equilibria (Chari and Kehoe, 1993), in which both the voters' and the incumbent politician's decision rules are required to be sequentially rational. The strategy for the voters Υ solves the voter problem if for every h_t^0, $\Upsilon|_{h_t^0}$ maximizes the expected sum of household utilities given $\digamma$. The strategy $\digamma$ solves the politician's problem if for every h_t^1, the continuation strategy $\digamma|_{h_t^1}$ maximizes the politician's expected utility given Υ. A sustainable equilibrium then consists of the set of strategies $\{\Upsilon, \digamma\}$ where Υ solves the voters' problem given $\digamma$, and $\digamma$ solves the politician's problem given Υ. I focus on the best sustainable equilibrium from the perspective of voters, that maximizes the weighted sum of household utilities. By the

Revelation Principle, we can restrict the analysis to equilibria with truthful reporting on the part of the politician.

Given the strategies defined above, I begin by characterizing the set of sustainable policies that can be supported in equilibrium. First, let $\Gamma(h^0_{t-1}, \widehat{\theta}_t)$ denote the set of targeted interventions – $\gamma_t g^c_t + \theta_t g^d_t$– given report $\widehat{\theta}_t$, after which voters would reelect the incumbent politician. Then, let $\phi_t = \{g^d_t, g^c_t, g^i_t\}$ be an allocation of the government budget between targeted transfers and untargeted transfers. The allocation ϕ_t is feasible if the following conditions are satisfied:

$$\gamma_t g^c_t + \theta_t g^d_t + g^i_t \leq \tau, \tag{7}$$

$$g^c_t \geq 0; \; g^d_t \geq 0; \; g^i_t \geq 0. \tag{8}$$

The first condition limits the government expenses to the available government budget each period. Condition (8) bounds each type of transfer to be non-negative. Moreover, the politician will be reelected after proposing allocation ϕ_t if the total targeted interventions – $\gamma_t g^c_t + \theta_t g^d_t$– are in the set acceptable to voters, i.e.,

$$\phi_t \in \Gamma(h^0_{t-1}, \widehat{\theta}_t). \tag{9}$$

Finally, the politician reports truthfully the need for funds if at allocation ϕ_t the following holds for each t :

$$\begin{aligned} v(h^1_{t-1}, \theta_t, \gamma_t|\theta_t) + \widehat{\beta}\mathbb{E}\left[V_{t+1}(h^1_{t-1}, \theta_t, \gamma_t|\theta_t)\right] \geq \; & v(h^1_{t-1}, \theta_t, \gamma_t|\widehat{\theta}_t) + \\ & \widehat{\beta}\mathbb{E}\left[V_{t+1}(h^1_{t-1}, \theta_t, \gamma_t|\widehat{\theta}_t)\right], \; \forall \widehat{\theta}_t \in \Theta, \end{aligned} \tag{10}$$

so that the politician is better off reporting the true need for liquidity rather than sending any other report $\widehat{\theta}_t$.

The following proposition establishes that the above conditions must be satisfied for any allocation ϕ_t to be part of a sustainable equilibrium.

Proposition 1 *The sequence of allocations $\{\phi_t\}_{t=0,..,\infty}$ is supported by sustainable equilibrium strategies if and only if conditions (7)-(10) are satisfied for each ϕ_t, $t = 0, ..., \infty$.*

Proof. In the Appendix. ■

Given the results of Proposition 1, let Φ denote the set of allocations ϕ_t are supported by a sustainable equilibrium. For the rest of the analysis, we will consider only the allocations that belong to set Φ. To make further progress in analyzing the resulting equilibria, I proceed to analyze the constrained maximization problem in three steps: first, derive the properties of the reelection condition chosen by voters each period given a report $\widehat{\theta}_t$ and the observed policies $\{g_t^i, (\tau - g_t^i)\}$; second, study the problem for the incumbent given the voters reelection condition; third, derive the inter-temporal problem for the voters given the incumbent politician's response to their reelection strategy.

3.2 Voters' Reelection Strategy

At the beginning of each period, voters set their reelection strategy. They can commit to this strategy, and at the end of the period, either keep or replace the incumbent politician. Each period, voters can condition their replacement decision on the report $\widehat{\theta}_t$ and the observed distribution of government funds, between untargeted transfers g_t^i and targeted interventions $(\tau - g_t^i)$.

Lemma 1 *For every report $\widehat{\theta}_t$, there exists $g_t^*(h_{t-1}^0, \widehat{\theta}_t) \geq 0$ such that $\forall g_t^i(h_{t-1}^0, \widehat{\theta}_t) \geq \tau - g_t^*(h_{t-1}^0, \widehat{\theta}_t)$, $g_t^i(h_{t-1}^0, \widehat{\theta}_t) \in \Gamma(h_{t-1}^0, \widehat{\theta}_t)$ and $\forall g_t^i(h_{t-1}^0, \widehat{\theta}_t) < \tau - g_t^*(h_{t-1}^0, \widehat{\theta}_t)$, $g_t^i(h_{t-1}^0, \widehat{\theta}_t) \notin \Gamma(h_{t-1}^0, \widehat{\theta}_t)$.*

Proof. In the Appendix. ■

Lemma 1 states that, for each report $\widehat{\theta}_t$, the voters will limit the total targeted interventions (targeted transfers and rents) to a maximum level of $g_t^*(h_{t-1}^0, \widehat{\theta}_t)$. A level of targeted interventions above this limit would be welfare-reducing for voters; it would lead to a decrease in untargeted transfers that would be costlier to voters than the gains from higher targeted transfers. This is due to the higher utility cost of decreasing untargeted interventions, specifically the increase in political rents.

3.3 Politician's Problem

Given the results summarized in Lemma 1 regarding the voters' reelection strategy, we can now analyze the problem for the incumbent politician. In case of removal from office, the politician receives $\underline{V}$, as described above. Therefore, for each report $\widehat{\theta}_t$, the politician will offer policies $\phi_t \in \Gamma(h_{t-1}^0, \widehat{\theta}_t)$, which by Lemma 1 implies that the following constraint must hold:

$$\gamma_t g_t^c + \theta_t g_t^d \leq g_t^*(\widehat{\theta}_t).$$

Then, each period, the politician chooses $\left\{g_t^d, g_t^c, g_t^i, \widehat{\theta}_t\right\}$ to maximize (5), taking into account the cutoff $g_t^*(h_{t-1}^0, \widehat{\theta}_t)$ for targeted interventions above which voters would remove him from power. In recursive form, the politician's problem for each report $\widehat{\theta}$ is given by:

$$V\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right) \equiv \max_{\left\{g^d, g^c, g^i\right\}} v\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right) + \widehat{\beta}\mathbb{E}\left[V'\left(\theta', \gamma', g^{*\prime}\left(\widehat{\theta}'\right)\right)\right] \tag{11}$$

subject to

$$\begin{aligned}
\gamma g^c + \theta g^d &\leq g^*\left(\widehat{\theta}\right), & (12)\\
\gamma g^c + \theta g^d + g^i &\leq \tau, & (13)\\
g^c \geq 0;\ g^d \geq 0;\ g^i &\geq 0. & (14)
\end{aligned}$$

Constraint (12) is the re-election constraint imposed by voters given report $\widehat{\theta}$. Constraint (13) is the resource constraint of the government, and constraint (14) is the non-negativity requirement for all government policies.

Denote by $\phi^P\left(\widehat{\theta}\right) \equiv \left\{g^d\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right), g^c\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right), g^i\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right)\right\}$ the set of policies that satisfy conditions (12)-(14). Given the concavity of the politician's instantaneous utility $v\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right)$ and the linear constraints, it follows that the solution to the system (12)-(14) is unique, and $V\left(\theta, \gamma, g^*\left(\widehat{\theta}\right)\right)$ is a well-defined function. Since there are no inter-period linkages other than through the voters' strategies $\left\{g^*\left(\widehat{\theta}\right)\right\}$, the politician's problem given $g^*\left(\widehat{\theta}\right)$ is a static optimization over $\left\{g^d, g^c, g^i\right\}$. This leads to the following choice of policies as a function of $g^*\left(\widehat{\theta}\right)$, assuming an interior solution:

$$\begin{aligned}
g^i &= \tau - g^*\left(\widehat{\theta}\right), & (15)\\
g^c &= \frac{g^*(\widehat{\theta}) - \theta g^d}{\gamma}, & (16)
\end{aligned}$$

and g^d is given by the implicit equation

$$\theta f'(\overline{k} - x + g^d + \tau - g^*(\widehat{\theta})) = R\gamma f'\left(\overline{k} + \frac{g^*(\widehat{\theta}) - \theta g^d}{\gamma} + \tau - g^*(\widehat{\theta})\right). \tag{17}$$

Assumption 1 *The government budget τ is sufficiently small and the loss x is sufficiently* *large such that the following conditions hold* $\forall\theta\in\Theta$, $\forall\gamma\leq\max\{1-\theta,\nu\}$:

$$\theta f'(\overline{k}-x) \quad > \quad R\gamma f'(\overline{k}+\tau), \tag{18}$$

$$\tau \quad \leq \quad \theta^1 x. \tag{19}$$

Assumption 1 states that in the absence of untargeted transfers $(g^i=0)$, the targeted transfers to distressed firm would be positive $\left(g^d>0\right)$. Moreover, the government budget available for public intervention is at most equal to the total loss of distressed firms. This assumption ensures that it will never be optimal to have untargeted transfers, since using up the entire budget for targeted transfers would be preferred.

3.4 Voters' Reelection Strategy

Having derived the politician's problem, we can now study the optimal problem for the voters. By Lemma 1, the voters are choosing a sequence $\left\{g_t^*(h_{t-1}^0,\widehat{\theta}_t)\right\}_{t=0}^{\infty}$ to solve their utility maximization problem, given the politician's strategy. Let

$$u^H(\theta,\gamma,g^*(\widehat{\theta}))\equiv u(\phi^P(\widehat{\theta}),\theta,\gamma) \tag{20}$$

denote the instantaneous utility for voters at shock values θ, γ, given the report $\widehat{\theta}$ about the fraction of distressed firms, and the allocation $\phi^P(\widehat{\theta})$ corresponding to the politician's strategy $\digamma$. Given the sequence sequence $\left\{g_t^*(h_{t-1}^0,\widehat{\theta}_t)\right\}_{t=0}^{\infty}$, let

$$EV_{t+1}(\widehat{\theta}_t)\equiv\mathbb{E}\left[V_{t+1}\left(\theta_{t+1},\gamma_{t+1},g_{t+1}^*\left(\theta_{t+1}\right)|\widehat{\theta}_t\right)\right] \tag{21}$$

be the continuation utility expected by the politician on the equilibrium path from period $t+1$ on, after report $\widehat{\theta}_t$ in period t and with truthful reporting of funding needs in all periods after t.

Define

$$v^p(\theta_t,g_t^*(h_{t-1}^0,\theta_t))\equiv\mathbb{E}_{\gamma_t}\left[v(\theta_t,\gamma_t,g_t^*(h_{t-1}^0,\theta_t))\right], \tag{22}$$

the expected value of politician's instantaneous utility before the value of γ_t is observed.

Then, the best sustainable equilibrium is a solution to the following program:

$$\max_{g_t^*(h_{t-1}^0,\theta_t)}\mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t u^H(\theta_t,\gamma_t,g_t^*(h_{t-1}^0,\theta_t))\right] \tag{23}$$

subject to

$$v^p(\theta_t, g_t^*(h_{t-1}^0, \theta_t)) + \widehat{\beta} EV_{t+1}(\theta_t) \geq v^p\left(\theta_t, g_t^*\left(h_{t-1}^0, \widehat{\theta}_t\right)\right) + \widehat{\beta} EV_{t+1}\left(\widehat{\theta}_t\right), \ \forall \widehat{\theta}_t \in \Theta, \tag{24}$$

$$g_t^*(h_{t-1}^0, \theta_t) \geq 0 \tag{25}$$

$$g_t^*(h_{t-1}^0, \theta_t) \leq \tau \tag{26}$$

Constraint (24) is the incentive compatibility constraint for the incumbent politician. The politician must obtain weakly higher utility when reporting the true shock θ_t today, than when deviating and reporting any other shock $\widehat{\theta}_t$. Constraints (25) and (26) are the lower bound and upper bound on the restriction that voters can set on targeted interventions.

To make progress in characterizing the equilibrium, we can restate the problem as a recursive program:

$$U(EV) = \max_{\{g^*(\theta), EV'(\theta)\}} \mathbb{E}_{\theta,\gamma}\left[u^H(\theta, \gamma, g^*(\theta)) + \beta U'(EV'(\theta))\right] \tag{27}$$

subject to

$$EV = \mathbb{E}_{\theta,\gamma}\left[v(\theta, \gamma, g^*(\theta)) + \widehat{\beta} EV'(\theta)\right], \tag{28}$$

$$v^p(\theta, g^*(\theta)) + \widehat{\beta} EV(\theta) \geq v^p\left(\theta, g^*\left(\widehat{\theta}\right)\right) + \widehat{\beta} EV'\left(\widehat{\theta}\right), \ \forall \widehat{\theta} \in \Theta, \tag{29}$$

$$g^*(\theta) \geq 0, \tag{30}$$

$$g^*(\theta) \leq \tau, \tag{31}$$

$$EV'(\theta) \geq \underline{EV}, \tag{32}$$

$$EV'(\theta) \leq \overline{EV}. \tag{33}$$

Constraint (28) represents the promise keeping constraint. It is the expected utility derived by the politician on the equilibrium path given the voters' ability to commit to their reelection strategy. Voters start the current period with a commitment to deliver to the politician expected utility EV. This restricts the path of current and future reelection cutoffs. Constraint (29) is the incentive-compatibility constraint for the incumbent politician. This is the recursive-form equivalent of constraint (24), and it ensures that the politician will prefer to report the firms' true need for funding. Constraints (30) and (31) are the lower bound and upper bound, respectively, on $g^*(\theta)$, the limit on targeted interventions. Constraints

(32) and (33) are the lower bound and upper bound, respectively, on the continuation utility voters can promise the politician.

To derive the bounds $\underline{EV}$ and $\overline{EV}$, note that the politician's utility increases as the cutoff $g^*(\theta)$ increases. A higher cutoff $g^*(\theta)$ gives the politician more freedom to choose policies without the threat of removal. Therefore, the utility that can be promised to the politician is bounded by the following lower and upper limits that correspond to removal from office and $g^*(\theta) = \tau$, respectively. So

$$\underline{EV} = \underline{V}, \tag{34}$$

and

$$\overline{EV} = \mathbb{E}_{\theta,\gamma} \left(\frac{v(\theta, \gamma, g^*(\theta))}{1 - \widehat{\beta}} \right) \Bigg|_{g^*(\theta)=\tau}. \tag{35}$$

In the next paragraphs, I discuss the role of political rents and private information in problem (27) and characterize the equilibrium.

3.5 Benchmarks

The analysis of problem (27) relies on two key elements. First, the connection between a fraction of the firms and the politician allows for political rents, and leads to the politician having a different object function from that of the voters. Second, private information limits the ability of voters to punish the politician for any deviations from their preferred policy. In the absence of these two distortions, voters would be able to implement their preferred policy.

Proposition 2 *The policy that maximizes household utility in the absence of connected firms and private information uses the available budget, τ, solely for targeted transfers: $g_t^d = \tau$ and $g_t^c = g_t^i = 0$ $\forall t$.*

The voters' preferred policy involves $g_t^d = \tau$ and $g_t^c = g_t^i = 0$, $\forall t$, since the government budget available for transfers is lower than the total loss of firms $\left(\tau < \theta^1 x\right)$ and the marginal return from targeted transfers to distressed firms is higher than from untargeted transfers or from transfers to connected firms which are not distressed. Without connected firms that can lobby, the households and the politician have the same preferences, $u^H(\theta, \gamma, g^*(\theta)) = v(\theta, \gamma, g^*(\theta))$, so the politician would prefer the same policies as the voters: $g_t^d = \tau$ and $g_t^c = g_t^i = 0$ $\forall t$. Therefore, without connected firms there would be no agency problem, and the optimal policy that maximizes household utility would be implemented.

Without private information over θ, but with connected firms, constraint (29) would not be part of the problem. Yet, voters would still be unable to observe how much is transferred to connected firms which are not distressed. In this situation, some level of untargeted transfers could still be optimal. Voters balance the costs of untargeted transfers - due to them funding undistressed firms - and the costs of political rents due to transfers to connected firms. Specifically, voters prefer positive untargeted transfers if the marginal benefit from providing untargeted transfers is higher than the marginal cost of reducing the budget for targeted interventions, and implicitly reducing g^d and g^c. Deriving these marginal costs from the voters' objective, given the politician's transfer choices, we obtain the following condition for positive untargeted transfers to be preferred by voters:

$$(1-\theta-\gamma) > f'\left(\overline{k}-x+g^{dv}\right)\left(\theta \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau} - \theta + \frac{1}{R}\left(1-\theta \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau} - \gamma\right)\right), \tag{36}$$

where g^{dv} is the value at which

$$f'\left(\overline{k}-x+g^{dv}\right) = Rf'\left(\overline{k}+\frac{\tau-\theta g^{dv}}{\gamma}\right). \tag{37}$$

I make the following assumption:

Assumption 2 *Parameters $\left\{R, \overline{k}, \tau, x\right\}$ are chosen such that condition (36) holds given g^{dv} defined implicitly in (37) above, $\forall \theta \in \Theta, \gamma \in [0, 1-\theta]$.*

Assumption 2 states that a positive level of untargeted transfers will be preferable to voters given the cost associated with targeted transfers to connected firms. The following benchmark result is therefore reached in the case of no private information.

Proposition 3 *Without private information over θ, but with connected firms that can receive targeted transfers, voters' optimal reelection strategy policy takes the form of a cutoff $g_t^*(\theta) = \tau - g_t^i$, where $g_t^i > 0$ under Assumption 2.*

A key implication of Proposition 3 is that, in the absence of private information, voters' optimal reelection strategy does not involve any history dependence. Shocks are independent, and hence there is no rationale for introducing history dependence. Yet, the results change once private information is taken into account, as it will be discussed in the next section.

3.6 Best Sustainable Equilibrium

We begin the analysis of problem (27) by showing that the function $U(EV)$ is concave and differentiable. These results are captured in the following two lemmas.

Lemma 2 *The value function $U(EV)$ is concave.*

Proof. In the Appendix. ■

Lemma 3 *The value function $U(EV)$ is differentiable for $EV \in (\underline{EV}, \overline{EV})$.*

Proof. In the Appendix. ■

In order to simplify the analysis of the problem, I make the following additional assumptions about the utility functions:

Assumption 3 *The function $v^p(\theta, g^*)$ defined in (22) satisfies: $v^p(\theta^{i+1}, g^*) - v^p(\theta^{i+1}, g^{*\prime}) \geq v^p(\theta^i, g^*) - v^p(\theta^i, g^{*\prime})$ $\forall g^*, g^{*\prime}$ with $g^{*\prime} < g^*, 1 \leq i < N$.*

Under Assumption 3, if an incentive-compatible mechanism exists for problem (27) in which types are separated, then the only incentive compatibility constraints that bind in the set of constraints denoted by (29) are those for adjacent $\theta-$types, in the upward direction. The argument and proof for this result are given in the Appendix. To ensure that the types can be separated, I make following assumption.

Assumption 4 *Consider the case without private information over θ. The following conditions hold $\forall 1 < n \leq N$, given the cutoff $g^*(\theta^n)$ that maximizes voters' utility:*

$$\left.\frac{\partial u^H(\theta^n, \gamma, g^*)}{\partial g^*}\right|_{g^*(\theta^n)} - \left.\frac{\partial u^H(\theta^{n-1}, \gamma, g^*)}{\partial g^*}\right|_{g^*\left(\theta^{n-1}\right)} > 0, \ \forall \gamma,$$

and

$$\left.\frac{\partial v^p(\theta^n, g^*)}{\partial g^*}\right|_{g^*(\theta^n)} - \left.\frac{\partial v^p(\theta^{n-1}, g^*)}{\partial g^*}\right|_{g^*\left(\theta^{n-1}\right)} > 0,$$

where v^p is defined in (22).

Assumption 4 ensures that the preferred policy for the voters, in the case without private information over θ, is monotonically increasing in θ. The second part of the statement also ensures that the politician's expected utility has the same property.

Lemmas 2 and 3 and the additional Assumptions 3 and 4 allow us to characterize the best subgame perfect equilibrium from the perspective of the voters. The first result in the analysis shows that the best sustainable equilibrium exhibits history dependence.

Proposition 4 *In the best sustainable equilibrium described above, voters' reelection decisions are history dependent: higher targeted transfers in the current period (higher $g^d_{t_0}$ and $g^c_{t_0}$) lead to more restrictions on targeted transfers in future periods, through lower future cutoffs $g^*_t, \forall t > t_0$.*

Proof. In the Appendix. ■

Proposition 4 shows that government policies in the current period have persistent effects. They affect voters' reelection strategies and therefore affect the set of future policies that a politician can engage in without risking removal from office. The intuition for the this result is that voters want to induce the politician to truthfully report the firms' current need for funding. To do this, voters punish reports of a high funding need, to discourage overreporting of funding needs, and conversely they reward reports of a low funding need. If a politician claims that many firms are distressed in the current period, and therefore need funding, voters will want to give the politician leeway to fund these firms, even if some of them are connected to the government. Otherwise, voters would risk large losses to their output. Yet, if next period the politician makes the same claim of high need for funding, then voters are less willing to accept the politician's claims and give him leeway. If the shock is indeed high and the firms need government support in order to avoid high output losses, then the politician will be forced to provide this support through other means than just targeted transfers.

Voters' reelection strategy involves a cutoff limit on targeted transfers, which restricts the politician's ability to freely choose policies. The politician's utility therefore increases as the cutoff on targeted interventions is set higher, expanding the set of policies permissible to a politician seeking reelection. Therefore, voters reward the politician following a low report $\widehat{\theta}_t$ by committing to increase the cutoffs on targeted transfers in the current period and in future periods. Through their commitment to higher cutoffs in the periods following a low report, voters make current government policies have persistent effects. Moreover, they also create volatility in the future policies chosen by the politician, since each cutoff g^*_t reflects both responses to reports of current shocks as well as commitments taken after past reports. This last remark is also summarized in the following corollary.

Corollary 1 *Voters' strategy in the best sustainable equilibrium introduces volatility in the policies undertaken by the government.*

To see the main driver of these results, notice that, for an interior solution to V', the first-order condition emerging from problem (27) is

$$\frac{\beta}{\widehat{\beta}}U_V(EV'(\theta)) + \mu + \sum_{\widehat{\theta}\neq\theta}\phi_{\theta,\widehat{\theta}} - \sum_{\widehat{\theta}\neq\theta}\phi_{\widehat{\theta},\theta}\frac{\pi(\widehat{\theta})}{\pi(\theta)} = 0 \tag{38}$$

where μ and $\pi(\theta)\phi_{\theta,\widehat{\theta}}$ are the Lagrange multipliers on constraints (28) and (29), respectively, and U_V is the derivative of U with respect to EV'. The envelope condition is given by

$$U_V(EV) = -\mu. \tag{39}$$

Combining the above conditions and taking expectations over θ we obtain

$$\mathbb{E}\left[U_V(EV'(\theta))\right] = \frac{\widehat{\beta}}{\beta}U_V(EV). \tag{40}$$

Equation (40) shows that $U_V(EV)$ is a martingale for $\widehat{\beta} = \beta$ or a submartingale for $\widehat{\beta} < \beta$. In order to satisfy the incentive compatibility constraint (29), the continuation value that must be promised to the politician, $EV'(\theta)$, must be higher following lower targeted spending in the current period (lower $g^*(\theta)$). Therefore, if $g^*(\theta)$ is increasing in θ, then $EV'(\theta)$ must be decreasing with θ. Equation (40) shows that, if $\widehat{\beta} = \beta$, then, due to the concavity of U, the promised continuation value $EV'(\theta)$ will be higher than the current promised utility EV following a low θ shock and it will be lower than EV following a high shock.

Corollary 2 *The future cutoffs that limit targeted transfers increase following a low shock θ, and they decrease following a large shock θ.*

The above corollary summarizes the result that high shocks in the current period will reduce future targeted transfers, by making the voters commit to lower future cutoffs that limit targeted interventions. Through this commitment, voters punish the politician for reporting a high need for funding today, promising him a lower expected continuation value. This introduces persistence and volatility in the policy, even though the shocks themselves are not correlated.

3.7 Two Types Of $\theta-$Shocks And Two Periods

To illustrate the above result, consider a two period version of the above model. Assume that the model only has periods $t = 0, 1$ and there are only two possible values of the shock

θ, $\Theta = \{\theta^L, \theta^H\}$. In each period, the sequence of events follows the timing described in 2.2 above. Each period, the politician chooses the transfers $\left\{g_t^d(\theta_t,\gamma_t,g_t^*), g_t^c(\theta_t,\gamma_t,g_t^*), g_t^i(\theta_t,\gamma_t,g_t^*)\right\}_{t=0,1}$ according to the program (11) and conditions (12)-(14).

The maximization problem for voters is given by

$$\max_{\{g_0^*,g_1^*\}} \mathbb{E}\left[u^H(\theta_0,\gamma_0,g_0^*) + \beta\mathbb{E}\left[u^H(\theta_1,\gamma_1,g_1^*)\right]\right] \tag{41}$$

subject to

$$\begin{aligned} v^p(\theta_0, g_0^*(\theta_0)) + \widehat{\beta}\mathbb{E}\left[v^p(\theta_1, g_1^*(\theta_0,\theta_1))\right] &\geq v^p\left(\theta_0, g_0^*\left(\widehat{\theta}_0\right)\right) + \\ &\quad \widehat{\beta}\mathbb{E}\left[v^p\left(\theta_1, g_1^*\left(\widehat{\theta}_0,\widehat{\theta}_1\right)\right)\right], \forall \widehat{\theta}_0 \in \Theta, \quad \text{(42a)} \\ v^p(\theta_1, g_1^*(\theta_0,\theta_1)) &\geq v^p\left(\theta_1, g_1^*\left(\theta_0,\widehat{\theta}_1\right)\right), \ \forall \widehat{\theta}_1 \in \Theta, \quad \text{(42b)} \\ g_0^*(\theta_0) &\geq 0, \ g_1^*(\theta_0,\theta_1) \geq 0. \quad \text{(42c)} \end{aligned}$$

The problem for the politician has the property that $v^p(\theta, g^*)$ is an increasing function of g^* maximized at $g^* = \tau, \forall\theta$. The cutoff g^* is the best response for voters given the information they have access to, and the second period is the last period of the game. Therefore, an incentive compatible cutoff $g_1^*(\theta_0,\theta_1)$ may vary only due to the reports from period 0, as separation of types cannot be achieved based on the report from the first period θ_1; however, implementing a non-constant schedule for $g_0^*(\theta_0)$ requires promising different continuation values to the politician such that the incentive compatibility constraint is satisfied. Therefore, the cutoff $g_1^*(\theta_0,\theta_1)$ will be a non-constant function of θ_0 whenever $g_0^*(\theta_0)$ is non-constant.

Denote by $\overline{g^*}$ the constant limit that would be chosen by households each period. Given Assumption 2, $\overline{g^*} > 0$. The following result captures the trade-off faced by voters when deciding their reelection strategy.

Proposition 5 *Under Assumptions 2 and 4, there exists ratio $\frac{\theta_L^*}{\theta_H^*}$ such that:*

- *for $\frac{\theta_L}{\theta_H} < \frac{\theta_L^*}{\theta_H^*}$, a report θ_0 of more distressed firms in period 0 will result in a lower cutoff $g_1^*(\theta_0,\theta_1)$ for targeted transfers in period 1;*
- *for $\frac{\theta_L}{\theta_H} \geq \frac{\theta_L^*}{\theta_H^*}$, the cutoff $g_1^*(\theta_0,\theta_1)$ on targeted transfers in period 1 will be independent of the report θ_0 about the fraction of distressed firms in period 0;*

Proof. In the Appendix. ■

The above proposition shows that when the size of shocks differs sufficiently between a crisis and a non-crisis, policies from period 0 will have persistent effects in period 1. Voters find it optimal to offer the politician incentives to truthfully report the firms' need for funding in period 0. The offer incentives by promising different cutoffs for targeted transfers in period 1, cutoffs above which they would remove the politician. Offering these incentives allows voters to bring the first period policies closer to their preferred values, compared to the policies that would be implemented with a non-contingent cutoff $\overline{g^*}$. The large difference between shocks θ_L and θ_H makes the gains in utility from adapting the reelection cutoff to the report on θ exceed the costs of having to implement the promised reelection cutoffs in period 1. In order to offer incentives for a truthful report, voters must reward the report of a low shock with a higher promised cutoff on targeted transfers in the next period. Similarly, they must punish a report of a high shock with a lower promised cutoff next period. Therefore, the need to provide incentives in period 0 leads to a persistent effect of the first period policies, as well as volatility in the size of targeted transfers, even absent any change in shock values from one period to the next.

If the ratio $\frac{\theta_L}{\theta_H}$ is large, so that the difference in the share of distressed projects between the two states is small, then offering incentives for truthful reporting is not optimal for voters. The cost of providing such incentives, in terms of lost household utility in the second period, would be larger than the gain from moving policies closer to the voters' preferred level in the first period.

The above result is similar to the bunching versus separating result in Amador et al. (2006). In their framework, the threshold for separation is given by the degree of disagreement between the selves. Here, too, the threshold is given by the degree of disagreement between two agents – voters and the politician – both in the current period, and in future periods. This disagreement comes from the higher weight placed by the politician on transfers to connected firms, relative to the value placed by voters on these transfers. As detailed in Amador et al. (2006), extending the above conclusion to more than two discrete $\theta-$types does not lead to a simple characterization of the optimal solution. Using a continuous distribution for θ can, under specific conditions, lead to a full characterization of the allocation.[19] The analysis in this model is restricted to the set of shocks over which separation is optimal, by imposing the conditions specified in Assumption 4. Therefore, the infinite horizon problem continues to assume a discrete distribution for the $\theta-$types.[20]

[19] See Amador et al. (2006) for further details.

[20] An extension of the analysis to the case with a bunching threshold might require a continuous distrib-

3.8 Long-run Implications

In this section, I study the long run implications of the model for the mix of targeted and untargeted transfers chosen by the politician. The main questions explored in this section are whether the expected continuation value obtained by the politician in the best sustainable equilibrium converges to a stationary distribution, and how do the cutoffs for targeted transfers vary in the long run.

If the discount factors are the same for voters and the politician ($\beta = \widehat{\beta}$), then the continuation utility given to the politician in the long run will be at either the high end or the low end of its possible values ($\overline{EV}$ and $\underline{EV}$ respectively), and it will converge almost surely. The argument for this is similar to the immiseration result obtained in Thomas and Worrall (1990) and Atkeson and Lucas (1992), and the details are given in the Appendix. The intuition for the result is that the rewards and punishments necessary to give incentives to the politician are optimally spread over the entire time horizon, which makes the expected continuation utility EV behave like a random walk. Each period, a new shock accumulates, leading to more diverging rewards or punishments.

Proposition 6 *With no difference in discount factors between voters and the politician ($\beta = \widehat{\beta}$), the expected continuation value for the politician (EV) converges almost surely to its boundary ($\overline{EV}$ or $\underline{EV}$). Therefore, in the long run, the politician receives the maximum possible reward after a low reported need for funding and is punished maximally after a high reported need for funding.*

Proof. In the Appendix. ■

Proposition 6 states that the long run distribution for the expected politician utility (EV) has mass points only at $\underline{EV}$ and $\overline{EV}$. The result emerges because voters optimally backload the incentives offered to the politician. Over time, voters increase the continuation value promised to the politician as a reward after a report of a low shock θ, and they decrease the continuation value promised after a report of a high shock θ. This is necessary in order to induce truthful reports about the state of the economy, and to optimally spread the cost of distortions over time. The intuition is that the longer the politician is in power, the more he must be rewarded for complying with the voters' conditions. Since voters must make promises every period, these promises accumulate and increase the reward for the politician. Similarly, the punishments increase over time, the longer the politician is in power. In the long run, this amounts to maximal rewards and punishments. Since the maximum punishment and

ution of types.

the maximum reward, $\underline{EV}$ and $\overline{EV}$, respectively, correspond to either politician replacement or to having no cutoff for targeted transfers ($g_t^* = \tau$), we obtain the following corollary.

Corollary 3 *With no difference in discount factors between voters and the politician ($\beta = \widehat{\beta}$), the balance between targeted and untargeted transfers will be chosen by the politician without any binding restrictions from voters.*

If the discount factors are different for voters and the politician, so that $\widehat{\beta} < \beta$, then the submartingale that characterizes the continuation value describes a mean-reversion process. The continuation value EV converges to an invariant distribution, as shown in Farhi and Werning (2007). The invariant distribution ψ^* has no mass at the bounds and

$\sum U_V(EV)\psi^*(EV) = 0$. Therefore, in the long run, the optimal policy will feature both targeted and untargeted transfers, and the cutoff for targeted transfers will bind with positive probability.

Proposition 7 *With different discount factors($\beta > \widehat{\beta}$), the continuation value for the politician (EV) has an invariant distribution with no mass at the bounds $\overline{EV}$ and $\underline{EV}$. The optimal policy in the long run involves both targeted and untargeted transfers.*

Proof. In the Appendix. ■

The intuition for Proposition 7 is that voters value their future consumption more than the politician. Because of this, it is not preferable for them to promise high rewards for the politician in the future. Since they value these rewards more than the politician, the cost to them is higher than the benefit to the politician. The promised rewards to the politician do not increase up to the maximum level. Similarly, the punishment for reporting a high fraction of distressed firms does not increase to the maximum. Voters prefer to offer more rewards to the politician in the short-term rather than backload political rents, as rents obtained further in the future are less valuable to the politician. In this case, even in the long-run, the politician is constrained by voters to choose a certain combination of targeted and untargeted transfers.[21]

[21] The implications of the above result are based on a strong set of assumptions. Implementing the optimal contract requires permanent commitment from households and no renegotiation over time. This strong assumption simplifies the analysis, by restricting the voters to only using one possible instrument for incentives provision: the cutoff on targeted interventions. An extension of the model to allow for renegotiation would change the results.

4 The Case With Public Debt

The model without debt highlights that the optimal cutoff on targeted transfers is history dependent even in an environment in which the periods are not linked through any additional state variables. However, with a fixed government budget each period, an increase in untargeted transfers necessarily leads to a decrease in targeted interventions. In this section, we allow for income to be shifted across periods through the use of public debt. The ability to take on debt allows the politician to shift resources from one period to the next. The question is then how the existence of debt affects voters' ability to restrict inefficient transfers and induce the politician to truthfully report the fraction of distressed firms. In particular, we can examine the change in voters' cutoffs on targeted interventions, above which thet would replace the politician.

Consider the case in which $\beta = \widehat{\beta}$. The politician now has access to a debt market, and he can take on one-period non-contingent debt b_{t+1} at rate $\frac{1}{\beta}$, where the value of b_{t+1} is limited below by an exogenously given limit $\underline{b}$, and it is limited above by the no-Ponzi condition. The debt is observable to households, and households can condition reelection on the size of b_{t+1}. As before, the problem can be split into a subproblem for the politician given the voters' reelection strategy and a subproblem for voters given the politician's observable policy choices and his report on shock θ.

First, we stablish the result that, with truthful reporting of shocks θ_t, the equilibrium strategy for voters is to use a cutoff for debt taking, above which they replace the politician.

Lemma 4 *For every report $\widehat{\theta}_t$ and $g_t^*(h_{t-1}^0, \widehat{\theta}_t)$, there exists $b_t^*(h_{t-1}^0, \widehat{\theta}_t) \geq 0$ such that $\forall b_{t+1}(h_{t-1}^0, \widehat{\theta}_t) \leq b_t^*(h_{t-1}^0, \widehat{\theta}_t)$, $\rho_t(g_t, b_{t+1} | g_t^i \geq \tau - g_t^*) = 1$, and $\rho_t = 0$ otherwise.*

Lemma 4 states that the reelection strategy for the voters for evert report $\widehat{\theta}_t$ will involve setting a cutoff value g_t^* for targeted transfers and a cutoff value b_t^* for debt, above which the politician will be removed from office. The intuition for this result is similar to the intuition for the cutoff $g_t^*(h_{t-1}^0, \widehat{\theta}_t)$. The voters' benefit from debt is lower than that of the politician, and therefore, they always prefer lower debt that the politician. Their utility varies monotonically with debt, and this gives the cutoff result in Lemma 4.

The politician's problem each period, given a schedule $\{g^*, b^*\}$:

$$V\left(\theta,\gamma,g^*\left(\widehat{\theta}\right),b^*\left(\widehat{\theta}\right)\right) \equiv \max_{\{g^d,g^c,g^i,b'\}} v\left(\theta,\gamma,g^*\left(\widehat{\theta}\right),b^*\left(\widehat{\theta}\right)\right) + \widehat{\beta}\mathbb{E}\left[V'\left(\theta',\gamma',g^{*\prime}\left(\widehat{\theta}'\right),b^{*\prime}\left(\widehat{\theta}'\right)\right)\right] \tag{43}$$

subject to

$$\gamma g^c + \theta g^d \leq g^*\left(\widehat{\theta}\right), \tag{44a}$$

$$\gamma g^c + \theta g^d + g^i \leq \tau + \beta b' - b, \tag{44b}$$

$$b' \geq \underline{b}, \tag{44c}$$

$$b' \leq b^*\left(\widehat{\theta}\right), \tag{44d}$$

$$g^c \geq 0,\ g^d \geq 0,\ g^i \geq 0. \tag{44e}$$

Constraint (44a) is the limit on targeted transfers imposed by voters as part of their reelection condition given report $\widehat{\theta}$. Constraint (44b) is the resource constraint faced by the politician when he can take on public debt. Constraint (44c) is the exogenous lower bound on debt. Constraint (44d) is the constraint on debt as part of voters' reelection strategy. Finally, constraint (44e) is the non-negativity requirement for all government policies.

Given the concavity of the politician's instantaneous utility $v\left(\theta,\gamma,g^*\left(\widehat{\theta}\right),b^*\left(\widehat{\theta}\right)\right)$ and the linear constraints, it follows that the solution to (12)-(14) is unique, and

$V\left(\theta,\gamma,g^*\left(\widehat{\theta}\right),b^*\left(\widehat{\theta}\right)\right)$ is a well-defined function. Since the politician has a higher preference for debt in the current period than voters, due to the higher preference for transfers to connected firms, constraint (44d) will bind and $b' = b^*\left(\widehat{\theta}\right)$. We are therefore still in a situation in which there are no inter-period linkages other than through voters' strategies $\left\{g^*\left(\widehat{\theta}\right),b^*\left(\widehat{\theta}\right)\right\}$. The politician's problem given $g^*\left(\widehat{\theta}\right)$ and $b^*\left(\widehat{\theta}\right)$ is a static optimization over $\{g^d, g^c, g^i\}$. This leads to the following choice of policies as a function of $g^*\left(\widehat{\theta}\right)$ and $b^*\left(\widehat{\theta}\right)$, assuming an interior solution:

$$g^i = \tau + b^*\left(\widehat{\theta}\right) - b - g^*\left(\widehat{\theta}\right), \tag{45}$$

$$g^c = \frac{g^*(\widehat{\theta}) - \theta g^d}{\gamma}, \tag{46}$$

and g^d is given by the implicit equation

$$\theta f'\left(\overline{k} - x + g^d + \tau + b^*\left(\widehat{\theta}\right) - b - g^*(\widehat{\theta})\right) = \gamma R f'\left(\overline{k} + \frac{g^*(\widehat{\theta}) - \theta g^d}{\gamma}\right).$$

Analogous to the previous section, let

$$v^p(\theta_t, g_t^*(h_{t-1}^0, \theta_t), b_t^*(h_{t-1}^0, \theta_t)) \equiv \mathbb{E}\left[v^p(\theta_t, \gamma_t, g_t^*(h_{t-1}^0, \theta_t), b_t^*(h_{t-1}^0, \theta_t))\right],$$

the expected utility of the politician in the current period before the realization of the γ_t shock.

The subproblem for the voters, taking into account the response from the politician, is given by:

$$\max_{g_t^*(h_{t-1}^0, \theta_t), b_t^*(h_{t-1}^0, \theta_t)} \mathbb{E}\sum_{t=0}^{\infty} \beta^t u^H\left(\theta_t, \gamma_t, g_t^*(h_{t-1}^0, \theta_t), b_t^*\left(h_{t-1}^0, \theta_t\right)\right) \tag{47}$$

subject to

$$v^p(\theta_t, g_t^*(h_{t-1}^0, \theta_t), b_t^*(h_{t-1}^0, \theta_t)) + \widehat{\beta} E V_{t+1}^h(\theta_t) \geq v^p\left(\theta_t, g_t^*\left(h_{t-1}^0, \widehat{\theta}_t\right), b_t^*(h_{t-1}^0, \widehat{\theta}_t)\right) + \widehat{\beta} E V_{t+1}^h\left(\widehat{\theta}_t\right), \ \forall \widehat{\theta}_t \in \Theta, \tag{48}$$

$$g_t^*(\theta_t) \geq 0, \tag{49}$$

$$b_t^*(h_{t-1}^0, \theta_t) \geq \underline{b}, \tag{50}$$

$$\mathbb{E}\sum_{t=0}^{\infty} \beta^t b_t^*(h_{t-1}^0, \theta_t) \leq \frac{\tau}{1-\beta}. \tag{51}$$

Constraint (48) is the incentive compatibility constraint for the politician, who must be induced to truthfully report the shock θ_t each period. Constraint (49) is the lower bound for targeted interventions, $g_t^*(\theta_t)$. Constraint (50) is the exogenous lower bound for debt-taking. Constraint (51) gives the intertemporal resource constraint, that limits maximum debt-taking to the lifetime resources available to the government. While there is no constraint for the upper limit for $g_t^*(\theta_t)$, we can see from problem (43) that the politician will weakly prefer to choose $g_t^*(\theta_t)$ equal to the all resources available in period t rather than setting $g_t^*(\theta_t)$ above that value.

Using the strategy in Farhi and Werning (2007), let η denote the multiplier on the intertemporal resource constraint (51). We can then form the Lagrangian

$$\mathfrak{L} \equiv \sum_{t=0}^{\infty} \beta^t \mathbb{E}\left[u^h(\theta_t, \gamma_t, g_t^*(h_{t-1}^0, \theta_t), b_t^*\left(h_{t-1}^0, \theta_t\right)) - \eta b_t^*(h_{t-1}^0, \theta_t)\right].$$

Therefore, the problem reduces to studying the maximization of $\mathfrak{L}$ subject to constraint (48). This problem is then equivalent to the maximization problem

$$K(V) = \sup_{\{g_t^*, b_t^*\}} \mathfrak{L}, \tag{52}$$

subject to constraints (48)-(51).

As in the case without debt, the above problem can be expressed in recursive form as

$$\begin{aligned} U(EV) &= \max_{g^*(\theta), b^*(\theta), EV'(\theta)} \mathbb{E}_{\theta,\gamma}\left[u^h(\theta, \gamma, g^*(\theta), b^*(\theta)) - \right. & (53)\\ & \left. \eta b_t^*(h_{t-1}^0, \theta) + \beta U(EV'(\theta))\right] & (54) \end{aligned}$$

subject to

$$EV = \mathbb{E}_{\theta,\gamma}\left[v(\theta, \gamma, g^*(\theta), b^*(\theta)) + \beta EV'(\theta)\right], \tag{55}$$

$$\begin{aligned} v^p(\theta, g^*(\theta), b^*(\theta)) + \beta EV'(\theta) &\geq v^p\left(\theta, g^*\left(\widehat{\theta}\right), b^*\left(\widehat{\theta}\right)\right) + \beta EV'(\widehat{\theta}), \forall \widehat{\theta} \in \Theta, & (56)\\ g^*(\theta) &\geq 0, & (57)\\ b^*(\theta) &\geq \underline{b}, & (58)\\ b^*(\theta) &\leq \frac{\tau}{1-\beta}, & (59)\\ EV'(\theta) &\geq \underline{EV}, & (60)\\ EV'(\theta) &\leq \overline{EV}. & (61) \end{aligned}$$

Constraint (55) represents the promise keeping constraint, constraint (56) is the incentive-compatibility constraint for the incumbent politician. Constraint (57) is the lower bound on direct interventions. Constraints (58) and (59) give the lower and upper bounds on debt. Similarly, constraints (60) and (61) give the lower and upper bounds, respectively, on the expected continuation utility that voters can offer the politician. Since the utility of the politician is increasing in the cutoffs $g^*(\theta)$ and $b^*(\theta)$, we can, as in the case without debt, derive the lower and upper limits on the expected utility that can be promised to the politician. These limits correspond to removal from office and $g^*(\theta) = \tau$ and $b^*(\theta) = \frac{\tau}{1-\beta}$, respectively:

$$\underline{EV} = \underline{V}, \tag{62}$$

and

$$\overline{EV} = \mathbb{E}_\theta \left(\frac{v^p(\theta, g^*(\theta), b^*(\theta))}{1-\widehat{\beta}} \right) \Bigg|_{g^*(\theta)=\tau, b^*(\theta)=\frac{\tau}{1-\beta}}. \tag{63}$$

Problem (53) is similar to the problem without debt in that it delivers the same martingale properties for the politician's continuation value.

Proposition 8 *Consider the model with public debt. The best sustainable equilibrium has the property that voters' reelection decisions are history dependent: higher targeted transfers in the current period (higher g_t^d and g_t^c) lead to more restrictions on targeted transfers in future periods, through lower future cutoffs g_j^* and b_j^*, $\forall j > t$.*

Proof. In the Appendix. ∎

Proposition 8 shows that the presence of public debt delivers the same result as Proposition 4, that the cutoffs on targeted intervention are history dependent. A report of a high shock θ, so a high need for funding in the current period is punished by promising the politician a lower level of utility in the future. This is achieved by increasing the restrictions on the politician in future periods, through both a lower cutoff on targeted interventions and more limited access to debt.

While it does not change the qualitative features of the equilibrium, the existence of debt does affect voters' choices of reelection cutoffs and therefore the equilibrium balance between targeted and untargeted transfers. Higher outstanding debt in a period will lead to a higher cutoff on targeted spending. Higher outstanding debt decreases the cost to voters of allowing more transfers to be given to connected firms (along with more targeted transfers to distressed firms) relative to the utility cost of using the scarcer available revenue for untargeted transfers. Second, taking on more debt increases the politician's relative preference for targeted transfers relative to untargeted transfers. This in turn affects voters' ability to use reelection as an instrument for reducing inefficient transfers. The result of this is captured in the following Proposition.

Proposition 9 *In the model with public debt, the politician must be promised a higher expected utility in equilibrium compared to the case without debt. The transfers targeted to connected firms are also higher than in the case without debt.*

Proof. In the Appendix. ∎

The result in Proposition 9 emerges because both the politician, and voters derive utility from the output produced by firms. All transfers benefit both voters and the politician, but the politician places higher weight on transfers to connected firms. Therefore, with access to debt, the politician will increase all transfers, but he will increase the transfers to connected firms by more than voters would prefer. Each period, the utility of voters changes in the same way as the utility of the politician, but the utility of the politician increases by more relative to that of voters. The intuition is that the politician now has more access to funds that he can use for transfers to connected firms, while voters have limited means of restricting his behavior. The existence of public debt then makes the incentive compatible mechanism costlier to implement relative to the no debt case, because of the higher flexibility that the politician in accessing public funds. It does not change the result that the cutoff g_t^* is history dependent, but it does change the costs to voters of providing incentives.

The above result also shows that the politician benefits from having access to public debt. The cost of providing incentives is higher for voters, but that does not necessarily imply that voter welfare goes down. On the one hand, public debt allows for a smoothing of intervention costs over time, which increases overall welfare. On the other hand, offering incentives to the politician imposes a higher utility cost on voters. The overall effect on voter welfare could go in either direction, depending on how much the politician's preference for transfers to connected firms differs from that of voters. We therefore obtain the result that constraints on debt-taking are desirable in environments with a high divergence between voters and the politician, in which the costs of offering incentives to the politician outweigh the benefits of smoothing the cost of interventions over time.

Corollary 4 *There exist environments (in terms of production functions $f(\cdot)$ and weight R on connected firms) in which budget balance requirements increase voter welfare. These environments require a high weight R on transfers to connected firms. Otherwise, public debt is welfare increasing for both voters and the politician.*

Proof. In the Appendix. ■

The intuition for Corollary 4 is that not having access to debt is only preferable to voters if debt reduces their ability to restrict transfers to connected firms which are not distressed, and transfers to connected but undistressed firms are highly inefficient for voters (given the production function $f(\cdot)$). These transfers benefit the politician more than they benefit voters, leading to welfare losses for voters and welfare gains to the politician. Restricting debt is desirable only if the loss from these inefficient transfers outweighs the benefits coming from having more public funds available in periods of severe crisis, when government intervention is most valuable.

5 Extension - Non-Financial Public Goods

So far, the model only considered the government's role as lender of last resort in a financial crisis. The Appendix presents an extension of the model in which a non-financial public good can also be provided by the government along with transfers to firms. I assume that this additional public good can only be provided by the government, and it offers the same utility to both households and the politician. This additional public good offers a dimension of policy along which households and the government have the same preferences, and it also allows us to consider a different use for public funds, other than transfers to firms. The analysis of the model presented in the Appendix shows that expanding the set of public goods provided by the government does not change the main implications of the model regarding the history dependence of the cutoffs on targeted transfers, nor the persistent effects of policies. Yet, we can show that adding such a non-financial public good can have a disciplining effect on the politician. It can lead to cases where untargeted transfers are not offered in equilibrium. In this case, the government will prefer to respond to any cutoffs on targeted transfers by increasing the provision of the other public good rather than resorting to untargeted transfers.

6 Conclusion

This paper develops a political economy model of government intervention in financial markets when the government has private information about the shocks hitting the economy, and in which policy is decided by an elected politician. The politician is connected to some of the firms operating in this economy, and he derives political rents from making transfers to these firms. These lobbying firms are not distressed, and their use of public funds to expand output is socially inefficient. The government has access to two types of interventions: it can directly provide funds to firms through targeted transfers; or, it can make funds accessible to all firms through untargeted transfers. Making funds accessible to all firms means that some funds will go to undistressed firms, which would be an inefficient use of public funds

The key friction of the model is that targeted transfers can be directed to connected firms that are not distressed, leading to an outcome that is socially inefficient, but beneficial for the politician, due to the political rents extracted from firms that lobby the government. In order to restrict the inefficient transfers to connected firms, voters can punish the incumbent politician with removal from power. Given these ingredients, the model shows that the policies chosen by the politician have persistent effects through the voters' reelection decisions in future periods. A politician who uses targeted transfers in the current period faces a stricter reelection condition from voters in future periods. If an incumbent wants to remain in office, he will then have to provide fewer targeted transfers in future periods, even as the same shocks hit the economy.

The model shows how reelection pressures affect the choice of government interventions in crises. It presents a mechanism that results in a combination of targeted and untargeted transfers that changes over time depending on the government's past actions. This pattern is maintained even if the government has access to public debt, or if the government is able to provide non-financial public goods along with transfers to firms. It shows how a targeted intervention by the government in a financial crisis can have the side effect of making future targeted interventions less likely.

The model offers several avenues for future research. First, the paper does not consider the viability or solvability of distressed firms. The targeted transfers from the government could, however, be used to support inefficient projects. This would lead to an increased probability of default by these firms in the future, essentially creating more volatility in the economy. Another interesting extension of the model is to consider the difference in timing between targeted and untargeted interventions. Legislative procedures associated with targeted transfers are generally viewed as lengthier than policy decisions made outside of the legislative process. This difference in timing would introduce an even stronger incentive for voters to restrict targeted transfers and accept more untargeted transfers when faster intervention reduces firms' losses.

The model's implications provide a possible mechanism that explains the observed pattern of government intervention in the recent financial crisis. The implications of the model could be tested empirically by relating the type of government intervention to its timing relative to the duration of the crisis, and to the degree of electoral pressures faced by the government. These pressures can come in the form of scheduled elections or lobbying activities.

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Appendix

A Proofs from Section 3

A.1 Proof of Proposition 1

Assume the allocation ϕ is supported by sustainable equilibrium strategies. Then, condition (10) must be satisfied for the politician to follow the equilibrium strategy of reporting the true shock θ. The inequality in condition (10) ensures that reporting $\widehat{\theta} \neq \theta$, with associated limit $g^*(\widehat{\theta})$ and continuation value $V_{t+1}(\widehat{\theta}_t, h_t)$, is a weakly dominated strategy. Conditions (7), (8) and (9) are necessary for feasibility.

Assume conditions (7)-(10) are satisfied. Then the allocation ϕ is feasible given conditions (7), (8) and (9). Finally, condition (10) implies that the politician does not have an incentive to deviate from the equilibrium strategy of reporting the true value of θ.

A.2 Note on full information solution and Assumption 2

The condition in Assumption 2 is obtained from the following inequality, taking the marginal benefit and cost to voters of increasing g^i from 0.

$$\theta f'\left(\overline{k} - x + g^{dv}\right) + (1 - \theta - \gamma)\, f'\left(\overline{k}\right) + \gamma f'\left(\overline{k} + \frac{\tau - \theta g^{dv}}{\gamma}\right) \;>\; \theta f'\left(\overline{k} - x + g^{dv}\right) \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau}$$

$$+\; \gamma f'\left(\overline{k} + \frac{\tau - \theta g^{dv}}{\gamma}\right) \left.\frac{\partial g^{cv}}{\partial g^*}\right|_{g^*=\tau},$$

$$\theta f'\left(\overline{k} - x + g^{dv}\right) + (1 - \theta - \gamma)\, f'\left(\overline{k}\right) + \gamma f'\left(\overline{k} + \frac{\tau - \theta g^{dv}}{\gamma}\right) > \theta f'\left(\overline{k} - x + g^{dv}\right) \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau}$$

$$+\, \gamma f'\left(\overline{k} + \frac{\tau - \theta g^{dv}}{\gamma}\right) \left(\frac{1}{\gamma} - \frac{\theta}{\gamma} \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau}\right),$$

$$\theta f'\left(\overline{k} - x + g^{dv}\right) + (1 - \theta - \gamma)\, f'\left(\overline{k}\right) + \frac{\gamma}{R} f'\left(\overline{k} - x + g^{dv}\right) \;>\; \theta f'\left(\overline{k} - x + g^{dv}\right) \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau}$$

$$+\, \frac{f'\left(\overline{k} - x + g^{dv}\right)}{R} \left(1 - \theta \left.\frac{\partial g^{dv}}{\partial g^*}\right|_{g^*=\tau}\right),$$

$$
\begin{aligned}
(1-\theta-\gamma)\, f'\left(\overline{k}\right) &> f'\left(\overline{k}-x+g^{dv}\right)\left(\theta\left.\frac{\partial g^{dv}}{\partial g^{*}}\right|_{g^{*}=\tau}+\frac{1}{R}\left(1-\theta\left.\frac{\partial g^{dv}}{\partial g^{*}}\right|_{g^{*}=\tau}-\gamma\right)-\theta\right), \\
(1-\theta-\gamma) &> f'\left(\overline{k}-x+g^{dv}\right)\left(\theta\left.\frac{\partial g^{dv}}{\partial g^{*}}\right|_{g^{*}=\tau}-\theta+\frac{1}{R}\left(1-\theta\left.\frac{\partial g^{dv}}{\partial g^{*}}\right|_{g^{*}=\tau}-\gamma\right)\right).
\end{aligned}
$$

where g^{dv} is the value chosen by the politician when the limit on direct interventions is τ:

$$
f'\left(\overline{k}-x+g^{dv}\right)=Rf'\left(\overline{k}+\frac{\tau-\theta g^{dv}}{\gamma}\right).
$$

The first order condition for an interior $g^{*}(\theta)$, given conditions (15)-(17), must satisfy

$$
\begin{aligned}
&\theta f'\left(\overline{k}-x+g^{dv}+\tau-g^{*}(\theta)\right)\left(\frac{\partial g^{dv}}{\partial g^{*}}-1\right)-(1-\theta-\gamma)\, f'\left(\overline{k}+\tau-g^{*}(\theta)\right) \\
&+\gamma f'\left(\overline{k}+\frac{g^{*}(\theta)-\theta g^{dv}}{\gamma}+\tau-g^{*}(\theta)\right)\left(\frac{1}{\gamma}-\frac{\theta}{\gamma}\frac{\partial g^{dv}}{\partial g^{*}}-1\right) \;=\; 0. \qquad (64)
\end{aligned}
$$

Given conditions (15)-(17), it also follows that:

$$
\begin{aligned}
&\theta\left[f''(\overline{k}-x+g^{d}+\tau-g^{*})\right]\left(\frac{\partial g^{dv}}{\partial g^{*}}-1\right)= \\
&\qquad \gamma R\left[f''\left(\overline{k}+\frac{g^{*}(\theta)-\theta g^{dv}}{\gamma}+\tau-g^{*}(\theta)\right)\right]\left(\frac{1}{\gamma}-\frac{\theta}{\gamma}\frac{\partial g^{dv}}{\partial g^{*}}-1\right),
\end{aligned}
$$

so we can derive the following bounds for $\frac{\partial g^{dv}}{\partial g^{*}}$:

$$
1<\frac{\partial g^{dv}}{\partial g^{*}}<\frac{1-\gamma}{\theta}.
$$

Therefore, condition (64) can be satisfied for appropriate parameters $\left\{R,\overline{k},x,\tau\right\}$ and functional forms.

A.3 Note of Incentive Compatibility

We simplify the problem by using the following Lemma.

Lemma 5 *Under Assumption 3, if an incentive-compatible mechanism exists in which the $\theta-$types are separated, then the only IC constraints that bind are those for adjacent $\theta-$types, in the upward direction.*

Proof. Define $v^p(\theta^i, g^*(\theta^i)) \equiv \mathbb{E}_\gamma \left[v(\theta^i, \gamma, g^*(\theta^i)) \right]$.

Let

$$C_{i,j} = v^p(\theta^i, g^*(\theta^i)) + \beta EV'(\theta^i) - v^p(\theta^i, g^*(\theta^j)) - \beta EV'(\theta^j).$$

We first show that if $C_{i,i+1} = 0$, then $C_{i,j} \geq 0 \; \forall j, i$.

$$C_{i,i+1} = 0 \Leftrightarrow \beta EV'(\theta^i) - \beta EV'(\theta^{i+1}) = v^p(\theta^i, g^*(\theta^{i+1})) - v^p(\theta^i, g^*(\theta^{i+1})).$$

By Assumption 3,

$$v^p(\theta^{i+1}, g^*(\theta^{i+1})) - v^p(\theta^{i+1}, g^*(\theta^i)) \geq \beta EV'(\theta^i) - \beta EV'(\theta^{i+1}),$$

so

$$v^p(g^*(\theta^{i+1}), \theta^{i+1}) - v^p(g^*(\theta^i), \theta^{i+1}) - \beta EV'(\theta^i) + \beta EV'(\theta^{i+1}) > 0.$$

Thus,

$$C_{i,i+1} = 0 \rightarrow C_{i+1,i} \geq 0$$

$C_{i,i+1} = 0$ means, $\forall k > 0$, with $i + k \leq N$:

$$\begin{aligned}
\beta EV'(\theta^i) - \beta EV'(\theta^{i+1}) &= v^p(\theta^i, g^*(\theta^{i+1})) - v^p(\theta^i, g^*(\theta)); \\
\beta EV'(\theta^{i+1}) - \beta EV'(\theta^{i+2}) &= v^p(\theta^{i+1}, g^*(\theta^{i+2})) - v^p(\theta^{i+1}, g^*(\theta^{i+1})); \\
& \quad (...) \\
\beta EV'(\theta^{i+k-1}) - \beta EV'(\theta^{i+k}) &= v^p(\theta^{i+k-1}, g^*(\theta^{i+k})) - v^p(\theta^{i+k-1}, g^*(\theta^{i+k-1})).
\end{aligned}$$

Adding up the above equalities $\Rightarrow$

$$\beta EV'(\theta^i) - \beta EV'(\theta^{i+k}) = \sum_{n=i}^{i+k-1} \left\{ v^p(\theta^n, g^*(\theta^{n+1})) - v^p(\theta^n, g^*(\theta^n)) \right\}.$$

Then

$$\left\{v^p(\theta^i, g^*(\theta)) + \beta EV'(\theta^i) - v^p(\theta^i, g^*(\theta^{i+k}),) - \beta EV'(\theta^{i+k})\right\}$$
$$= \left\{ v^p(\theta^i, g^*(\theta^i)) - v^p(\theta^i, g^*(\theta^{i+k})) + \sum_{\theta=i}^{i+k-1} \left\{v^p(\theta^n, g^*(\theta^{n+1})) - v^p(\theta^n, g^*(\theta^n))\right\} \right\}$$

By repeatedly applying the inequality in Assumption 3 in the above sum, it follows that

$$v^p(\theta^i, g^*(\theta^i)) + \beta EV'(\theta^i) - v^p(\theta^i, g^*(\theta^{i+k})) - \beta EV'(\theta^{i+k}) \geq 0.$$

Therefore $C_{i,i+1} = 0$ implies $C_{i,i+k} \geq 0$, $1 < k \leq N - i$.

Then, we show that it must be the case that $C_{i,i+1} = 0$. Notice that the utility of the voters is maximized when $\overline{G}^B$ is implemented in period 2, which leads to an expected utility of EV'^B for the government. As $\left|EV'(\theta^i) - EV'^B\right|$ increases, voters' utility decreases, since it is a concave function that is maximized at the point corresponding to EV'^B. It follows then that $EV'(\theta^N) \leq EV'^B \leq EV'(\theta^1)$.

Assume that $C_{i,i+1} > 0$. If $EV'(\theta^{i+1}) \leq EV'^B$, then increasing $EV'(\theta^j)$ by a small ϵ $\forall j \leq i$ would still satisfy the incentive compatibility constraints, but would also increase the utility of voters. Similarly, if $EV'(\theta^{i+1}) > EV'^B$, increasing $EV'(\theta^j)$ by a small ϵ, $\forall j > i$ would still satisfy the incentive compatibility constraints and increase the utility of voters. Therefore, $C_{i,i+1} > 0$ would not be optimal. ■

A.4 Proof of Lemma 2

The function

$$u^H = \theta f(\overline{k} - x + g^d + g^i) + (1 - \theta - \gamma) f(\overline{k} + g^i) + \gamma f(\overline{k} + g^c + g^i)$$

is strictly concave in transfers (since $f(\cdot)$ is strictly concave). Given conditions (15)-(17), the equilibrium untargeted transfer $g^i(\theta)$ is a linear function of $g^*(\theta)$. Also, the first-order conditions for the politician yield

$$\theta f'(\overline{k} - x + g^d + \tau - g^*(\theta)) = \gamma R f'\left(\overline{k} + \frac{g^*(\theta) - \theta g^d}{\gamma} + \tau - g^*(\theta)\right).$$

Since the function $f(\cdot)$ is strictly concave, it follows from the above equality that $g^d(\theta, g^*(\theta))$ is weakly concave. Then,

$$\begin{aligned}
\frac{\partial^2 u^H(\theta,\gamma,g^*)}{\partial g^{*2}} &= \Bigg\{\theta f''\left(\overline{k}-x+g^d(\theta,g^*)+g^i(\theta,g^*)\right)\left(\frac{\partial g^d(\theta,g^*)}{\partial g^*}-1\right)^2 \\
&+\theta f'\left(\overline{k}-x+g^d(\theta,g^*)+g^i(\theta,g^*)\right)\frac{\partial^2 g^d(\theta,g^*)}{\partial g^{*2}} \\
&+(1-\theta-\gamma)f''(\overline{k}+g^i(\theta,g^*)) \\
&+\gamma f''\left(\overline{k}+\frac{g^*(\theta)-\theta g^d}{\gamma}+\tau-g^*(\theta)\right)\left(\frac{1}{\gamma}-\frac{\theta}{\gamma}\frac{\partial g^d}{\partial g^*}-1\right)^2 \\
&+\gamma f'\left(\overline{k}+\frac{g^*(\theta)-\theta g^d}{\gamma}+\tau-g^*(\theta)\right)\left(-\frac{\theta}{\gamma}\frac{\partial^2 g^d}{\partial g^{*2}}\right)\Bigg\},
\end{aligned}$$

which, given

$$f'\left(\overline{k}-x+g^d(\theta,g^*)+g^i(\theta,g^*)\right)=Rf'\left(\overline{k}+\frac{g^*(\theta)-\theta g^d}{\gamma}+\tau-g^*(\theta)\right),$$

is reduced to

$$\begin{aligned}
\frac{\partial^2 u^H(\theta,\gamma,g^*)}{\partial g^{*2}} &= \Bigg\{\theta f''\left(\overline{k}-x+g^d(\theta,g^*)+g^i(\theta,g^*)\right)\left(\frac{\partial g^d(\theta,g^*)}{\partial g^*}-1\right)^2 \\
&+\theta f'\left(\overline{k}-x+g^d(\theta,g^*)+g^i(\theta,g^*)\right)\frac{\partial^2 g^d(\theta,g^*)}{\partial g^{*2}}\left(1-\frac{1}{R}\right) \\
&+(1-\theta-\gamma)f''(\overline{k}+g^i(\theta,g^*)) \\
&+\gamma f''\left(\overline{k}+\frac{g^*(\theta)-\theta g^d}{\gamma}+\tau-g^*(\theta)\right)\left(\frac{1}{\gamma}-\frac{\theta}{\gamma}\frac{\partial g^d}{\partial g^*}-1\right)^2\Bigg\}.
\end{aligned}$$

Since $f''<0$ and $\frac{\partial^2 g^d(\theta,g^*)}{\partial g^{*2}}<0$, it follows that $\frac{\partial^2 u^H(\theta,g^*)}{\partial g^{*2}}<0$. So, the voters' utility for each shock value θ –$u^H(\theta,g^*(\theta))$– is strictly concave. Then, $u^H=\mathbb{E}\left[u^H(\theta,g^*)\right]$ is also strictly concave.

We use an inductive argument to show the concavity of U. Let $\alpha=\{g^*(\theta)),EV'(\theta)\}_{\theta\in\Theta}$ denote the choice variables of the voters each period, for each reported θ. Then

$$U_k(EV)=\max_{\alpha}\mathbb{E}\left[u^H(\theta,g^*(\theta))+\beta U_{k-1}(EV'(\theta))\right].$$

Assume $U_{k-1}(EV')$ is strictly concave. Consider two continuation values EV'_a and EV'_b associated with corresponding solutions $\alpha_a=\{g^*_a(\theta),EV'_a(\theta)\}_{\theta\in\Theta}$ and $\alpha_b=\{g^*_b(\theta),EV'_b(\theta)\}_{\theta\in\Theta}$,

α_a and α_b are feasible given the politician and the government constraints. Also, let $z \sim U[0,1]$ and $p \in (0,1)$. Let policy sequence α_c be defined as follows:

$$\alpha_c = \begin{cases} \alpha_a & if\ z \leq p \\ \alpha_b & if\ z > p \end{cases}.$$

Policy α_c is feasible since α_a and α_b are feasible. The expected continuation value for the government from policy α_c is

$$EV_c'(\theta) = pEV_a'(\theta) + (1-p)EV_b'(\theta),$$

and voters get an expected continuation utility

$$pW(EV_a'(\theta)) + (1-p)U(EV_b'(\theta)).$$

However,

$$U(EV_c') = \max_{\alpha} \mathbb{E}\left[u^H(\theta, \gamma, g^*(\theta)) + \beta W(EV'(\theta))\right].$$

Let α^* be a solution to this maximization problem. It follows then that $U(EV_c'(\theta)) \geq pW(EV_a'(\theta)) + (1-p)U(EV_b'(\theta))$. Therefore, $U(EV)$ is concave.

A.5 Proof of Lemma 3

Since $u^H(\cdot)$ and $v(\cdot)$ are concave and differentiable, we can use the argument from Lemma 1 of Benveniste and Scheinkman (1979) to show that $U(EV)$ is differentiable at EV over $(\underline{EV}, \overline{EV})$. We need to show that there exists a function $Q(EV+\epsilon)$ for some small ϵ, which is differentiable, weakly concave and satisfies $Q(EV+\epsilon) \leq U(EV+\epsilon)$, where $Q(EV+\epsilon) = U(EV+\epsilon)$ for $\epsilon = 0$. To do this, we construct the function $Q(EV+\epsilon)$ using the perturbation method from Ales et al. (2012).

Let $\alpha = \{g^*(\theta)), EV'(\theta)\}$ be a solution to the maximization problem 27 given some $EV \in (\underline{EV}, \overline{EV})$. Then, starting from an interior solution α we can construct a perturbed solution $\widehat{\alpha}(\epsilon)$ that satisfies the constraints of problem 27 and provides the government with expected utility $EV+\epsilon$. We construct $\widehat{\alpha}(\epsilon)$ such that the following condition is satisfied:

$$\widehat{g^*}(\theta, \epsilon) = g^*(\theta)) + \xi^G(\theta, \epsilon).$$

Also, define functions $\xi^d(\theta,\epsilon)$, $\xi^i(\theta,\epsilon)$ and $\xi^r(\theta,\epsilon)$ as:

$$\begin{aligned}
\widehat{g}^d(\theta,\gamma,\widehat{g^*},\epsilon) &= g^d(\theta,\gamma,g^*(\theta))+\xi^d(\theta,\epsilon);\\
\widehat{g}^c(\theta,\gamma,\widehat{g^*},\epsilon) &= g^c(\theta,\gamma,g^*(\theta))+\xi^c(\theta,\epsilon);\\
\widehat{g}^i(\theta,\gamma,\widehat{g^*},\epsilon) &= g^i(\theta,\gamma,g^*(\theta))+\xi^i(\theta,\epsilon).
\end{aligned}$$

The functions $\{\xi^{g^*}(\theta,\epsilon),\xi^d(\theta,\epsilon),\xi^c(\theta,\epsilon),\xi^i(\theta,\epsilon)\}_{\theta\in\Theta}$ are chosen such that the following conditions are satisfied:

$$\begin{aligned}
\mathbb{E}_\theta\left[v^p\left(\theta,\widehat{g^*}\right)\right] &= \mathbb{E}_\theta\left[v^p(\theta,g^*(\theta)|\alpha)\right]+\epsilon, && (65)\\
\theta f'\left(\overline{k}-x+\widehat{g}^d\left(\theta,\gamma,\widehat{g^*},\epsilon\right)+\widehat{g}^i\left(\theta,\gamma,\widehat{g^*},\epsilon\right)\right) &= \gamma R f'\left(\overline{k}+\widehat{g}^c\left(\theta,\gamma,\widehat{g^*},\epsilon\right)\right.\\
&\quad \left.+\,\widehat{g}^i\left(\theta,\gamma,\widehat{g^*},\epsilon\right)\right), && (66)\\
\theta\widehat{g}^d\left(\theta,\gamma,\widehat{g^*},\epsilon\right)+\gamma\widehat{g}^c\left(\theta,\gamma,\widehat{g^*},\epsilon\right) &= \widehat{g^*}(\theta,\epsilon), && (67)\\
\widehat{g}^i\left(\theta,\gamma,\widehat{g^*},\epsilon\right) &= \tau-\widehat{g^*}(\theta,\epsilon), && (68)\\
v^p\left(\theta,\widehat{g^*}\right)+\beta V'(\theta) &\geq v^p\left(\theta,\widehat{g^*}'\right)+\beta V'(\theta'),\ \forall\theta,\theta'\in\Theta. && (69)
\end{aligned}$$

The above equations are sufficient to obtain solutions for $\{\xi^{g^*}(\theta,\epsilon),\xi^d(\theta,\epsilon),\xi^c(\theta,\epsilon),\xi^i(\theta,\epsilon)\}$ where $\xi^{g^*}(\theta,0)=\xi^d(\theta,0)=\xi^c(\theta,0)=\xi^i(\theta,0)=0$. Since $V(\cdot)$ and $f(\cdot)$ are differentiable, then it follows that the functions $\{\xi^{g^*}(\theta,\epsilon),\xi^d(\theta,\epsilon),\xi^c(\theta,\epsilon),\xi^i(\theta,\epsilon)\}_{\theta\in\Theta}$ coming out of the above equalities are also differentiable around $\epsilon=0$.

Let $Q(EV+\epsilon)$ denote the household utility obtained under policy $\widehat{\delta}(\epsilon)$. Then at $\epsilon=0$, $\widehat{\alpha}(0)=\alpha$ and $Q(EV)=U(EV)$. By construction, the perturbed solution $\widehat{\alpha}(\epsilon)$ along with the solution to the politician sub-problem satisfy conditions (65)-(69), which implies $\widehat{\alpha}(\epsilon)$ satisfies all the constraints of problem (27) for $\epsilon\to 0$. Condition (69) implies that condition (29) is satisfied. Equality (65) implies that constraint (28) is satisfied, while equalities (66)-(68) directly imply that constraints (15) and (17) of the politician sub-problem are satisfied. Finally, feasibility condition that $EV\in(\underline{EV},\overline{EV})$ is satisfied by the assumption of a small perturbation around the interior solution α. It then follows that $\widehat{\alpha}(\epsilon)$ is a feasible solution to the voters' problem. This implies

$$U(EV+\epsilon)\geq Q(EV+\epsilon). \qquad (70)$$

Moreover, $Q(EV)=U(EV)$ and (70) imply $Q(EV+\epsilon)$ is locally concave around EV. Then, by Lemma 1 of Benveniste and Scheinkman (1979), the value function $U(EV)$ is differentiable for $EV \in (\underline{EV}, \overline{EV})$.

A.6 Proof of Proposition 4

According to Lemmas 2 and 3, $U(EV)$ is concave and differentiable., so the first-order conditions are necessary and sufficient for the maximization of problem of 27. Moreover, given Lemma 5, we can simplify the problem by only looking at the IC constraints where $\widehat{\theta} = \theta^{n+1}$ for $\theta = \theta^n$.

Denote by μ, $\pi(\theta)\phi_{n,n+1}$, $\pi(\theta)\underline{\nu}$, $\pi(\theta)\overline{\nu}$, $\pi(\theta)\underline{\iota}$, $\pi(\theta)\overline{\iota}$ the Lagrange multipliers on constraints (28), (29), (30), (31), (32) and (33) with messages $\theta = \theta^n$, $\widehat{\theta} = \theta^{n+1}$, and by U_{EV} the derivative of U with respect to EV. Then, we have, the following first-order conditions:

$$\frac{\beta}{\widehat{\beta}} U_{EV}(EV'(\theta^n)) + \mu + \phi_{n,n+1} - \phi_{n-1,n} \frac{\pi(\theta^{n-1})}{\pi(\theta^n)} - \underline{\iota} + \overline{\iota} = 0 \tag{71}$$

$$\begin{aligned} \Bigg\{ \mathbb{E}\left[\frac{\partial u^H(\theta^n, \gamma, g^*(\theta^n))}{\partial g^*}\right] + \left(\mu + \phi_{n,n+1}\right) \frac{\partial v^p(\theta^n, g^*(\theta^n))}{\partial g^*} \\ - \phi_{n-1,n} \frac{\pi(\theta^{n-1})}{\pi(\theta^n)} \frac{\partial v^p(\theta^{n-1}, g^*(\theta^n))}{\partial g^*} - \underline{\nu} + \overline{\nu} = 0 \Bigg\}. \end{aligned} \tag{72}$$

The envelope condition is given by

$$U_{EV}(EV) \geq -\mu. \tag{73}$$

Taking expectations in (71), for $EV'(\theta^n) < \overline{EV}$, we obtain

$$\mathbb{E}\left[U_{EV}(EV'(\theta^n))\right] + \mu \leq 0. \tag{74}$$

Combining with (73), we obtain

$$\mathbb{E}\left[U_{EV}(EV'(\theta))\right] \leq U_{EV}(EV), \tag{75}$$

where the above equations hold with equality for an internal solution.

This leads to 2 possible cases:

1. We have an interior solution everywhere ($EV' > \underline{EV}$, $EV' < \overline{EV}$). In this case, taking

expectations in the above expression, we can also infer that:

$$\frac{\beta}{\widehat{\beta}}\mathbb{E}\left[U_{EV}(EV')\right] - U_{EV}(EV) = 0.$$

Equation (40) shows that $U_{EV}(EV)$ is a martingale (for $\widehat{\beta} = \beta$) or a submartingale (for $\widehat{\beta} < \beta$). In order to satisfy the incentive compatibility constraint (29), $EV'(\theta)$ must be decreasing with θ (as $g^*(\theta)$ increases with θ).

If $\widehat{\beta} = \beta$, then from equation (40) and the concavity of U, $\exists\theta^*,\ \theta^* > \theta^1, \theta^* < \theta^N$ such that $EV'(\theta) < EV\ \forall\theta > \theta^*$ and $EV'(\theta) > EV\ \forall\theta < \theta^*$.

If $\widehat{\beta} < \beta$, then $\mathbb{E}\left[U_{EV'}(EV')\right] > U_{EV}(EV)$ for $U_{EV}(EV) < 0$, and $\mathbb{E}\left[U_{EV'}(EV')\right] < U_{EV}(EV)$ for $U_{EV}(EV) > 0$. That implies $\exists\theta$ such that $EV'(\theta) < EV$ if for $U_{EV}(EV) < 0$, but whether $EV' > EV$ for some θ is not immediately implied (the opposite is true for $U_{EV}(EV) > 0$).

2. The solution for EV' binds for some θ^n.

   (a) First, consider the case $\widehat{\beta} = \beta$. Assume EV' binds for some θ^n at the lower bound. Since the IC solution for separability requires EV' strictly decreasing in θ, it must be the case that $\theta^n = \theta^N$ for $EV'(\theta^n) = \underline{EV}$. The first-order condition for $EV'(\theta^N)$ is then

   $$\frac{\beta}{\widehat{\beta}}U_{EV}(EV'(\theta^N)) + \mu - \phi_{N-1,N} + \underline{\iota} = 0.$$

   So

   $$\frac{\beta}{\widehat{\beta}}U_{EV}(EV'(\theta^N)) = U_{EV}(EV) + \phi_{N-1,N} + \underline{\iota},$$

   $$\frac{\beta}{\widehat{\beta}}U_{EV}(\underline{EV}) = U_{EV}(EV) + \phi_{N-1,N} + \underline{\iota}. \tag{76}$$

   For condition (76) to hold, we need $\left(\phi_{N-1,N} + \underline{\iota}\right) > 0$ if $\widehat{\beta} = \beta$. Taking expectations of (71) over all θ, we have

   $$\frac{\beta}{\widehat{\beta}}\mathbb{E}\left[U_{EV}(EV')\right] = U_{EV}(EV). \tag{77}$$

   For $\widehat{\beta} = \beta$ and $\underline{\iota} > 0$, condition (77) implies $\mathbb{E}\left[U_{EV}(EV')\right] < U_{EV}(EV)$ so $EV'(\theta^1) > EV$.

   Assume we have a schedule that satisfies conditions (76), (77) and $EV'(\theta^N) = \underline{EV}$.

Then, following $EV = \underline{EV}$, we have the following conditions for $EV'(\theta^N)$:

$$\frac{\beta}{\widehat{\beta}} U_{EV}(EV'(\theta^N)) = U_{EV}(\underline{EV}) + \phi_{N-1,N} + \underline{\iota},$$

and

$$\frac{\beta}{\widehat{\beta}} \mathbb{E}\left[U_{EV}(EV'(\theta^N))\right] = U_{EV}(\underline{EV}).$$

The above conditions require $\phi_{N-1,N} \leq 0$ for $\widehat{\beta} = \beta$, and $EV'(\theta^N) \geq \underline{EV}$. For these conditions to hold, we must have $EV'(\theta^N) = \underline{EV}$, $\phi_{N-1,N} \geq 0$ and $EV'(\theta^n) > \underline{EV}, \forall n < N$.

If $\widehat{\beta} < \beta$, then the above conditions hold without the requirement $\phi_{N-1,N} \leq 0$, due to the reversal to the mean property implied by $\frac{\beta}{\widehat{\beta}}$.

(b) Now, assume EV' binds for some θ^n at the upper bound. Then, since the IC solution for separability requires EV' strictly decreasing in θ, it must be the case that $\theta^n = \theta^1$ for $EV'(\theta^n) = \overline{EV}$. for $EV'(\theta^1)$ is then

$$\frac{\beta}{\widehat{\beta}} U_{EV}(EV'(\theta^1)) + \mu + \phi_{1,2} - \bar{\iota} = 0$$

So

$$\frac{\beta}{\widehat{\beta}} U_{EV}(EV'(\theta^1)) = U_{EV}(EV) - \phi_{1,2} + \bar{\iota}$$

$$\frac{\beta}{\widehat{\beta}} U_{EV}(\overline{EV}) = U_{EV}(EV) - \phi_{1,2} + \bar{\iota} \tag{78}$$

For condition (78) to hold, we need $\left(-\phi_{1,2} - \bar{\iota}\right) < 0$ if $\widehat{\beta} = \beta$. Also, taking expectations of (71) over all θ, we have

$$\frac{\beta}{\widehat{\beta}} \mathbb{E}\left[U_{EV}(EV')\right] = U_{EV}(EV) \tag{79}$$

For $\widehat{\beta} = \beta$ and EV is at the bound, condition (79) implies $\mathbb{E}\left[U_{EV}(EV')\right] > U_{EV}(EV)$ so $EV'(\theta^1) < EV$. If $\widehat{\beta} < \beta$, then the above conditions require a small enough $\bar{\iota}$ such that conditions (78) and (79) still hold given $\frac{\widehat{\beta}}{\beta}$.

Assume we have a schedule that satisfies conditions (78), (79) and $EV'(\theta^1) = \overline{EV}$. Then, following $EV = \overline{EV}$, we have the following conditions for $EV'(\theta^1)$:

$$\frac{\beta}{\widehat{\beta}} U_{EV}(EV'(\theta^1)) = U_{EV}(\overline{EV}) - \phi_{1,2} + \bar{\iota}$$

and

$$\frac{\beta}{\widehat{\beta}}\mathbb{E}\left[U_{EV}(EV'(\theta^1))\right] = U_{EV}(\overline{EV}) + \overline{\iota}\pi(\theta^1).$$

The above conditions require $\left(-\phi_{1,2}+\overline{\iota}\right) \geq 0$ for $\widehat{\beta}=\beta$, and $EV'(\theta^1) \leq \overline{EV}$. For these conditions to hold, we must have $EV'(\theta^1) = \overline{EV}$, $\phi_{1,2} > 0$ and $EV'(\theta^n) < \overline{EV}, \forall n > 1$.

If $\widehat{\beta} < \beta$, then the above conditions continue to hold given $\frac{\widehat{\beta}}{\beta}$. Therefore, the martingale property continues to hold at the boundary.

A.7 Proof of Proposition 5

Let the cutoff on targeted interventions be $\overline{g}^{*B}$ in both periods. First, notice that the problem of choosing a constant g^* is the same in each period, hence the same cutoff $\overline{g}^{*B}$ is optimal in each period. Then consider a small increase in $\overline{g}^{*B}$ by some $\varepsilon > 0$ when $\theta_0 = \theta^H$ and a small decrease in $\overline{g}^{*B}$ by $\varsigma(\varepsilon) > 0$ in period 1 after $\theta_0 = \theta^H$, such that the incentive compatibility constraint holds for the θ^L type.

Let

$$\begin{aligned}
\Delta v^p\left(\theta_0, g_0^{*H}\right) &\equiv v^p\left(\theta_0, \overline{g}^{*B}+\varepsilon\right) - v^p\left(\theta_0, \overline{g}^{*B}\right);\\
\Delta v^p\left(\theta_1, g_1^{*H}\right) &\equiv v^p\left(\theta_1, \overline{g}^{*B}-\varsigma\right) - v^p\left(\theta_1, \overline{g}^{*B}\right).
\end{aligned}$$

Then, the binding IC constraint for the θ^L type is:

$$\Delta v^p\left(\theta^L, g_0^{*L}\right) + \widehat{\beta}\left[\Delta v^p\left(\theta^H, g_1^{*H}\right)\pi(\theta^H) + \Delta v^p\left(\theta^L, g_1^{*H}\right)\pi(\theta^L)\right] = 0$$

which can be expanded to

$$\begin{aligned}
&\mathbb{E}_\gamma\{\Delta u^H\left(\theta^L, \gamma_0, g_0^{*H}\right) + (R-1)\gamma_0\Delta f\left(\overline{k} + g^c\left(g_0^{*H}, \gamma_0\right) + g^i\left(g_0^{*H}, \gamma_0\right)\right)\\
&+\widehat{\beta}\left[\Delta u^H\left(\theta^H, \gamma_1, g_1^{*H}\right) + (R-1)\gamma_1\Delta f\left(\overline{k} + g^c\left(g_1^{*H}, \gamma_1\right) + g^i\left(g_1^{*H}, \gamma_1\right)\right)\right]\pi(\theta^H)\\
&+\widehat{\beta}\left[\Delta u^H\left(\theta^L, \gamma_1, g_1^{*H}\right) + (R-1)\gamma_1\Delta f\left(\overline{k} + g^c\left(g_1^{*H}, \gamma_1\right) + g^i\left(g_1^{*H}, \gamma_1\right)\right)\right]\pi(\theta^L)\} \;=\; 0,
\end{aligned}$$

with Δu^H and Δf defined analogous to Δv.

The change in the household utility is given by:

$$\begin{aligned}
\Delta U \;\equiv\; &\mathbb{E}_\gamma\{\Delta u^H\left(\theta^H, \gamma_0, g_0^{*H}\right)\pi(\theta^H)\\
&+\beta\left[\Delta u^H\left(\theta^L, \gamma_1, g_1^{*H}\right)\pi(\theta^L) + \Delta u^H\left(\theta^H, \gamma_1, g_1^{*H}\right)\pi(\theta^H)\right]\pi(\theta^H)\}.
\end{aligned}$$

Combining the two expressions above, we obtain

$$\begin{aligned}
\Delta U \quad \equiv \quad & \mathbb{E}_\gamma\{\Delta u^H\left(\theta^H,\gamma_0,g_0^{*H}\right)\pi(\theta^H)+\frac{\beta}{\widehat{\beta}}\pi(\theta^H)[-\Delta u^H\left(\theta^L,\gamma_0,g_0^{*H}\right) \\
& -\widehat{\beta}(R-1)\gamma_1\Delta f\left(\overline{k}+g^c\left(g_1^{*H},\gamma_1\right)+g^i\left(g_1^{*H},\gamma_1\right)\right)\pi(\theta^L) \\
& -\widehat{\beta}(R-1)\gamma_1\Delta f\left(\overline{k}+g^c\left(g_1^{*H},\gamma_1\right)+g^i\left(g_1^{*H},\gamma_1\right)\right)\pi(\theta^H) \\
& -(R-1)\gamma_0\Delta f\left(\overline{k}+g^c\left(g_0^{*H},\gamma_0\right)+g^i\left(g_0^{*H},\gamma_0\right)\right)]\}.
\end{aligned}$$

Notice that $\Delta u^H\left(\theta^L,\gamma_0,g_0^{*H}\right)<0$ by the concavity of $u^H\left(\theta,\gamma,g^*\right)$ and $g_0^{*H}>\overline{g}^{*B}(\theta^L)$, where $\overline{g}^{*B}(\theta^L)$ is the limit preferred by households at θ^L. By similar arguments, $\Delta u^H\left(\theta^H,\gamma,g_0^{*H}\right)>0$, so

$$\mathbb{E}_\gamma\{\Delta u^H\left(\theta^H,\gamma,g_0^{*H}\right)\pi(\theta^H)-\frac{\beta}{\widehat{\beta}}\pi(\theta^H)\Delta u^H\left(\theta^L,\gamma,g_0^{*H}\right)\}>0.$$

Also, since $\frac{\partial f(\cdot)}{\partial g^*}>0$, we have

$$\Delta f\left(\overline{k}+g^c\left(g_1^{*H},\gamma_1\right)+g^i\left(g_1^{*H},\gamma_1\right)\right)<0,$$

and

$$\Delta f\left(\overline{k}+g^c\left(g_0^{*H},\gamma_0\right)+g^i\left(g_0^{*H},\gamma_0\right)\right)>0.$$

Therefore,

$$\begin{aligned}
& \mathbb{E}_\gamma\{-\widehat{\beta}(R-1)\gamma_1\Delta f\left(\overline{k}+g^c\left(g_1^{*H},\gamma_1,\theta^L\right)+g^i\left(g_1^{*H},\gamma_1,\theta^L\right)\right)\pi(\theta^L) \\
& -\widehat{\beta}(R-1)\gamma_1\Delta f\left(\overline{k}+g^c\left(g_1^{*H},\gamma_1,\theta^H\right)+g^i\left(g_1^{*H},\gamma_1,\theta^H\right)\right)\pi(\theta^H) \\
& -(R-1)\gamma_0\Delta f\left(\overline{k}+g^c\left(g_0^{*H},\gamma_0,\theta^L\right)+g^i\left(g_0^{*H},\gamma_0,\theta^L\right)\right)]\}>0,
\end{aligned}$$

which is a sufficient condition for $\Delta U>0$.

Making the approximation

$$\Delta f\left(\overline{k}+g^c\left(g_0^{*H},\gamma_0,\theta^L\right)+g^i\left(g_0^{*H},\gamma_0,\theta^L\right)\right)\sim-\Delta f\left(\overline{k}+g^c\left(g_1^{*H},\gamma_1,\theta^L\right)+g^i\left(g_1^{*H},\gamma_1,\theta^L\right)\right)$$

reduces the above condition to

$$\mathbb{E}_{\gamma}\{-\Delta f\left(\overline{k}+g^{c}\left(g_1^{*H},\gamma_1,\theta^{H}\right)+g^{i}\left(g_1^{*H},\gamma_1,\theta^{H}\right)\right)$$
$$\left. +\Delta f\left(\overline{k}+g^{c}\left(g_1^{*H},\gamma_1,\theta^{L}\right)+g^{i}\left(g_1^{*H},\gamma_1,\theta^{L}\right)\right)\frac{\left(\frac{\gamma_0}{\gamma_1}-\widehat{\beta}\pi(\theta^{L})\right)}{\widehat{\beta}\left(1-\pi(\theta^{L})\right)}\right\} > \ 0. \tag{80}$$

By Assumption 4, the expression $\left\{-\left[\Delta v^{p}\left(\theta^{H},g_1^{*H}\right)-\Delta v^{p}\left(\theta^{L},g_1^{*H}\right)\right]\right\}$ is positive and increasing in $|\theta_H-\theta_L|$, which implies $\mathbb{E}_{\gamma}\{-\Delta f\left(\overline{k}+g^{c}\left(g_1^{*H},\gamma_1,\theta^{H}\right)\ +g^{i}\left(g_1^{*H},\gamma_1,\theta^{H}\right)\right)$ $+\Delta f\left(\overline{k}+g^{c}\left(g_1^{*H},\gamma_1,\theta^{L}\right)\ +g^{i}\left(g_1^{*H},\gamma_1,\theta^{L}\right)\right)\}>0$ and increasing in $|\theta_H-\theta_L|$. So for a small enough $\frac{\theta_L}{\theta_H}$ and large enough $\frac{\pi(\theta^L)}{1-\pi(\theta^L)}$ such that the inequality from condition (80) holds, we have $\Delta W>0$.

B Proofs from Section 3.8

B.1 Proof of Proposition 6

The proof follows a similar argument as in Thomas and Worrall (1990). According to Lemmas 2 and 3, $U(EV)$ is concave and differentiable, so the first-order conditions are necessary and sufficient for the maximization of problem of 27. Moreover, given Lemma 5, we can simplify the problem by only looking at the IC constraints for $\widehat{\theta}=\theta^{n+1}$ and $\theta=\theta^{n}$.

Denote by μ, $\pi(\theta)\underline{\iota}$, $\pi(\theta)\overline{\iota}$ and $\pi(\theta)\phi_{n,n+1}$ the Lagrange multipliers on constraints (28), (32), (32), and (29), for $\theta=\theta^{n}$ and $\widehat{\theta}=\theta^{n+1}$. Finally, denote by U_{EV} the derivative of U with respect to EV. Then, we have:

$$U_{EV}(EV'(\theta^{n}))+\mu+\phi_{n,n+1}-\phi_{n-1,n}\frac{\pi(\theta^{n-1})}{\pi(\theta^{n})}\leq 0 \tag{81}$$

$$\left\{\mathbb{E}_{\gamma}\left[\frac{\partial u^{H}(\theta^{n},\gamma,g^{*}(\theta^{n}))}{\partial g^{*}}\right]+\left(\mu+\phi_{n,n+1}\right)\frac{\partial v^{p}(\theta^{n},g^{*}(\theta^{n}))}{\partial g^{*}}\right.$$
$$\left.-\ \phi_{n-1,n}\frac{\pi(\theta^{n-1})}{\pi(\theta^{n})}\frac{\partial v^{p}(\theta^{n-1},g^{*}(\theta^{n}))}{\partial g^{*}}+\underline{\iota}-\overline{\iota}\right\}\ \leq\ 0$$

The envelope condition is given by

$$U_{EV}(EV)\geq-\mu. \tag{82}$$

Taking expectations in (81),

$$\mathbb{E}\left[U_{EV}(EV'(\theta^n))\right] + \mu \leq 0.$$

Combining with (82), we obtain

$$\mathbb{E}\left[U_{EV}(EV'(\theta))\right] \leq U_{EV}(EV).$$

This implies that $\{U_{EV}(EV_t)\}_{t=0}^{\infty}$ is a martingale and by the martingale convergence theorem, it converges almost surely to some random variable U_{EV} This implies $\{EV_t\}_{t=0}^{\infty}$ must have a convergent subsequence.$\{EV_{tn}\}_{t=0}^{\infty}$ converging to $EV_{\infty} \in \left[\underline{EV}, \overline{EV}\right]$.

Consider the case $EV_{\infty} \in (\underline{EV}, \overline{EV})$. Consider the case when state θ^1 occurs infinitely often. Take a subsequence formed only of θ^1. For the IC constraint (29) to hold with type separability, we must have $EV(\theta^1) > \mathbb{E}[EV]$ for $EV \in (\underline{EV}, \overline{EV})$, and

$$U_{EV}(EV'(1)) < U_{EV}(EV). \tag{83}$$

Denote the relationship between successive values of EV as $EV_{t+1} = z(EV_t, \theta^1)$, $t = 0, 1, ...$where z is a continuous function. Then, as EV_t converges to EV_{∞}, $z(EV_t, \theta^1)$ converges to $z(EV_{\infty}, \theta^1)$ and EV_{t+1} converges to $z(EV_{\infty}, \theta^1)$ as well. Therefore, we must have$U_{EV}(EV_{\infty}) = U_{EV}(z(EV_{\infty}, \theta^1))$, which contradicts (83). Therefore, $EV_{\infty} \notin (\underline{EV}, \overline{EV})$.

Consider now the case where $EV_{\infty} \in Bd\left[\underline{EV}, \overline{EV}\right]$.

Lemma 6 *For any $EV_t \in (\underline{EV}, \overline{EV})$ and $\gamma \in \left(U_{EV}(\overline{EV}), U_{EV}(\underline{EV})\right)$, if state θ^N is repeated M times consecutively, then $U_{EV}(EV_{t+M}) \geq \gamma$, for M large enough.*

Proof. Consider a sequence in which state θ^N is repeated M times consecutively. Then given the IC constraint (29), type separability implies $EV_{t+M} < EV_{t+M-1} < ... < EV_t$. Then $U_{EV,t+M} \geq U_{EV,t}$ since U is concave. Denote by ϕ the value in $\left(U_{EV}(\overline{EV}), U_{EV}(\underline{EV})\right)$ such that $U_{EV}(\phi) = \gamma$. Suppose there does not exist an M such that $U_{EV,t+M} \geq \gamma$. Then $\lim_{M\to\infty} U_{EV,t+M} < \gamma$ and $\lim_{M\to\infty} U_{EV,t+M} > \phi$. This implies EV converges to a value in $(\phi, \overline{EV})$ which is a contradiction given the first part of the above proof (it implies $EV(\theta^N) = EV$). So, $\forall \varepsilon > 0$, $\exists M$ subject to $U_{EV}(EV_{t+M}) \geq U_{EV}(\underline{EV}) + \varepsilon$. ■

Given Lemma 6, starting at any $EV_t \in (\underline{EV}, \overline{EV})$, $\exists$ a convergent subsequence $\{EV_{tn}\}_{t=0}^{\infty}$ that converges to $EV_{\infty} = \underline{EV}$. By a similar argument, $\overline{EV}$ is also a limit point for some subsequence $\{EV_{tn}\}_{t=0}^{\infty}$. So $EV_{\infty} \in Bd\left[\underline{EV}, \overline{EV}\right]$, and $\{EV_{tn}\}_{t=0}^{\infty}$ converges to a distribution with mass points at the boundary of $\left[\underline{EV}, \overline{EV}\right]$.

B.2 Proof of Proposition 7

The proof follows the proof of Proposition 3 from Farhi and Werning (2007), in the case with bounded utility. The approach consists of defining a transition function Q for the derivative $U_{EV}(EV)$ and constructing a sequence of distributions that converges weakly to an invariant distribution under Q. Let the policy function for EV' be given by the continuous function $g^v(EV, \theta)$ which maximizes the Bellman equation in problem (27). The derivative $U_{EV}(EV)$ is continuous and strictly decreasing given the concavity of U. Let $U_{EV}(\underline{EV}) = \overline{y}$ and $U_{EV}(\overline{EV}) = \underline{y}$, so we define the transition function $Q(y, \theta) = U_{EV}(g^v((U_{EV})^{-1}(y), \theta))$ for $y \in \left[\underline{y}, \overline{y}\right]$. For any probability measure μ, let $T_Q(\mu)$ be a probability measure defined by

$$T_Q(\mu)(A) = \int \mathbf{1}_{\{Q(y,\theta)\in A\}} d\mu(y) d\pi(\theta),$$

for any Borel set A. Also, let

$$T_{Q,n} \equiv \frac{T_Q + T_Q^2 + ... + T_Q^n}{n}.$$

Then $T_Q, n(\delta_y)$ is the empirical average of $\{U_{EV}(EV_t)\}_{t=1}^{n}$ over all histories of length n starting with $U_{EV}(EV_0) = y$.

We want to show that for any y there exists a subsequence of distributions $\left\{T_{Q,\phi(n)}(\delta_y)\right\}$ that converges weakly (i.e., in distribution) to an invariant distribution under Q.

Let EV_L be the minimum of g^v over $\left[\underline{EV}, \overline{EV}\right)$. This minimum is attained since $g^v(EV, \overline{\theta})$ is continuous and $\lim_{EV \to \overline{EV}} g^v(EV, \theta) = \overline{EV}$. Since $g^v > \underline{V}$, it must be that $EV_L > \underline{EV}$. The transition function is continuous with $Q(y, \theta) \leq U_{EV}(EV_L) < \infty$.

We then need to show that the sequence $\{T_{Q,n}(\delta_y)\}$ is tight in that for any $\epsilon > 0$ there exists a compact set A_ϵ such that $T_{Q,n}(\delta_y)[A_\epsilon] \geq 1 - \epsilon$ for all n. The expected value of the distribution $\{T_{Q,n}(\delta_y)\}$ is $\mathbb{E}_{-1}\left[U_{EV}(EV_t(\theta^{t-1})\right]$. From the first-order conditions, for an interior solution, we have that $\mathbb{E}_{-1}\left[U_{EV}(EV_t(\theta^{t-1})\right] = \left(\frac{\beta}{\hat{\beta}}\right)^t U_{EV}(EV_0) \to 0$. This implies

$$\begin{aligned} \min\{U_{EV}(EV_0), 0\} \;\; &\leq \;\; \mathbb{E}_{-1}\left[U_{EV}(EV_t(\theta^{t-1})\right] \leq \\ & T_Q^n(\delta_y)\left[(\underline{y}, A)\right](A) + \{1 - T_Q^n(\delta_y)\left[(\underline{y}, A)\right](A)\} U_{EV}(EV_L), \end{aligned}$$

for all A. This implies

$$T_Q^n(\delta_y)\left[(\underline{y},-A)\right] \leq \frac{U_{EV}(EV_L)-\min\{y,0\}}{A+U_{EV}(EV_L)}.$$

This implies that $\left\{T_Q^n(\delta_y)\right\}$ is tight and therefore $\{T_{Q,n}(\delta_y)\}$ is tight. Tightness implies that there exists a subsequence $\left\{T_{Q,\phi(n)}(\delta_y)\right\}$ that converges in distribution to some probability measure π^*. Then, given the continuity of $Q(y,\theta)$ and linearity of T_Q, it follows $T_Q(\pi^*)=\pi^*$. So π^* is an invariant measure under Q.

C Proofs from Section 4

C.1 Proof of Proposition 8

The proof is analogous to the proof of Proposition 4.

C.2 Proof of Proposition 9

Voters' utility each period is given by

$$\begin{aligned} u^H(\theta_t,\gamma_t,g_t^*,b_t^*) &= \theta_t f(\overline{k}-x+g_t^d+g_t^i) \\ &\quad +(1-\theta_t-\gamma_t)f(\overline{k}+g_t^i)+\gamma_t f(\overline{k}+g_t^c+g_t^i). \end{aligned}$$

The utility of households is marginally increasing in all types of transfers, $\left\{g_t^d,g_t^c,g_t^i\right\}$. Consider the optimal policy without debt $\{g_t^{*0}\}_{t=0}^{\infty}$ and the corresponding policy choices $\left\{g_t^{d0},g_t^{c0},g_t^{i0}\right\}$. At this policy, the marginal benefit to voters from increasing g_t^{i0} equals the marginal cost of decreasing g_t^{*0}. Then, having the ability to take on debt implies that in any period t in which debt is taken on, all types of transfers must increase. Otherwise, an increase in g_t^{i0} only would make the marginal benefit from increasing g_t^{*0} higher than the cost of decreasing g_t^{i0}. This implies that when debt in taken on, the optimal policy will relax the constraint on the politician's targeted interventions; the constraint will then be tighter when less debt is taken on.

Voters will take on debt if it increases their expected utility, and every period all types of transfers will be affected in the same way by debt. The politician's utility each period is

$$\begin{aligned} v(\theta_t, \gamma_t, g_t^*, b_t^*) &= u^H(\theta_t, \gamma_t, g_t^*, b_t^*) + \\ &\quad +(R-1)\gamma_t f(\overline{k} + g_t^c + g_t^i). \end{aligned}$$

Since $u^H(\theta_t, \gamma_t, g_t^*, b_t^*)$ is a weighted sum of outputs, per the above discussion, any increase in $u^H(\theta_t, \gamma_t, g_t^*, b_t^*)$ implies an increase in each component of this sum, it follows that $v(\theta_t, \gamma_t, g_t^*, b_t^*)$ also increases when $u^H(\theta_t, \gamma_t, g_t^*, b_t^*)$ increases. The increase in politician utility happens through both the utility from g_t^d and g_t^i, as well as through the utility from transfers g_t^c. This then implies that the politician will derive a higher expected utility from the contract with voters.

C.3 Argument for Corollary 4

Consider the case without debt. Voter utility is given by the maximization problem,

$$U(EV) = \max_{\{g^*(\theta), EV'(\theta)\}} \mathbb{E}_{\theta,\gamma} \left[u^H(\theta, \gamma, g^*(\theta)) + \beta U'(EV'(\theta)) \right].$$

With debt, voters' utility is given by

$$U(EV) = \max_{\{g^*(\theta), b^*(\theta), EV'(\theta)\}} \mathbb{E}_{\theta,\gamma} \left[u^h(\theta, \gamma, g^*(\theta), b^*(\theta)) + \beta U'(EV'(\theta)) \right].$$

The benefit for households of introducing public debt is the change in utility due to the increase in transfers g^d, while the cost each period comes from higher g^c and g^i, which are more costly in terms of future utility than their benefit in the current period. Therefore, taking on debt in the current period is preferred by voters if

$$\begin{aligned} &\theta f'(\overline{k} - x + g^d + g^i) \left(\frac{\partial g^d}{\partial g^*} \frac{\partial g^*}{\partial b^*} + \beta - \frac{\partial g^*}{\partial b^*} \right) + (1-\theta-\gamma) f'(\overline{k} + g^i) \left(\beta - \frac{\partial g^*}{\partial b^*} \right) \\ &+ f'(\overline{k} + g^c + g^i) \left(\left(1 - \theta \frac{\partial g^d}{\partial g^*} \right) \frac{\partial g^*}{\partial b^*} + \gamma\beta - \gamma \frac{\partial g^*}{\partial b^*} \right) - E\left[\frac{\partial U'}{\partial b^*} \right] \; > \; 0. \end{aligned}$$

Using the politician's first-order conditions for the choice of g^d versus g^c, we get

$$\begin{aligned}&f'(\overline{k}+g^c+g^i)\left(\theta\frac{\partial g^d}{\partial g^*}\frac{\partial g^*}{\partial b^*}(R-1)+R\theta\left(\beta-\frac{\partial g^*}{\partial b^*}\right)+\gamma\beta+(1-\gamma)\frac{\partial g^*}{\partial b^*}\right)\\&+(1-\theta-\gamma)f'(\overline{k}+g^i)\left(\beta-\frac{\partial g^*}{\partial b^*}\right)-E\left[\frac{\partial U'}{\partial b^*}\right]\;>\;0,\end{aligned}$$

or

$$\begin{aligned}&f'(\overline{k}+g^c+g^i)\left(\theta\frac{\partial g^d}{\partial g^*}\frac{\partial g^*}{\partial b^*}(R-1)+R\theta\left(\beta-\frac{\partial g^*}{\partial b^*}\right)+\gamma\beta+(1-\gamma)\frac{\partial g^*}{\partial b^*}\right)\\&+\left[\lambda-(\theta R+\gamma)\,f'(\overline{k}+g^c+g^i)\right]\left(\beta-\frac{\partial g^*}{\partial b^*}\right)-E\left[\frac{\partial U'}{\partial b^*}\right]\;>\;0,\end{aligned}$$

where λ is the Lagrange multiplier on the politician's budget constraint. Therefore,

$$\begin{aligned}&f'(\overline{k}+g^c+g^i)\left(\theta\frac{\partial g^d}{\partial g^*}(R-1)-1\right)\frac{\partial g^*}{\partial b^*}\\&+\lambda\left(\beta-\frac{\partial g^*}{\partial b^*}\right)-E\left[\frac{\partial U'}{\partial b^*}\right]\;\geq\;0.\end{aligned}$$

Consider the effect of increasing R in the above expression:

$$\begin{aligned}\frac{\partial}{\partial R}\;&=\;f''(\overline{k}+g^c+g^i)\frac{\partial\left(g^c+g^i\right)}{\partial R}\left(\theta\frac{\partial g^d}{\partial g^*}(R-1)-1\right)\frac{\partial g^*}{\partial b^*}\\&\quad+f'(\overline{k}+g^c+g^i)\left(\theta\frac{\partial g^d}{\partial b^*\partial R}(R-1)-\frac{\partial g^*}{\partial b^*\partial R}+\theta\frac{\partial g^d}{\partial b^*}\right)+o(2)\end{aligned}$$

Ignoring second order terms, the above expression is negative if $|f''|>f'$. In this case, a lower value of R in the current period corresponds to a higher benefit to voters from public debt. Therefore, given a production function $f(\cdot)$ that satisfies this condition, and a sufficiently high high value of R, the marginal benefit to voters of taking on debt is negative.

D Extension - Adding a Non-Financial Public Good

Assume a public good y can be supplied by the government each period, and it enters the utility of both the voters and the politician through the additive component $o(y)$, independent of θ, where $o(\cdot)$ is increasing and concave.

The politician's maximization problem (without debt) each period becomes:

$$\widetilde{v}(\theta, \gamma, g^*(\theta)) = \max_{\{g^d, g^c, g^i, y\}} \left[v\left(\theta, \gamma, g^*(\theta)\right) + o(y) \right] \tag{84}$$

subject to

$$\begin{aligned} \gamma g^c + \theta g^d &\leq g^* && (85) \\ \gamma g^c + \theta g^d + g^i + y &\leq \tau && (86) \end{aligned}$$

The government policy ignoring constraint (85), satisfies:

$$\begin{aligned} v_{g^d} &\leq \theta\lambda \\ v_{g^c} &\leq \gamma\lambda \\ o_y &\leq \lambda \\ v_{g^i} &\leq \lambda \end{aligned}$$

Given the underlying functions for $v(\cdot)$, this translates to

$$\begin{aligned} g^i &= 0, \\ f'(\overline{k} - x + g^d) &= Rf'(\overline{k} + g^c), \\ o'(y) &= f'(\overline{k} - x + g^d), \\ \gamma g^c + \theta g^d + y &= \tau. \end{aligned}$$

Denote by $\delta = \{g^d(\theta), g^c(\theta), y(\theta)\}$ the solution to the above system. Then constraint (85) does not bind for $g^* \geq \gamma g^c + \theta g^d$.The above system implies that $\left[\gamma g^c(\theta) + \theta g^d(\theta)\right] - \left[\gamma g^c(\theta') + \theta' g^d(\theta')\right] > 0$ for $\theta > \theta'$ (as the equilibrium choice for y must decrease in g^d). We are thus in the case in which the preferred policy choice of the politician is different from that of the voters, but the preferred policies of both the politician and voters vary monotonically with θ. This makes it possible for a limit on targeted transfers in the current period to lead to a separation of types.

Proposition 10 *For each report θ,there exist a value of the limit on targeted intervention, call it $g^*_C(\theta)$, such that:*

- *If the limit imposed by voters, g^*, is low enough such that $g^* \leq g^*_C(\theta) \leq \mathbb{E}\left[\gamma g^c + \theta g^d\right]$, then positive untargeted transfers are provided along with targeted transfers ($g^i > 0$).*

- *If the limit g^* is moderately high, so that $g^*_C(\theta) < g^* \leq \mathbb{E}\left[\gamma g^c + \theta g^d\right]$, no untargeted transfers are provided ($g^i = 0$), so that all public intervention is accomplished with targeted transfers.*

- *If $g^*_c(\theta) < \mathbb{E}\left[\gamma g^c + \theta g^d\right] \leq g^*$, then the politician is unconstrained when shock θ is realized, and only targeted transfers are be provided ($g^i = 0$).*

Proof:

The first-order conditions from the above problem when constraint (85) binds lead to the following system of equations for determining g^d, g^c, g^i and y as functions of g^* :

$$\begin{aligned}
\frac{v_{g^d}}{\theta} &= \frac{v_{g^c}}{\gamma} \\
g^c &= \frac{g^* - \theta g^d}{\gamma} \\
o_y &= v_{g^i} \\
g^i + y &= \tau - g^*
\end{aligned}$$

which can be expanded to

$$\begin{aligned}
f'(\overline{k} - x + g^d + g^i) &= Rf'\left(\overline{k} + \frac{g^* - \theta g^d}{\gamma} + g^i\right) \\
\theta f'(\overline{k} - x + g^d + g^i) + (1 - \theta - \gamma) f'(\overline{k} + g^i) + \gamma f'(\overline{k} + g^c + g^i) &= o'(\tau - g^* - g^i) \\
y &= \tau - g^* - g^i \\
g^c &= \frac{g^* - \theta g^d}{\gamma}
\end{aligned}$$

Denote by $\delta_c = \{g^d, g^c, g^i, y\}$ the internal solution to the above system. A solution that features $g^d > 0, g^c > 0$, and $y > 0$ exists because of the assumptions of the model while $g^i > 0$ if g^* is small enough such that condition (36) holds. So we can have a region where $g^i = 0$, but we don't have the unconstrained solution. More specifically, let the cutoff imposed by the voters be $\overline{g}$. We will then have:

- unconstrained solution:
  - $\overline{g} \geq \mathbb{E}\left[\gamma g^c + \theta g^d\right]$;
  - the cut-off will be $\overline{g} = g^*(\theta)$.

- constrained solution with $g^i = 0$:

– the condition for g^i to be at a corner:

$$\mathbb{E}_\gamma\left[\theta f'(\overline{k}-x+g^d+g^i)+(1-\theta-\gamma)f'(\overline{k}+g^i)+\gamma f'(\overline{k}+g^c+g^i)\right]<\lambda\forall g^i\geq 0,$$

where λ is the Lagrange multiplier on the budget constraint. At the margin, g^i is positive when

$$\mathbb{E}_\gamma\left[\theta f'(\overline{k}-x+g^d)+(1-\theta-\gamma)f'(\overline{k})+\gamma f'(\overline{k}+g^c)\right]=\lambda.$$

– this is equivalent to the following first-order condition being satisfied:

$$o'(\tau-\overline{g})=\mathbb{E}_\gamma\left[\theta f'(\overline{k}-x+g^d)+(1-\theta-\gamma)f'(\overline{k})+\gamma f'\left(\overline{k}+\frac{\overline{g}-\theta g^d}{\gamma}\right)\right]. \quad (87)$$

– the other first-order conditions are

$$\begin{aligned} f'(\overline{k}-x+g^d) &= Rf'\left(\overline{k}+\frac{\overline{g}-\theta g^d}{\gamma}\right), & (88)\\ y &= \tau-\overline{g}, & (89)\\ g^c &= \frac{\overline{g}-\theta g^d}{\gamma}. & (90)\end{aligned}$$

– therefore, condition (87) can be re-written as

$$\mathbb{E}_\gamma\left[f'(\overline{k}-x+g^d)\left(\theta+\frac{\gamma}{R}\right)+(1-\theta-\gamma)\right]=o'(\tau-\overline{g}), \quad (91)$$

where g^d is derived from the implicit equation (88).

– from (88), as $\overline{g}$ decreases, g^d decreases, which means $f'(\overline{k}-x+g^d)$ rises; on the other hand, as $\overline{g}$ decreases, $\tau-\overline{g}$ increases, which means $o'(\tau-\overline{g})$ decreases. Therefore, there exist a value of $\overline{g}$, call it g_C^*, such that condition (91) holds at $\overline{g}=g_c^*$. For $\overline{g}<g_C^*$, condition (91) implies we must have $g^i>0$ while for $\overline{g}>g_C^*$, g^i is at the corner, $g^i=0$.

- constrained solution with $g^i>0$: as shown above, for $\overline{g}<g_C^*$, the solution will feature $g^i>0$.