Dynamic Collective Choice with Endogenous Status Quo*

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Abstract

This paper analyzes an ongoing bargaining situation in which i) preferences evolve over time, ii) the interests of individuals are not perfectly aligned, and iii) the previous agreement becomes the next status quo and determines the payoffs until a new agreement is reached. We show that the endogeneity of the status quo exacerbates the players' conflict of interest and decreases the responsiveness of the bargaining outcome to the environment. Players vote more often for different alternatives even if on average their preferences agree. When players become very patient, the endogeneity of the status quo can bring the negotiations to a complete gridlock.

The polarizing effect of the endogenous status quo is higher the higher the dispersion of power. As a result, the endogenous status quo can alter the workings of biased decision rules. Decision rules that favor one alternative in a static setting, in a dynamic setting may result in this alternative being implemented less often.

We show that welfare can be improved if power is concentrated or the status quo is fixed exogenously. This paper hence supports the use of sunset provisions and simple majority in the legislative setting.

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1 Introduction

This paper analyzes an ongoing collective decision problem in which i) there are shocks to the environment that affect individual preferences, and hence call for renegotiation of the past agreement, ii) the interests of individuals are not perfectly aligned, and iii) agreements are determined using an endogenous status-quo protocol: the previous agreement determines the payoffs until a new agreement is reached.

A prominent example of negotiations in a changing environment with an endogenous status quo is legislative bargaining. Legislators' preferences reflect heterogeneous ideologies and constituencies, but can also be subject to shocks such as business cycles, the vagaries of public opinion, demographic transitions, inflation pressures, or terrorist threats. At the same time, in most democracies, policies tend to have an endogenous status quo: once enacted, a legislative act continues in effect until a further legislative action is taken. For instance, more than half of the U.S. federal budget—called mandatory spending—continues year after year by default.[1] Likewise, policies that address many ideologically charged issues such as immigration, minimum wage, or civil liberties are typically continuing in nature.[2]

The starting point of our analysis is an observation that the endogenous status quo creates a *dynamic linkage* between decisions. Consider, for example, legislators negotiating the size of mandatory spending in the U.S. budget. During a recession generous spending may be favored by all parties to stimulate a short-term economic growth. Conversely, in better times, all parties may prefer to curb it to bring the public debt under control. In normal times, however, legislators may genuinely disagree on the optimal level of public spending. Anticipating this disagreement, fiscal conservatives may be reluctant to increase public spending during a recession, out of fear that their liberal counterparts will veto a return to fiscal discipline when the economy improves. Likewise, liberals may refuse to lower spending in times of economic prosperity, out of fear that conservatives will oppose fiscal expansion when the boom is over.

This example suggests that the combination of a changing environment, conflict of in-

[1] Direct spending consists mainly of entitlement programs such as Social Security benefits, Medicare and Medicaid. It has constituted more than half of the budget since the 1990s. See Weaver (1985, 1988), Hird (1991) and Lowi (1969) on the ongoing nature of public policies in the U.S.

[2] Sunset provisions on such policies—provisions attached to a legislation that set its expiration day—are rather the exception than the norm. They are somewhat more frequently used in taxation. For instance, the U.S. Earned Income Tax Credit and its subsequent expansions in 1986, 1990, 1993, and 2001 did not have a sunset provision, but the "Vietnam tax surcharge" of The Revenue and Expenditure Control Act of 1968 had a two-year sunset clause. More recently, the "Bush tax cuts" of the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003 had a ten-year sunset clause. Another prominent exception is the U.K. income tax which is repealed and voted on again every year. We will discuss the role of sunset provisions in Section 5.

terest, and an endogenous status quo creates a trade-off between responding to shocks and securing a favorable bargaining position. In this paper, we study this trade-off, show that it results in large distortions, and study ways of mitigating these distortions.

In the basic model, two players engage in an infinite sequence of collective choices over two policies, called left and right. Players' preferences are unambiguously ordered along the ideological line: one player has a greater payoff differential between alternative left and right than her opponent. Both players, however, can prefer either alternative with positive probability. In each period, the state of the economy changes according to a Markov process and affects players' preferences. At the beginning of each period one policy, called the current status quo, is in place. If both players agree to move away from the status quo, the new policy is implemented. Otherwise, the status quo prevails. In both cases, the implemented policy determines the players' payoffs in this period and becomes the new status quo. We are looking for the stationary equilibria of this game.

As expected based on the example above, the endogeneity of the status quo distorts players' behavior. Each player is willing to sacrifice her current payoff to secure a favorable status quo. As a result, players use cutoff strategies: in each period a player votes for her preferred status quo unless the payoff from the other policy exceeds a certain cutoff. In other words, each player's vote is biased in favor of one alternative.

Perhaps somewhat surprisingly, a player's preferred status quo—and hence her voting bias—is determined not by her expected preferences, but by her expected preferences *conditional on disagreement*. That is, even if both players on average prefer right, in equilibrium the player who favors left whenever players disagree, biases her vote in favor of left.

This leads us to the central finding of this paper: the endogenous status quo exacerbates ideological differences between players. Players disagree more often than their actual preferences do. As a result, the bargaining outcome becomes less responsive to the environment.

We show that this effect can be quite dramatic. In particular, if players are patient enough, the negotiations may come to a gridlock in which players vote solely along ideological lines and the enacted policy is completely unresponsive to the environment. It is worth noting that this is not a direct consequence of players' patience, but stems from the fact that players' behavior feeds on itself. Patience increases the voting bias and the probability of disagreement, which increases the life expectancy of the status quo. This, in turn, makes the identity of the status quo more important and hence increases the voting bias further.

The behavior described above reminds us of what is commonly referred to as *partisanship:* each player votes for one particular alternative more often than is favored by her current preferences, and the behavior of the players results in more polarization. Although partisanship is often defined as a blind allegiance to a party or ideology, this paper shows that a similar behavior can be generated by strategic considerations. Moreover, it shows that strategic partisanship is determined not by the absolute, but by the relative ideology. For example, what drives the bias of a legislator when voting on fiscal policy is not whether she is Keynesian or neoclassical, but whether her beliefs on the efficacy of public policies are more or less optimistic than those of the other legislators .

Since the endogenous status-quo protocol increases the probability of disagreement, it is only natural to ask if its prominent counterpart performs better. To this end, in Section 5 we compare our game to a game in which the status quo is set exogenously in each period. Our analysis shows that the exogenous status-quo protocol increases utilitarian welfare when common shocks are temporary and nonrecurrent. When common shocks are recurrent, the status quo may additionally need to be tied to the relevant state variables.

Since in most democracies, the endogeneity of the status quo is the norm rather than the exception, one may doubt whether implementing an exogenous status quo and tying it to the state of the economy is feasible. We believe it is, as one can find examples of well functioning exogenous status-quo protocols. For instance, in the U.S. budget procedure, discretionary spending— which amounts to a third of the total federal budget— is zero by default. Similarly, certain policies are already tied to economic variables. For instance, in many countries, the unemployment and social security benefits are indexed to the inflation rate, the return of the pension fund, or life expectancy.

Our results extend to an $N-$player game with an arbitrary voting rule. Within this framework, we show that the endogenous status quo magnifies the effect of dispersion of power. If a voting rule requires the approval of a larger set of players, disagreement increases for two reasons. Like in a static game, disagreement becomes more likely because more players have to agree. However, since disagreement becomes more likely, defending the preferred status quo becomes more important to each player. As a result, each player votes in a more biased way, increasing the probability of disagreement further.

We find that the voting bias created by the endogenous status quo alters the workings of the biased voting rules. A left-biased voting rule is a rule that requires an agreement of a smaller number of players to move the status quo to left than it requires to move the status quo to right. In a static environment, such a rule unambiguously results in left being implemented more often. We show that this no longer holds in the dynamic setting: in response to such a rule, a player who favors right as the status quo increases her voting bias in favor of right. As a result, right may be implemented more often than it would under an unbiased rule. An example of a biased voting rule is the budget process in the U.S. Congress. According to the Congressional Budget Act and the Byrd Rule, any provision that is budget neutral or deficit reducing requires an agreement of a simple majority while any provision that increases spending or decreases revenues requires 60 per cent of the votes. Our findings suggest that conversely to the intended consequence, such a rule can hinder the reduction of budget deficits.

We shall point out that since under simple majority rule only one player is pivotal, under this rule the voting bias disappears. The pivotal player secures the change of the status quo whenever she wishes; hence, she finds it optimal to vote according to her current preferences. Although a simple majority is a widespread rule, in most modern democracies legislative proposals have to pass several hurdles to be enacted. These hurdles can take many forms, such as judicial review by constitutional court, presidential veto, bicameralism, lack of party discipline. Hence, a change in the law ultimately requires the consent of several players with conflicting preferences, and will thus generates the kind of strategic interactions that our model highlights. In a sense, our results imply that democratic systems with more checks and balance will display more partisanship in voting behavior.

Despite its pervasiveness, the impact of the endogenous status quo on negotiations in a changing environment has received little attention in the literature. This is likely due to the complexity of the strategic interactions that the endogenous status quo generates. This paper avoids many technicalities by restricting the choice set to two alternatives. This restriction eliminates the need to specify the details of bargaining rules, such as the determination of the proposer and the number of negotiation rounds. However, the main insights of this paper should be robust to relaxing this assumption: as long as there is some conflict of interest and payoffs are not transferable, players will trade off their current payoff for a better bargaining position in the future.

In the interest of clarity, our model is presented in the legislative bargaining context, but we want to stress that the results apply more generally. Prior agreements determine the default option in a host of nonlegislative bargaining contexts such as monetary policy,[3] labor contracts, financial contracts, and international treaties (such as those of the WTO, or the GATT).

The paper is organized as follows. Section 1.1 discusses the related literature. Section 2 describes the basic model. In Section 3, we solve a simple example that demonstrates the main findings of the model. Section 4 formalizes these findings. Section 5 compares the welfare in our game with the welfare under the exogenous status quo. Section 6 extends the model to N players and shows how our results change with the concentration of decision power. In Section 7 we discuss how the results extend to more general preference

[3] In the U.S., the interest rates are negotiated within the Federal Open Market Committee and remain in place until the committee agrees to change them according to its internal voting rule. See Riboni and Ruge-Murcia (2008) for more on the role of the status quo in monetary policy institutions.

distributions. Section 8 concludes. All proofs are in the appendix.

1.1 Related literature

The formal literature on ongoing legislation with endogenous status quo started with the seminal paper of Baron (1996).[4] His model has been extended to various multidimensional settings by Baron and Herron (2003), Kalandrakis (2004, 2007), Cho (2005), Fong (2006), Bernheim et al. (2006), Diermeier and Fong (2007a), Baron, Diermeier, and Fong (2007), and Battaglini and Palfrey (2007).[5] These models, however, consider static environments: policies evolve over time not because preferences change, but because the set of actions available to each player varies across voting stages. They focus on the dynamics of the proposal power under different institutional rules. We abstract away from the distributional issue of the proposal power and focus instead on the efficiency of the policy-making process and its responsiveness to economic and political shocks.[6]

Battaglini and Coate (2007, 2008) study the inefficiency of a dynamic legislative bargaining model of public finance. In their papers, the status quo is fixed and the dynamic linkage is the accumulation of the public good or debt, which affects the relative returns of pork-barrel programs. In their model, the availability of targeted public spending leads legislatures to pass inefficient budgets and be present-biased, more so the lower the supermajority requirement, while in our model, the continuing nature of policies lead voters to be future-biased, more so the larger the supermajority requirement.

Even though dynamic bargaining with an endogenous status quo and evolving preferences is at the center of many economically relevant situations, the existing literature on this topic is scarce. This may be a consequence of the relative intractability of these games. As Romer and Rosenthal (1978) showed in a static setup with single-peaked preferences, the induced preferences over the status quo are typically not convex, which makes the multiperiod extension technically hard to analyze. With a continuum of alternatives and an infinite horizon, stationary equilibrium existence is not guaranteed even under standard preference specifications.[7] To the best of our knowledge, only Diermeier and Fong (2007b), Riboni and Ruge-Murcia (2008) and Duggan and Kalandrakis (2009) make progress on

[4] Epple and Riordan (1987) study a similar model but consider nonstationary equilibria. The principle of an evolving status quo was first introduced in a cooperative bargaining literature by Kalai (1977).

[5] The models of Bernheim et al. (2006) and Diermeier and Fong (2007a) are originally cast in a single policy period, but they can be extended or interpreted as dynamic legislative bargaining games.

[6] Because most of these models consider the division of a pie of exogenous size or single-peaked preferences, equilibrium outcomes are always efficient in a static sense and can be inefficient in a dynamic sense only when citizens are sufficiently risk-averse. In contrast, when preferences vary as in our model, equilibrium outcomes are typically Pareto inefficient independently of risk aversion.

[7] See, e.g., Kalandrakis (2004b, 2007) or Duggan and Kalandrakis (2009) for more on this issue.

this front. Adding noise to the status quo, Duggan and Kalandrakis (2009) establish the existence of an equilibrium. The generality of their model does not allow an analytical equilibrium characterization, so they resort instead to numerical methods. Riboni and Ruge-Murcia (2008) analyze a game with quadratic utility functions and a finite state space. They analytically solve a two-period two-state example, but use numerical solutions for the general model. Diermeier and Fong (2007b) analyze a two-period three-state model with a richer institutional framework. Our paper differs from these contributions in that we simplify the space of alternatives, but fully characterize the policy dynamics with an infinite bargaining horizon for any preference distributions. Moreover, our institutionally sparse model allows us to isolate the effect of the endogeneity of the status quo in a transparent way.

Montagnes (2010) looks at a two-period financial contracting environment in which the current contract serves as the default option in future negotiations. He shows that both contracting parties may prefer to commit ex ante to ceding a future decision power to one of them. Such a commitment breaks the dynamic linkage and avoids inefficiencies in the initial contract.

Fernandez and Rodrik (1991) and Alesina and Drazen (1991) have emphasized that the distributional uncertainty of policy reforms can lead to status quo inertia. In our model, status quo inertia would also arise in an environment without uncertainty but with evolving preferences.

Our results on policy responsiveness are related to the political economy literature on growth and on the dynamics of welfare policies (Glomm and Ravikumar 1995; Krussell and Rios-Rull 1996,1999, Coate and Morris 1999; Saint Paul and Verdier 1997; Benabou 2000; Saint Paul 2001; Hassler et al. 2003, 2005). These models emphasize the effect of the current policy on private investment decisions, which in turn affect the policy preferences of voters in future periods and thus generate policy persistence. In contrast, in our paper, the current policy does not affect future preferences, but inertia emerges because today's policy affect future bargaining positions.

Finally, Casella (2005) shows that linking voting decisions across time allows voters to express their preference intensity, which can be socially beneficial. Our results suggests that the intertemporal trade-off induced by the endogeneity of the status quo, despite the pervasiveness of this institution, is not an efficient way to elicit preference intensity. Barbera and Jackson (2010) let ex ante identical voters choose the group decision rule after having learned their first period preferences. As in our framework, bundling the current and the future decision rules generate inefficiencies. But since the dynamic linkage is only between the first and the subsequent periods, sufficiently patient players always select the optimal voting rule.

2 The model

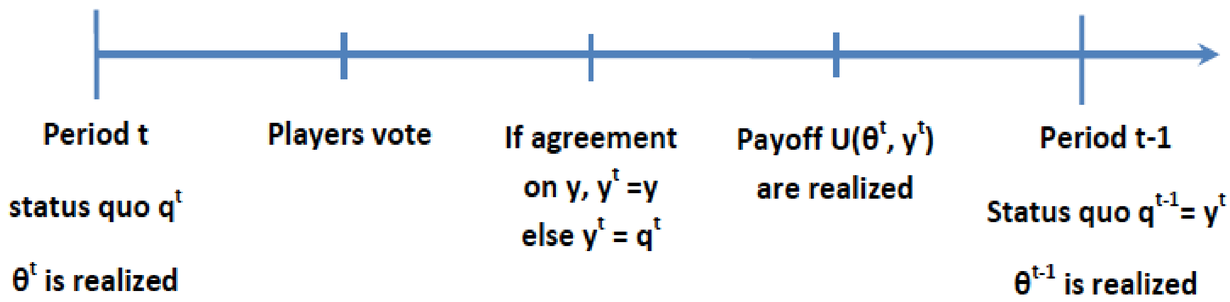
Two players, i and j, are in a relationship that lasts for infinitely many periods. In each period t, players adopt one of two alternatives, $y^t \in \{L, R\}$. The utility of player $k \in \{i, j\}$ in period t depends on the alternative adopted in period t and is given by

$$u\left(\theta_k^t, y^t\right) = \begin{cases} \theta_k^t \text{ if } y^t = R \\ -\theta_k^t \text{ if } y^t = L \end{cases} \tag{1}$$

Hence, if θ_k^t is positive (negative), player k prefers alternatives R (L) to be implemented in period t. We refer to θ_k^t as player k's *current preference* in period t. The profile of preferences $\left(\theta_i^t, \theta_j^t\right)$ follows a stationary Markovian process on a finite state space S. Throughout the paper, subscripts refer to the individuals while superscripts refer either to the time period or to the state. For a generic parameter p, the bold symbol $\boldsymbol{p}$ refers to the vector (p_i, p_j), and p^S refers to a vector of state dependent parameters $(p^s)_{s\in S}$. In particular, if the parameter is real, $\boldsymbol{p}^S$ is an element of $\mathbb{R}^{2S}$.

In period t, if the current state is $s \in S$, the preference parameters $\boldsymbol{\theta}^t$ are drawn from a joint distribution with an integrable density function f^s whose marginal distribution for each player has full support. The probability of moving from state $s \in S$ to state $s' \in S$ is denoted by $\pi(s, s')$. In the sequel, we will refer to f^S as the preference distribution, and to π as the transition matrix. The stationarity of the preference distribution is a simplifying assumption which is consistent with the recurring nature of shocks that affect issues such as taxation, public spending, immigration, or civil liberties (e.g., economic cycles, demographic transitions, public opinion swings, or national security threats). The fact that within the state preferences are redrawn every period captures the remaining shocks that are temporary and nonrecurring. Players discount future payoffs with the same factor $\delta \in (0, 1)$.

The game proceeds as follows. Each period starts with one alternative in place. We call this alternative *the status quo* in period t and denote it by q^t. At the beginning of each period, the state s^t is drawn from the distribution $\pi(., s^{t-1})$ and the preference profile $\boldsymbol{\theta}^t$ is drawn from the distribution f^{s^t}. After players observe s^t and $\boldsymbol{\theta}^t$, they vote on which alternative to adopt in period t. If both players vote for the same alternative, this alternative is implemented. If they disagree, the status quo q^t stays in place. The implemented alternative y^t, be it the new agreement or the status quo q^t, determines the payoff in period t and becomes the status quo for the next period q^{t+1}. We denote the game that begins with status quo $q^0 \in \{R, L\}$ and state $s^0 \in S$ by $\Gamma^{en}_{q^0,s^0}$. The following diagram summarizes the model.



In this game, the alternative implemented in some period t has no effect on the preferences in future periods, so each period is an independent social choice problem, and the dynamic linkage between periods comes solely from the strategic incentives generated by the endogeneity of the status quo. In the sequel, to isolate the effect of the endogeneity of the status quo on equilibrium behavior and welfare, we shall compare $\Gamma^{en}_{q^0,s^0}$ to the game $\Gamma^{ex}_{q^0,s^0}$, which differs from $\Gamma^{en}_{q^0,s^0}$ only in that the status quo is exogenously fixed at q^0 in every period.

We look for stationary equilibria in stage-undominated strategies (henceforth equilibria) as defined in Baron and Kalai (1993).[8] The stationarity assumption may be quite appropriate in the legislative applications in which it is likely that the game is played by a sequence of short lived legislators. In such cases assuming institutional memory required for more complicated equilibria may be inappropriate. Stage-undomination is a standard equilibrium refinement in dynamic voting games, which basically amounts to assuming that in every period players cast their votes as if they were pivotal. In effect, stage undomination eliminates pathological equilibria such as both players always voting for the status quo.[9]

A few comments on the model are in order. First, we analyze a two-player game with a unanimity requirement to change the status quo, but we show in section 6 that our results extend to an $N-$player game with any arbitrary voting rule. Second, restricting attention to two alternatives allows us to abstract away from the details of the stage game and the issue of proposal power.[10] It thereby allows us to isolate the effect of the endogeneity of the status

[8] As is typical for dynamic infinite-horizon games, the set of payoffs attainable in subgame-perfect equilbia is lage, but as argued in Baron and Ferejohn (1989), most of them rely on a very high degree of sophistication of the players.

[9] Moreover, the equilibria eliminated by this refinement hinge on details of the bargaining protocols which are difficult to map to reality: for instance, they would disappear if we assumed instead that players vote sequentially. See, e.g., Acemoglu, Egorov, and Sorin (2009).

[10] With two alternatives, many static bargaining protocols are equivalent. In particular, using standard equilibrium concepts, equilibrium outcomes are the same when players vote simultaneously or sequentially, when they make take-it-or-leave-it offers, or when we allow for n rounds of bargaining within each period with either a random or alternating proposer.

quo on the efficiency and responsiveness of the bargaining outcomes to the environment in a transparent way. Third, what players know about each other's preferences is immaterial. Finally, we assume that today's action has no impact on tomorrow's preferences (that is, π does not depend on the status quo q) because this dynamic linkage has already received some attention in the dynamic political economy literature (see the references in section 1.1), and ruling it out allows us to isolate the effect of the dynamic linkage generated by the endogeneity of the status quo.

3 An example

We start by solving a simple example, which illustrates the workings of the model. We formalize all observations of this example later in the paper.

Assume that $|S| = 1$, and that $\theta_i^t = \bar{\theta}_i + \varepsilon^t$ and $\theta_j^t = \bar{\theta}_j + \varepsilon^t$. Hence, players' preferences are perfectly correlated, and ε^t is the common shock. We assume that for each t, $\varepsilon^t \sim N(0,1)$ and is i.i.d. over time. Parameter $\bar{\theta}_i$ is the expected preference of player i, $\bar{\theta}_j$ is the expected preference of player j. If $\bar{\theta}_i - \bar{\theta}_j \geq 0$, then player i always receives higher (lower) utility from R (L) than player j. Hence, $\bar{\theta}_i - \bar{\theta}_j$ can be interpreted as players' ideological polarization.

A policy implemented in each period impacts player k's payoff via two channels. First, it affects her current payoff θ_k^t. Second, it determines the future status quo. Let $V_k(q)$ be the continuation value for player $k \in \{i, j\}$ when the status quo is q. Since player k votes as if she were pivotal, in period t she votes for R if

$$\theta_k^t + \delta V_k(R) > -\theta_k^t + \delta V_k(L),$$

and for L if the reverse inequality holds. Therefore, she uses a cutoff strategy with the cutoff

$$c_k = \frac{\delta}{2}\left(V_k(L) - V_k(R)\right). \tag{2}$$

Observe that the future payoffs depend on the current status quo only in instances in which players disagree. Disagreement happens when players' preferences θ_i^t and θ_j^t are on opposite sides of their respective cutoffs c_i and c_j. Hence, we can rewrite the right-hand side of (2) as follows:

$$\begin{aligned} c_k = \frac{\delta}{2} \quad & \left(\int_{-\infty}^{c_j}\int_{c_i}^{\infty}\left(-\theta_k + \delta V_k(L) - (\theta_k + \delta V_k(R))\right) f(\boldsymbol{\theta})\, d\theta_i d\theta_j \right. \\ & \left. + \int_{c_j}^{\infty}\int_{-\infty}^{c_i}\left(-\theta_k + \delta V_k(L) - (\theta_k + \delta V_k(R))\right) f(\boldsymbol{\theta})\, d\theta_i d\theta_j\right). \end{aligned}$$

Substituting (2) inside the integral in the above equation, we obtain that the equilibrium cutoffs solve the following fixed point problem:

$$\begin{aligned} c_i &= \delta \left(\int_{-\infty}^{c_j} \int_{c_i}^{\infty} (c_i - \theta_i) f(\boldsymbol{\theta}) \, d\theta_i d\theta_j + \int_{c_j}^{\infty} \int_{-\infty}^{c_i} (c_i - \theta_i) f(\boldsymbol{\theta}) \, d\theta_i d\theta_j \right), \\ c_j &= \delta \left(\int_{-\infty}^{c_j} \int_{c_i}^{\infty} (c_j - \theta_j) f(\boldsymbol{\theta}) \, d\theta_i d\theta_j + \int_{c_j}^{\infty} \int_{-\infty}^{c_i} (c_j - \theta_j) f(\boldsymbol{\theta}) \, d\theta_i d\theta_j \right). \end{aligned} \tag{3}$$

From (2), we see that the sign of c_k measures whether player k prefers the next period's status quo to be R (c_k negative) or L (c_k positive), and the absolute value of c_k measures the intensity of this preferences. Hence, $\theta_k - c_k$ measures player k's *intertemporal preferences.* Equation (3) shows that the voting cutoffs of each player are given by her expected intertemporal preferences in the next period *conditional on disagreement*

We solve the model numerically for $\delta = 0.95$ and $\bar{\theta}_i = 1$, while varying $\bar{\theta}_j$. When $\bar{\theta}_j = 0.1$, then the resulting cutoffs are $c_j \approx 0.09$ and $c_i \approx -0.19$. When $\bar{\theta}_j = 0.01$, players are more polarized, and the resulting cutoffs are $c_j \approx 0.8$ and $c_i \approx -1.25$. And finally, when $\bar{\theta}_j = -0.1$, the resulting cutoffs are $c_j \approx 1.25$ and $c_i \approx -5.2$.

We would like to point out a few features of this example. First, observe that player i always uses a negative cutoff while player j always uses a positive cutoff. This happens even though in the first two cases both players prefer R on average. The reason for this is that the status quo matters only in case of disagreement, and when players disagree, i prefers R but j prefers L.

Second, the voting cutoffs act as a polarization-magnifying preference shift. To see this note that if players were voting according to their current preferences, they would disagree when $\varepsilon^t \in \left(-\bar{\theta}_i, -\bar{\theta}_j\right)$, while in our game they disagree when $\varepsilon^t \in \left(-\bar{\theta}_i + c_i, -\bar{\theta}_j + c_j\right)$. Hence, players vote *as if* their preferences where more polarized, with the polarization equal to $\bar{\theta}_i - \bar{\theta}_j + c_j - c_i$. Note that the effects are large: for $\bar{\theta}_j = -0.1$, $\bar{\theta}_i - \bar{\theta}_j + c_j - c_i \approx 7.55$; hence, the players vote as if their ideological differences were 7 times larger than their actual polarization.

Third, players disagree more often than their preferences do, and this effect can be quite large. When $\bar{\theta}_j = 0.01$, for example, the probability that players' preferences disagree is 0.34, while the probability that in a single period the players vote for opposite alternatives is 0.77. For $\bar{\theta}_j = -0.1$, these probabilities are 0.43 and 0.92 respectively. Comparing different cases, we see that the cutoffs increase with the initial polarization $\bar{\theta}_i - \bar{\theta}_j$. In fact, as we increase δ to 1, for $\bar{\theta}_j = -0.1$ the voting cutoffs increase to $c_i = -\infty$ and $c_j = \infty$. That is, as players become infinitely patient, they disagree with probability 1, and negotiations come to a complete gridlock.

The following observation is key to understanding the magnitude of the equilibrium cutoffs in this example. If players expected that their opponent uses a 0 cutoff, they would still expect some disagreement, and hence player j would use a positive cutoff to defend L as a status quo and player i would use a negative cutoff to defend R as a status quo. But if players use these non-zero cutoffs, the probability of disagreement increases, which in turn makes defending the status quo even more important. Realizing that, each player has an incentive to become more biased, which again increases the probability of disagreement. In other words, players' voting behavior feeds on itself: an expectation of disagreement increases the importance of defending the preferred status quo which in turn increases disagreement.

The equilibrium behavior of the players reminds us of what is commonly referred to as *partisanship.* Oxford Dictionaries define partisanship as prejudice in favour of a particular cause; a bias. In multi-party systems, this term carries a negative connotation—it refers to those who wholly support their party's policies and are reluctant to acknowledge any common ground with their political opponents. This definition resonates with our example: each player favors a distinct alternative for which she votes more often than her current preferences justify, and this in turn leads to more disagreement. Hence, we interpret the equilibrium cutoffs as a measure of players' partisanship

This example suggests that the direction of partisanship is determined not by the absolute ideology but by the relative ideology of the players. In panels A and B, both players prefer R ex ante. However, in equilibrium the less rightist player j ends up being partisan in favor of L.

4 The equilibrium

The following proposition characterizes the equilibria of the game $\Gamma^{en}_{q^0,s^0}$.

Proposition 1 *In all equilibria, the players use state-dependent, status quo-independent cutoff strategies: there exists $\boldsymbol{c}^S \in \mathbb{R}^{2S}$ such that in state $s \in S$, player $k \in \{i,j\}$ votes for R if $\theta_k > c^s_k$ and for L if $\theta_k < c^s_k$. The equilibrium cutoffs are the fixed points of the mapping $\boldsymbol{H}^S$ defined by: for all $s \in S$ and all $\boldsymbol{c}^S \in \mathbb{R}^{2S}$*

$$\boldsymbol{H}^s\left(\boldsymbol{c}^S\right) = \delta \sum_{s' \in S} \pi\left(s, s'\right) \left(\int_{-\infty}^{c_j^{s'}} \int_{c_i^{s'}}^{\infty} \left(\boldsymbol{c}^{s'} - \boldsymbol{\theta}\right) f^{s'}\left(\boldsymbol{\theta}\right) d\theta_i d\theta_j + \int_{c_j^{s'}}^{\infty} \int_{-\infty}^{c_i^{s'}} \left(\boldsymbol{c}^{s'} - \boldsymbol{\theta}\right) f^{s'}\left(\boldsymbol{\theta}\right) d\theta_i d\theta_j \right). \tag{4}$$

The set of equilibrium cutoffs is a complete lattice for the partial order $(\leq,\geq)^S$ defined by: for all $\boldsymbol{c}^S, \boldsymbol{d}^S \in \mathbb{R}^{2S}$, $\boldsymbol{c}^S (\leq,\geq)^S \boldsymbol{d}^S$ if for all $s \in S$, $c^s_i \leq d^s_i$ and $c^s_j \geq d^s_j$.

Consistent with our example, players use cutoff strategies. However, since the continuation of the game depends on the state, cutoffs are state-dependent. Equation (4) says that cutoffs of player k are determined by the expected intertemporal preference of player k, $c_k^s - \theta_k$, conditional on players disagreeing, i.e., $c_k^s - \theta_k^s$ being of opposite sign for $k \in \{i, j\}$.

For most of the paper, we will make the following assumption.

Assumption 1 *For all $s \in S$ and all $\theta_i < \theta_j$, $f^s(\theta_i, \theta_j) = 0$.*

Assumption 1 means that $\theta_i \geq \theta_j$ with probability 1. This assumption has a natural interpretation in political economy or monetary applications: players can be unambiguously ranked on the ideological spectrum. Player i is the more rightist and there is no preference reversal. Note, however, that this assumption imposes no restriction on the preference distribution of a single player nor on the probability that players' preferences disagree: both players might prefer policy L arbitrarily often in some state s and policy R arbitrarily often in another state s'.

When preference reversal is ruled out, we can show the following:

Proposition 2 *Under assumption 1, in all equilibria of $\Gamma^{en}_{q^0,s^0}$, for all $s \in S$, $c_i^s \leq 0$ and $c_j^s \geq 0$.*

Proposition 2 states that the more leftist player is always biased in favor of L and the more rightist player is always biased in favor of R. And since preference reversal is ruled out, Proposition 2 pins down the direction of disagreement in all equilibria across all states: conditional on disagreement, player i votes for R and player j votes for L.

To understand the consequences of the endogeneity of the status quo, it is instructive to compare players' behavior under this bargaining protocol $\Gamma^{en}_{q^0,s^0}$ to players' behavior under its natural alternative: the bargaining protocol $\Gamma^{ex}_{q^0,s^0}$ in which the status quo is exogenously fixed at q^0 in every period. If the status quo were fixed exogenously at R or L, the policy implemented in one period would not affect the subsequent bargaining situation. Hence, the players would consider each period in isolation and vote according to their current preferences. This observation is summarized in the following remark.

Remark 1 *The game $\Gamma^{ex}_{q^0,s^0}$ has a unique equilibrium. In that equilibrium, the players use voting cutoffs $c_i^s = c_j^s = 0$ in all states and all periods.*

The comparison of $\Gamma^{en}_{q^0,s^0}$ with $\Gamma^{ex}_{q^0,s^0}$ delivers the main qualitative insight of this paper: the endogenous status quo amplifies the ideological differences between players. This is formally stated in the following corollary.

Corollary 1 *Under assumption 1, the endogenous status quo increases the probability of disagreement and hence the status quo inertia: for any history along the equilibrium path up to a period t, the probability that players vote for opposite alternatives in that period is higher in $\Gamma^{en}_{q^0,s^0}$ than in $\Gamma^{ex}_{q^0,s^0}$.*

To understand the above corollary, note that if the status quo is exogenous, in a given period t, players disagree when

$$\theta^t_j \leq 0 \leq \theta^t_i,$$

while if the status quo is endogenous, and if the current state in period t is s, players disagree when

$$\theta^t_j - c^s_j \leq 0 \leq \theta^t_i - c^s_i.$$

Since $c^s_i \leq 0$ and $c^s_j \geq 0$, these two expressions imply that the range of preference realizations for which players disagree and the status quo stays in place is greater under the endogenous status quo.

As mentioned in the leading example, the behavior of the players reminds us of what is commonly referred to as partisanship. Hence, in the rest of the paper, we use the following terminology.

Definition *The partisanship of player $k \in \{i, j\}$ in state $s \in S$ is $|c^s_k|$.*

4.1 The magnitude of partisanship

Proposition 1 does not claim uniqueness, and in fact, there may be multiple equilibria. Multiplicity is driven by the fact that partisanship feeds on itself. If players' expect low partisanship, disagreement happens rarely, and therefore defending the correct status quo is not very important, which in turn results in low partisanship. If players' expect the opponent to be very partisan, however, disagreement happens often, and therefore defending the correct status quo becomes essential, which in turn results in high partisanship. However, Proposition 3 says that we can identify the Pareto-dominant equilibria.

Proposition 3 *Let $\boldsymbol{c}^S$ and $\boldsymbol{d}^S$ be the cutoffs of two equilibria of $\Gamma^{en}_{q^0,s^0}$. Under assumption 1, if $\boldsymbol{c}^S \, (\leq, \geq)^S \, \boldsymbol{d}^S$, then $\boldsymbol{d}^S$ Pareto dominates $\boldsymbol{c}^S$. In particular, the least and the most partisan equilibria, i.e., the least and the greatest equilibria for the order $(\leq, \geq)^S$, are the Pareto best and worst equilibria, respectively.*

When deriving comparative statics, we use Pareto efficiency as a selection criterion and focus on the least partisan equilibrium. An additional support for this equilibrium selection can be found in Dziuda and Loeper (2010, proposition 2), where it is shown that the least partisan equilibrium is the limit of the finite horizon version of the game $\Gamma^{en}_{q^0,s^0}$ as the bargaining horizon goes to infinity. We want to stress, however, that the exact same comparative statics holds for the most partisan equilibrium.

The following definition will be helpful when deriving comparative statics with respect to the preference distribution f^S:

Definition *Let f^S and g^S be two preference distributions. The distribution f^S is more polarized than g^S if there exists a random variable $\boldsymbol{\varepsilon}^S$ with support on $(\mathbb{R}_+ \times \mathbb{R}_-)^S$ and a random variable $\boldsymbol{\theta}^S$ such that for all $s \in S$, the probability density of $\boldsymbol{\theta}^s$ and $\boldsymbol{\theta}^s + \boldsymbol{\varepsilon}^s$ is g^s and f^s, respectively.*

We use the terminology "more polarized" because if g^S satisfies Assumption 1, the preference distribution f^S is more polarized than g^S if f^S can be obtained from g^S by shifting the preferences of the rightist player farther to the right and the preferences of the leftist player farther to the left.

The next proposition shows how partisanship varies with the main preference parameters:

Proposition 4 *If we denote by $\boldsymbol{c}^S\left(\delta, f^S\right)$ the cutoffs in the least partisan equilibrium of Γ^{en}_q with a discount factor δ and a distribution of preference f^S, then*

a) partisanship increases with patience: if f^S satisfies assumption 1, $\boldsymbol{c}^S\left(\delta, f^S\right)$ is increasing in δ in the order $(\leq, \geq)^S$;

b) partisanship increases with the polarization of preferences: if f^S is more polarized than g^S, $\boldsymbol{c}^S\left(\delta, f^S\right) (\leq, \geq)^S \boldsymbol{c}^S\left(\delta, g^S\right)$.

The intuition for part (a) is that when players trade off the adequacy of the policy to the current environment versus securing a favorable status quo for tomorrow, more patient players put more weight on the latter and thus are more partisan. As for part (b), the preferences of more polarized players are more likely to disagree, which makes the status quo more important and thus increases partisanship. Hence, more polarized players disagree more often not only because their preferences disagree more often, but also because their equilibrium behavior is more partisan. This result resonates with Corollary 1 in that it shows that status quo endogeneity exacerbates the ideological differences between players.

At this point, we are ready to state formally that the polarizing effect of status quo endogeneity identified in this paper can be dramatic.

Proposition 5 *If we denote by* $\boldsymbol{c}^S\left(\delta, f^S\right)$ *the cutoffs in the least partisan equilibrium of* Γ_q^{en} *with a discount factor* δ *and a preference distribution* f^S*, then there exists a preference distribution* g^S *such that for all* f^S *which are more polarized than* g^S*, for all* $s \in S$*,* $\lim_{\delta\to 1} \boldsymbol{c}^s\left(\delta, f^S\right) = (-\infty, +\infty)$*.*

Proposition 5 states that when players are sufficiently polarized and patient, their partisanship can lead to complete gridlock. In this case, despite the fact that in all periods, players agree with positive probability, they almost always vote for opposite alternatives in equilibrium. They totally disregard their preference realizations and vote instead entirely along ideological lines. As a result, the policy is totally unresponsive to the shock to the environment.[11]

Observe that this result is not a mechanical consequence of increasing patience. The alternative adopted in period t impacts players' payoff in some subsequent period t' only if players' preferences disagree for all periods between $t+1$ and t', which happens with a probability smaller than 1, for a given level of partisanship. Hence, the difference in continuation value induced by different status quos stays finite even as $\delta \to 1$. For this reason, for the best response of a player to a finite level of partisanship of her opponent is also a finite level of partisanship irrespective of the players' patience. What drives the completely unresponsive behavior of patient players is the vicious cycle in which patience increases partisanship, partisanship then increases the life expectancy of the status quo, and this in turn increases the impact of patience on partisanship.

5 Welfare Analysis

Since the endogenous status-quo protocol increases the probability of disagreement, it is only natural to ask if its prominent counterpart performs better. In this section, we compare our game to a game in which the status quo is set exogenously in each period.

Let $\Gamma_{q^S,s}^{ex}$ denote a game that starts in state s in which the status quo is set to a predetermined $q^S \in \{L, R\}^S$. That is, the status quo may depend on the state, but does not depend on the actions of the players. Denote by $W\left(\Gamma_{q,s}^{en}\right)$ and $W\left(\Gamma_{q^S,s}^{ex}\right)$ the expected level of utilitarian welfare in some equilibrium of $\Gamma_{q,s}^{en}$ and $\Gamma_{q^S,s}^{ex}$ respectively.

The endogenous status quo affects welfare via two channels. First, it creates partisanship. This is detrimental to welfare, as Pareto dominated alternatives are implemented with positive probability; for example, when $q^s = R$, $\theta_j^s < 0$, and $c_i^s < \theta_i^s < 0$, player i vetoes

[11] The proof of this result does not require Assumption 1, g^S can be chosen to have full support in all states.

the Pareto optimal alternative L. Second, since the voting cutoffs are state-dependent, the frequencies with which players implement different alternatives may vary across states. That is, one alternative may serve as a status quo more often in some states than others. This in turn may be beneficial to welfare if the optimal status quo is state dependent. An exogenous status quo, on the other hand, eliminates partisanship (see Remark 1). Hence, if additionally the status quo is optimally chosen in each period, $\Gamma^{ex}_{q^S,s}$ must unambiguously dominate $\Gamma^{en}_{q,s}$, as is formalized by the next proposition.

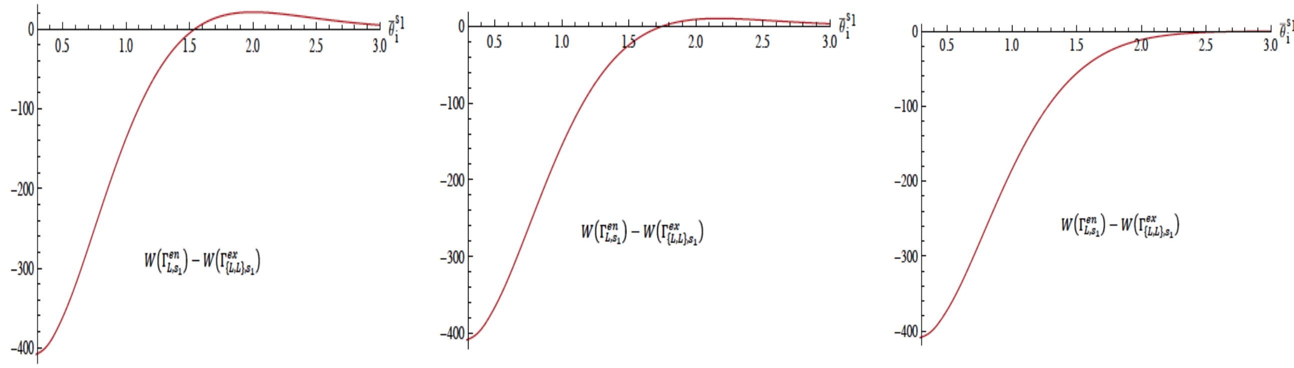
Proposition 6 *There exists $q^S \in \{R, L\}^S$ such that for all q and all $\delta < 1$, $W\left(\Gamma^{en}_{q,s}\right) \leq W\left(\Gamma^{ex}_{q^S,s}\right)$.*

However, if the status quo is restricted to be the same in all states, welfare comparison becomes ambiguous. Example 1 below illustrates this.

Example 1 *Assume that $S = (s_1, s_2)$, and $\pi_{s_1,s_1} = \pi_{s_2,s_2} \equiv \pi \geq \frac{1}{2}$, so that the states are somewhat persistent. Let $\theta^s_i = \bar{\theta}^s_i + \varepsilon$ and $\theta^s_j = \bar{\theta}^s_j + \varepsilon$, where $\varepsilon \sim N(0,1)$. That is, players' preferences are perfectly correlated. Assume that in s_1, i is more rightist than j : $\bar{\theta}^{s_1}_i > \bar{\theta}^{s_1}_j$. Assume also that $\bar{\theta}^{s_1}_i + \bar{\theta}^{s_1}_j \geq 0$, which implies that if players' preferences disagree, then R is socially better in s_1, and hence R is the socially optimal status quo in s_1. Let s_2 be symmetric with respect to s_1 : $\bar{\theta}^{s_2}_i = -\bar{\theta}^{s_1}_j$ and $\bar{\theta}^{s_2}_j = -\bar{\theta}^{s_1}_i$. Such symmetry implies that i is more rightist than j also in s_2, but L is the socially optimal status quo in s_2.*

The following figure compares welfare in the least partisan equilibrium of the game with an endogenous status quo that starts in s_1 with $q = L$, with a game with a state-independent exogenous status quo that starts in s_1 and has $q^S = \{L, L\}$. We fix players' initial polarization $\bar{\theta}^{s_1}_i - \bar{\theta}^{s_1}_j$ at 0.5 and let $\bar{\theta}^{s_1}_i$ move. Note that given our assumptions, when $\bar{\theta}^{s_1}_i = 0.25$, then both states are identical. When $\bar{\theta}^{s_1}_i$ increases, then the average preferences in s_1 move to the right and average preferences in s_2 move to the left. This means that the states move away from each other, and in each state the probability of preference disagreement decreases. Each panel depicts $W\left(\Gamma^{en}_{L,s_1}\right) - W(\Gamma^{ex}_{\{L,L\},s_1})$ as a function of $\bar{\theta}^{s_1}_i$ for three different values of

$\pi \in \{0.99, 0.8, 0.5\}$.



Panel A: $\pi = 0.99$ *Panel B:* $\pi = 0.8$ *Panel C:* $\pi = 0.5$

All panels show that the exogenous status quo dominates for small $\bar{\theta}_i^{s_1}$, *but this can reverse for large* $\bar{\theta}_i^{s_1}$. *Panels A, B and C reveal that as* π *increases, the reversal happens—if at all—for larger* $\bar{\theta}_i^{s_1}$. *The intuition for this is as follows. When* $\bar{\theta}_i^{s_1} = 0.25$, *both states are identical, and the exogenous status quo dominates trivially by Proposition 6. As* $\bar{\theta}_i^{s_1}$ *increases, the probability of disagreement in each state decreases; hence, defending the status quo becomes less important, and the partisanship in* Γ^{en}_{L,s_1} *decreases. So, the negative welfare aspect of* Γ^{en}_{L,s_1} *becomes small. At the same time, players become more likely to agree, and the agreement is likely to be* L *in* s_1 *and* R *in* s_2. *Hence, in* Γ^{en}_{L,s_1} *the optimal status quo is likely to arise in each state. But this can be beneficial only the new status quo remains optimal for a long time, and this happens only if states are quite persistent.*

Example 1 suggests, however, that when the endogenous status quo dominates, the difference in welfare is small. We conjecture that this is true more generally. For the endogenous status quo to dominate, partisanship cannot be too large. By Proposition 5, this requires that players' preferences are not too polarized. But slightly polarized preferences disagree relatively rarely, and hence the identity of the status quo—and in particular whether it is state dependent or not—matters little for players' welfare.

Our analysis provides support for implementing the exogenous status-quo protocol when common shocks are temporary and nonrecurrent ($|S| = 1$). When common shocks are recurrent ($|S| > 1$), the exogenous status quo may additionally need to be tied to some relevant state variables.

Since in most democracies, the endogeneity of the status quo is the norm rather than the exception, one may doubt, however, whether implementing a state-dependent exogenous status quo is feasible. We believe that it is, as one can find examples of well functioning exogenous status-quo protocols. For instance, in the U.S. budget procedure, discretionary spending— which amounts to a third of the total federal budget— is zero by default. Likewise, the UK income tax is zero if the legislature fails to reach an agreement Similarly, certain policies are already tied to economic variables. For instance, in many countries, the total spending on unemployment and social security benefits depends on the state of the economy (e.g., the number of unemployed, the number of retirees), and the level of the benefits is tied to the inflation rate. In the Netherlands, the level of pension benefits is indexed to the return of the pension fund, and in Sweden and France the benefits and the retirement age are also tied to life expectancy.[12]

Our analysis provides also support for sunset provisions. A sunset provision (or a sunset clause) is a clause that repeals a law, a tax change, or a regulation after a prespecified duration, unless further legislative action is taken. Sunset provisions can be automatic—any policy change comes with the clause attached—or endogenous—legislators must agree to attach the clause every time the policy is changed. When automatic, a sunset provision is virtually identical to the exogenous status-quo protocol. An example of automatic sunset provisions are sunset legislations in 24 U.S. states that require an automatic termination of a state agency, board, commission, or committee (see The Book of the States, 2011, Council of State Governments). A standard rationale for these sunset legislations have been to improve control of the agencies through periodic reviews. The argument advanced by our model has instead a more strategic underpinning: by severing the link between today's agreement and tomorrow's status quo, sunset provisions increase agreement and make the establishment and abolishment of these agencies responsive to the environment.[13]

We want to stress, however, that the rarity of the exogenous status quo and automatic sunset provisions shall not be viewed as a test of our analysis. Proposition 6 implies that players jointly benefit from the exogenous status quo, but is mute about the individual ranking. For many ideologically charged policies such as income taxation, privacy protection, or hand-weapon regulation, the different political actors may favor different permanent status quos; hence, they may favor different protocols. A careful analysis of the negotiations over bargaining protocols and sunset provisions is left for future research, but one can conjecture that these negotiations may themselves create partisanship and lead to the inertia of the

[12] See Bikker and Vlaar (2007).

[13] Automatic sunset provisions are virtually absent at the federal level, though there are attempts in the U.S. Congress to pass The Federal Sunset Act which introduces automatic sunset legislation at the federal level. There exist, however, examples of endogenous sunset provisions at the federal level. For example, many of the provisions of the USA Patriot Act of 2001 had a four-year sunset clause, while the tax cuts authorized in the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003 had a ten- and five-year sunset clauses, respectively.

current rules.

6 N-player game

In this section, we extend the model to $N > 2$ players. Abusing notation, N will also refer to the set of players. For any generic parameter p, the bold symbol $\boldsymbol{p}$ now refers to the vector $(p_n)_{n \in N}$. The payoff of each player is given by (1), where $\left(\boldsymbol{\theta}^t\right)_{t \geq 1}$ follows a Markovian process on the finite state space S, with a probability density function f^S and a transition matrix π. In line with with Assumption 1, we assume that f^S satisfies no-preference-reversal: in all states, $\theta_1 \geq .. \geq \theta_N$ with probability one.

The game proceeds exactly as in the two-player game, but we allow for a broader class of voting rules. A voting rule is characterized by a pair of collections of coalitions (Ω_L, Ω_R), which determine the voting outcome as follows. If the status quo is L (R) in a given period, then it is replaced by R (L) only if the set of players who vote for R (L) in this period is an element of Ω_L (Ω_R). We impose the following conditions on the voting rules.

Definition *A voting rule is a pair of collection of coalitions $\Omega = (\Omega_L, \Omega_R)$ where for all $q \in \{L, R\}$, $\Omega_q \in 2^N$ satisfies the following conditions:*
(i) Monotonicity: if $C \in \Omega_q$ and $C \subseteq C'$, then $C' \in \Omega_q$),
(ii) Properness: if $C \in \Omega_q$, $N \setminus C \notin \Omega_q$
(iii) Nonemptyness: $\{1..N\} \in \Omega_q$
(iv) Joint properness: for all $n \in N$, if $\{1, ..., n\} \in \Omega_L$, then $\{n+1, ..., N\} \notin \Omega_R$, and if $\{1, ..., n\} \in \Omega_R$, then $\{n+1, ..., N\} \notin \Omega_L$.

Conditions (i) to (iii) are standard in the literature (see, e.g., Austen Smith and Banks 2000). Monotonicity ensures that adding a vote in favor of R does not change the outcome to L; properness ensures that the outcome of the vote is unique; nonemptyness ensures that the voting rule is Paretian. Condition (iv) assures that if a coalition can change the status quo, then the remaining players cannot reverse this change. Conditions $(i) - (iv)$ encompass majoritarian voting rules, but they do not exclude other nonunaimous, nonanonymous, and nonneutral voting rules.

The $N-$player game that uses the voting rule Ω and that starts in state s^0 with status quo q^0 is denoted $\Gamma^{en}_{q^0,s^0}(\Omega)$.

6.1 The equilibrium

Suppose that all players vote according to their current preferences θ^s_i. Then since $\theta_1 \geq .. \geq \theta_N$, if player n votes for R, then all players $i \leq n$ also vote for R. Conditions $(i) - (iv)$ imply then that there exists a player such that in a one-shot game R replaces L if an only if that players votes for R. Similarly, there exists a player such that in a one-shot game L replaces R if and only if this player votes for L. We will call these players pivotal. Formally:

Definition *The pivotal players for the voting rule Ω are (n_L, n_R) such that*

$$\begin{aligned} \{1, ..., n_L\} &\in \Omega_L \text{ and } \{1, ..., n_L - 1\} \notin \Omega_L, \\ \{n_R, ..., N\} &\in \Omega_R \text{ and } \{n_R + 1, ..., N\} \notin \Omega_R. \end{aligned}$$

Hence, n_q is the player whose support would be needed in a one-shot game to replace status quo q with the other alternative. Note that the uniqueness of n_L and n_R follows from conditions $(i) - (iii)$ in the above definition, and condition (iv) implies that $n_R \geq n_L$: the pivotal player to move to L is more rightist than the pivotal player to move to R.

The following proposition says that as in the two-player game, all players are partisan. Moreover, in equilibrium the behavior of the pivotal players determines uniquely the outcome: both pivotal players have to agree to move away from the status quo.

Proposition 7 *In all equilibria of $\Gamma^{en}_{q^0,s^0}(\Omega)$, the players use state dependent but status-quo independent cutoff strategies: there exists $\boldsymbol{c}^S \in \mathbb{R}^{N \times S}$ such that in state $s \in S$, player $n \in N$ votes for R if $\theta_n > c^s_n$ and for L if $\theta_n < c^s_n$. The equilibrium cutoffs are given by the fixed point of the mapping $\boldsymbol{H}^S$ defined as follows: for all $\boldsymbol{c}^S \in \mathbb{R}^{N \times S}$,*

$$H^s_n\left(\boldsymbol{c}^S\right) = \delta \sum_{s'} \pi\left(s, s'\right) \left(\int_{\boldsymbol{\theta} \in \mathbb{R}^N : \theta_{n_L} \leq c_{n_L} \text{ and } \theta_{n_R} \geq c_{n_R}} \left(c^{s'}_n - \theta_n\right) f^{s'}(\boldsymbol{\theta})\, d\boldsymbol{\theta} \right). \tag{5}$$

For all $s \in S$, $c^s_1 \leq .. \leq c^s_N$, so in any period, the status quo is changed if and only if players n_L and n_R vote for the other alternative. Moreover, for all $s \in S$, $c^s_{n_L} \leq 0 \leq c^s_{n_R}$. If additionally for all $i > j$, $\theta_i > \theta_j$ with strictly positive probability, then $c^s_{n_L} = c^s_{n_R} = 0$ in each $s \in S$ if and only if $n_L = n_H$.
The set of equilibrium cutoffs of the pivotal players $\left(c^s_{n_L}, c^s_{n_R}\right)$ is a complete lattice for the partial order $(\leq, \geq)^S$, and this order coincides with the Pareto order for these two players.

The proof of Proposition 7 proceeds by showing that since θ^t_n is increasing in n, partisanship is also monotonic in n, and hence the status quo changes if and only if voters n_R and n_L vote against it. Therefore, analyzing $\Gamma^{en}_{q^0,s^0}(\Omega)$ boils down to analyzing the 2-player game $\Gamma^{en}_{q^0,s^0}$ with the preference distribution $\left(\theta^t_{n_R}, \theta^t_{n_L}\right)$. Our previous results imply then that the pivotal voters are partisan in a direction that exacerbates their conflict of interests, $c^s_{n_L} \leq 0 \leq c^s_{n_R}$, and thus the endogeneity of the status quo increases the probability that they disagree.

It is worth pointing out, that partisanship disappears when $n_L = n_H$. This happens when one player is a dictator, but also under a simple majority, as under a simple majority, the median player is always pivotal. This means that the detrimental effect of the endogenous status quo identified in Section 5 disappears under simple majority. However, as we argue in more detail at the end of this section, in most modern democracies even if each legislative body uses simple majority, a system of check and balances creates two distinct pivotal players and our results follow.

6.2 Concentration of power, partisanship, and welfare

A natural question is how different voting rules affect the equilibrium behavior. In what follows, we will say that a rule has a greater concentration of power if a smaller set of voters is required to change the status quo. Formally:

Definition *The concentration of power under Ω is greater than under Ω' if $\Omega_L \subseteq \Omega'_L$ and $\Omega_R \subseteq \Omega'_R$.*

The following proposition compares rules with different concentration of power.

Proposition 8 *Let $\boldsymbol{c}^S(\Omega)$ denote the least partisan equilibrium cutoffs of $\Gamma^{en}_{q^0,s^0}(\Omega)$. If the concentration of power under Ω is greater than under Ω', then for all $s \in S$,*

$$c^s_{n'_L}(\Omega') \leq c^s_{n'_L}(\Omega) \leq c^s_{n_L}(\Omega) \leq 0 \leq c^s_{n_R}(\Omega) \leq c^s_{n'_R}(\Omega) \leq c^s_{n'_R}(\Omega'), \tag{6}$$

where (n_L, n_R) and (n'_L, n'_R) are the pivotal players under Ω and Ω', respectively.

The intuition behind Proposition 8 is as follows. A dispersion of power makes more extreme players pivotal:

$$n'_L \leq n_L \leq n_R \leq n'_R.$$

This has two consequences: from Proposition 8, we know that for a given voting rule Ω, more extreme players are more partisan, which explains the four inner inequalities in (6). But since the players determining the policy are now n'_L and n'_R instead of n_L and n_R, their disagreement is more likely than the disagreement of n_L and n_R, which increases the inertia of the status quo, and thus the partisanship of the players. This effect explains the two outer inequalities in (6). Hence, a dispersion of power increases status quo inertia not only because more players have to agree, but also because the pivotal players become more partisan.

The impact of the dispersion of power on utilitarian welfare, however, is ambiguous. The fact that it increases partisanship is clearly detrimental. However, players whose preferences are closer to the players pivotal under a less concentrated rule may benefit from the fact that the change from the status quo is determined by someone more similar to these players. This beneficial effect is absent for the initial pivotal players; hence, the dispersion of power is clearly detrimental to them. And if the pivotal players are representative of the society, then the dispersion of power is socially detrimental. This is formalized by the proposition and the corollary below.

Proposition 9 *If the concentration of power under Ω is greater than under Ω', then both pivotal players under Ω are better off under Ω than under Ω'.*

Corollary 2 *For all $\alpha \in \left]\frac{1}{2}, 1\right]$, let Ω^{α} be the α-supermajority rule, i.e.,*

$$\Omega_L^M = \Omega_L^M = \{C \subseteq N : |C| \geq \alpha N\}.$$

If for all $n \in N$, and all $s \in S$, $\theta_n^s = \bar{\theta}_n^s + \varepsilon^s$, where $\left(\bar{\theta}_n^s\right)_{n \in N} \in \mathbb{R}^N$ (the profile of ideology) is symmetrically distributed; that is, for all $n \in N$, $\bar{\theta}_n^s + \bar{\theta}_{N+1-n}^s$ is independent of n, and ε^s (the common shock) is a random variable, then the utilitarian social welfare under Ω^{α} is decreasing in α.

Propositions 8 and 9 have important consequences for constitutional design. As already argued by Thomas Jefferson (The Letters of Thomas Jefferson, To James Madison, Sept. 6. 1789), there exists no modern democracy in which a single decision maker is pivotal in every decision, even when majority rule is used at all stages of the decision process. For instance, short of a strong party discipline and a sufficient majority in both chambers, bicameralism implies the existence of two distinct pivotal voters. Moreover, in most countries, majoritarian decision making is complemented by other rules and institutions, such as the presidential veto power, judicial review by the constitutional court, the possibility of public initiative, not to mention supramajoritarian requirement such as the filibuster tradition in the U.S. Congress. It is widely assumed that check and balances that increase the dispersion of power tend to increase inertia in the legislative process. Our model shows that when check and balances are used to set continuing policies, they create partisanship. This partisanship further exacerbates their inertial effect, which may be socially detrimental.

Another way to interpret our results is to say that checks and balances need to be complemented by using the protocol of the exogenous status quo or sunset provisions in order to disperse the power without leading the legislative process to a gridlock.

These results contrast with the literature on majoritarian incentives with distributive policies. As Buchanan and Tullock (1962) and Riker (1962) first argued, majoritarian institutions allow the concentration of benefits and the collectivization of costs, and thus lead to the adoption of inefficient pork-barrel programs, more so the lower the supermajority requirement.[14] The reason why our model generates opposite welfare results is that the literature on pork barrel politics focuses on targeted spending programs—which are a small fraction of the U.S. federal budget— in static environments while we focus instead on entitlement programs and other continuing policies—which represents more than half of the federal budget and the majority of the legislative production of the congress—in changing environments.

6.3 Biased voting rules

It is not uncommon for a voting rule to require an approval of a larger set of voters to change the status quo in one direction. An example of such a rule is the U.S. budget process. This process is governed by the Congressional Budget Act, which prevents the use of the filibuster against the budget resolutions. At the same time, the Byrd Rule, which was adopted in 1985 and amended in 1990, modifies the Congressional Budget Act to allow the use of filibuster against any provision that would increase the deficit for a fiscal year beyond those covered by the reconciliation measure. Byrd Rule effectively requires a higher majority to raise the budget deficit than to lower it, and curtailing the latter was one of its rationales. However, the consequences of this rule may be unintended. The democrats may be unwilling to reduce the budget deficit in good times, realizing that it will be very difficult to increase it in the future. As a result, deficit reduction may become more difficult than if filibuster were allowed for all or none of the budget resolutions. The example below demonstrates such possibility.

Example 2 *Let* $|S| = 1$ *and* $N = 3$. *Let* $\theta_i = \bar{\theta}_i + \varepsilon$, *with* $\bar{\theta}_1 > \bar{\theta}_2 > \bar{\theta}_3$ *and* $\varepsilon \sim N(0, 1)$. *Consider two voting rules. Under the simple majority rule, a policy replaces the status quo if it is approved by two players. Under the* $R-$*biased rule, a simple majority is needed to replace* L, *and unanimity is required to replace* R.

Using the definition of pivotal players from above, it is easy to see that under the simple majority rule, player 2 *is always pivotal. Under the* $R-$*biased rule, player* 2 *is pivotal to approve the change to* R *and player* 1 *is pivotal to approve the change to* L. *In a one-shot game, players would vote according to their preferences under both rules. Hence, under simple majority,* L *would be implemented if* $\varepsilon < -\bar{\theta}_2$. *Under the* $R-$*biased rule,* L *would stay*

[14] Ferejohn, Fiorina, and McKelvey (1987) and Baron (1991) first formalized this prediction in models of legislative bargaining.

in place if $\varepsilon < -\bar{\theta}_2$, while L would replace R if $\varepsilon < -\bar{\theta}_1$. Hence, L would be implemented less often, and in this sense the R−biased rule favors R.

Proposition 7 says that under simple majority players vote like in the one-shot game, but under the R−biased rule they are partisan. Hence, under the latter, L stays in place when $\varepsilon < c_2 - \bar{\theta}_2$, while L replaces R when $\varepsilon < c_1 - \bar{\theta}_1$. Since from Proposition 7 $c_2 > 0 > c_1$, compared to the simple majority rule, L is implemented less often, but stays in place more often. The latter effect may dominate if players' partisanship is strong. Assume that $\bar{\theta}_3 = 0.3$ and $\delta = 0.9$. We show numerically that indeed for $\bar{\theta}_2 \leq -0.5$, the long-run probability of L being implemented is higher under the R−biased rule. For example, when $\bar{\theta}_2 = -0.5$, then in the long run the probability that L is implemented under the majority rule is 0.69. *The R−biased rule would decrease this probability to* 0.55 *in a one-shot game. In equilibrium under the R−biased rule, however, the probability is* 0.9996.

7 More general preference distribution

We discuss now how the results of Section 4 extend when we relax Assumption 1 about no preference reversal. That is, we assume that f^S can have full support. Note that Proposition 1 was derived without Assumption 1, so for any f^S players use cutoff strategies in any equilibrium.[15]

First, observe that the partisanship generated by the endogeneity of the status quo is a rule, not an exception. From Proposition 1, an equilibrium with zero cutoffs (i.e., $c_i^s = c_j^s = 0$ for all s) exists if and only if for all $s \in S$,

$$\sum_{s' \in S} \pi(s, s') \left(\int_{-\infty}^{0} \int_{0}^{\infty} \boldsymbol{\theta} f^{s'}(\boldsymbol{\theta})\, d\theta_i d\theta_j + \int_{0}^{\infty} \int_{-\infty}^{0} \boldsymbol{\theta} f^{s'}(\boldsymbol{\theta})\, d\theta_i d\theta_j \right) = (0, 0). \tag{7}$$

Hence, save for nongeneric cases, players will be partisan, unless conditional on their current preferences disagreeing they are indifferent between the two alternatives in all states. Clearly, condition (7) is satisfied only in special cases. For instance, if $|S| = 1$ and the distribution of $\boldsymbol{\theta}$ is bivariate normal, condition (7) holds if and only if $\bar{\boldsymbol{\theta}} = (0, 0)$.[16]

Second, the polarizing and inertial effect of the endogeneity of the status quo are robust phenomena. As shown in the appendix, Proposition 4 part b) holds for any f^S: even if we allow for preference reversal, more polarized players are more partisan. Proposition 5 also

[15] For more extensive analysis of the general preference distributions see Dziuda and Loeper (2010).

[16] For the formal proof, see Dziuda and Loeper (2010, Example 5 in the appendix). In that paper, we also showed (see Example 1) that the symmetry of the preference distribution across players and the symmetry of the marginal distribution of each player's preferences across alternatives is not a sufficient condition for (7) to hold.

holds unchanged: the endogenous status quo can lead patient players to a complete gridlock.

The main change in the analysis is the determination of the sign of the equilibrium cutoffs. Since one cannot order players' preferences, Proposition 2 does not extend automatically. Moreover, as we shall see in Example 3 below, the signs of the cutoffs may even change across equilibria. Proposition 10 below states, however, that if one player is rightist and the other is leftist in a sense defined below, then there exists an intuitive equilibrium in which the former is partisan for R and the latter is partisan for L. Proposition 10 provides also a reason for focusing on the intuitive equilibria.

To state these results formally, let us introduce some notations: let $\Gamma^{en}_{q^0,s^0}(t)$ denote the finite horizon game which proceeds as $\Gamma^{en}_{q^0,s^0}$ but ends after t periods. As Shown in Dziuda and Loeper (2010), this game admits a unique stage-undominated equilibrium, which is in cutoff strategies, and we shall denote by $\boldsymbol{c}^S(t)$ the equilibrium cutoffs in period t. The definition below links player's ideological position to her preferences over the status quo in absence of partisanship. For example, if $H^s_k(0,...,0) < 0$, the player k prefers R in case of disagreement in state s and hence is a rightist in state s. Formally:

Definition *Player k is rightist (leftist) in all states if $H^s_k(0,...,0) \leq 0$ (≥ 0) for all $s \in S$.*

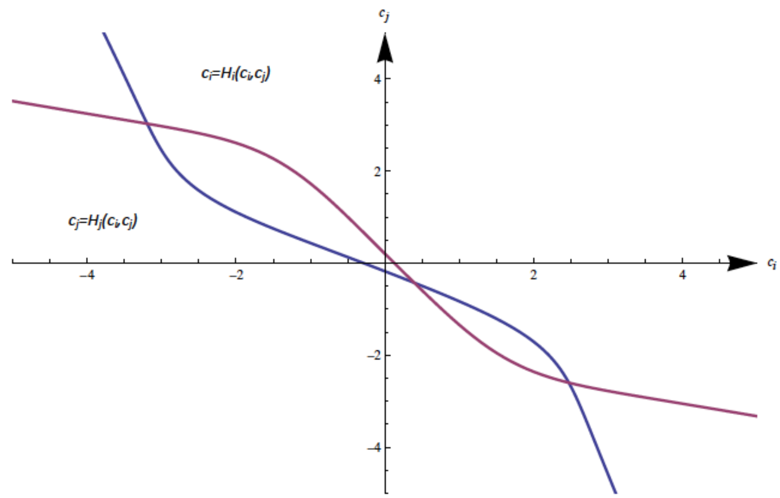
We can now state the proposition.

Proposition 10 *Assume that f^S is such that player i is rightist and player j is leftist in all $s \in S$. Then, there exists equilibria $\boldsymbol{c}^S$ such that $\boldsymbol{c}^S(\leq,\geq)^S\,\mathbf{0}^S$. The set of such equilibria forms a complete lattice for the order $(\leq,\geq)^S$. The least partisan of these equilibria in the order $(\leq,\geq)^S$, is equal to $\lim_{t\to\infty}\boldsymbol{c}^S(t)$. The comparative statics in Proposition 4 hold for that equilibrium selection.*

If the condition from Proposition 10 does not hold, general results are more elusive. To understand why, consider $|S| = 1$ and $H_i(0,0) > 0$ and $H_j(0,0) > 0$. In that case, the players' expected preferences conditional on disagreement are congruent: they both prefer L to be the status quo. Hence, one could conjecture that the game has an equilibrium in which both players are partisan for L. However, this might not be true. If i votes often for L, then the disagreement in which i prefers R and j prefers L happens rarely. The reverse disagreement may be more likely, so j may prefer to defend R as the status quo. As a result, j may end up partisan for R.

One could conjecture that allowing for preference reversal should decrease partisanship, as no player can be sure which alternative she will prefer when players' disagree. This is not necessarily true, however, as the following example demonstrates.

Example 3 *Suppose that $|S| = 1$ and $\theta_i = \bar{\theta}_i + \varepsilon_i$ and $\theta_j = \bar{\theta}_j + \varepsilon_j$. Let ε_i and ε_j be i.i.d. with ε_k drawn from $N(0,1)$ with probability $\frac{1}{2}$ and from $N(0,10)$ with the remaining probability. The figure below depicts the fixed point of $\boldsymbol{H}$ for $\bar{\theta}_i = -\bar{\theta}_j = 0.1$ and shows that $\Gamma^{en}_{q^0}$ has two equilibria with $c_i > 0 > c_j$ and one with $c_i < 0 < c_j$.*



Proposition 2 says that the equilibrium with $c_i < 0 < c_j$ is the limit of the finite horizon game. In that equilibrium $c_i = -c_j = -3.2$. If we assumed that ε_i and ε_j were perfectly correlated instead with the same marginal distribution as above, then $c_i = -c_j = 0.00036$. Hence, allowing for preference reversal can have a dramatic effect on partisanship. Moreover, as $\bar{\theta}_i = -\bar{\theta}_j \to 0$, all three equilibria characterized in the case of $\bar{\theta}_i = -\bar{\theta}_j = 0.1$ still exists. Only in the middle one players' partisanship vanishes, but as argued in Proposition 10, the equilibrium in which $c_i < 0 < c_j$ is the most plausible. Hence, preference reversal can cause arbitrarily similar players to be very partisan for opposite alternatives and behave as if their interest were highly discordant.[17]

Allowing for preference reversal complicates the equilibrium welfare comparison between the exogenous and endogenous status quo. The reason is that besides the two effects of partisanship on welfare outlined in Section 5, a third beneficial effect arises. A partisan player, while voting for her preferred status quo, may defer to her opponent's preferences: if $c_i < \theta_i < 0 < \theta_j$, player i will vote for the alternative preferred by player j. This may be socially beneficial if the opponent's preferences are relatively more intense. In Dziuda and

[17] This phenomenon cannot occur in the case of no preference reversal: for $|S| = 1$ and for any sequence of preference distribution $\left(\boldsymbol{\theta}^k\right)_{k\geq 1}$ such that $\bar{\boldsymbol{\theta}}_i^k - \bar{\boldsymbol{\theta}}_j^k$ tends to 0, all equilibrium thresholds tend to $(0,0)$. To see this, observe that since $\theta_i^k - \theta_j^k > 0$ with probability 1, $E\left(\left|\boldsymbol{\theta}_i^k - \boldsymbol{\theta}_j^k\right|\right)$ must tend to 0. So $\left|H_i^k - H_j^k\right|$ tends to 0 uniformly over $\mathbb{R}^2$. Using proposition 2, the fixed point of $\boldsymbol{H}$ must all tend to $(0,0)$.

Loeper 2010 (Proposition 7) we show that under some regularity conditions which basically require that the probability of a preference reversal is not too large, the welfare results in Proposition 6 hold.

8 Conclusion

Negotiations in a changing environment with an endogenous default option are at the center of many economically relevant situations. They present the negotiating parties with a fundamental trade-off between responding to the current environment and securing a favorable bargaining position for the future. In this paper, we show that this trade-off has a detrimental impact on the efficiency of agreements and their responsiveness to political and economic shocks. Bundling the vote on today's policy and tomorrow's status quo exacerbates the players' conflict of interest and increases the probability of a disagreement, which in turn increases status quo inertia. Even if some agreements are commonly known to be mutually beneficial, they may not be adopted.

Our paper sheds light on the effect of some important rules governing legislative institutions: we provide a new argument in favor of sunset provisions and we show that a supermajority requirement exacerbates the detrimental impact of an endogenous default on the responsiveness of the policies to the environment.

This parsimonious model lends itself to many extensions. First, adding transfers—interpreted as pork-barrel spending—to the $N-$player model would allow us to analyze the trade-off between their positive role as a lubricant for passing efficient policies and the perverse incentives they generate to concentrate benefits and collectivize cost. Such a model would reasonably approximate the U.S. budget process, which distinguishes between two expenditure categories: discretionary spending and direct spending. The former requires an annual appropriation bill while the latter is continuing in nature. The model, hence, could shed also some light on the evolution of these two types of spending over time.

Second, by enriching the policy space one could analyze whether the evolving environment can make inefficient compromises persistent. Third, in many situations, implemented policies affect the future state of the economy, which introduces an additional dynamic linkage. For example, an expansionary fiscal policy increases public debt, leading all players to adopt a more fiscally conservative stand in the future. Technically, this amounts to introducing a state variable in the model. And finally, one could introduce elections to see whether strategic delegation would exacerbate or mitigate the partisanship of the legislature.

9 Appendix

Throughout the appendix, we will use the following notations:

Notation 1 *For any preference distribution f^S, all $\delta \in [0,1]$, all $s \in S$, and all $\boldsymbol{c}^S \in \mathbb{R}^{2S}$, we denote by $\boldsymbol{G}^s(\delta, f^s, \boldsymbol{c})$ the map defined by:*

$$\boldsymbol{G}^s(\delta, f^s, \boldsymbol{c}^s) = \delta\left(\int_{-\infty}^{c_j^s}\int_{c_i^s}^{\infty}(\boldsymbol{c}^s - \boldsymbol{\theta}) f^s(\boldsymbol{\theta})\, d\theta_i d\theta_j + \int_{c_j^s}^{\infty}\int_{-\infty}^{c_i^s}(\boldsymbol{c}^s - \boldsymbol{\theta}) f^s(\boldsymbol{\theta})\, d\theta_i d\theta_j\right). \quad (8)$$

We denote by $\boldsymbol{H}^s(\delta, f^S, \boldsymbol{c}^S)$ the map defined by:

$$\boldsymbol{H}^s(\delta, f^S, \boldsymbol{c}^S) = \sum_{s' \in S}\pi(s, s')\, \boldsymbol{G}^{s'}\left(\delta, f^{s'}, \boldsymbol{c}^{s'}\right). \quad (9)$$

We denote by $\boldsymbol{c}^S(\delta, f^S)$ the smallest fixed point of $\boldsymbol{H}^S(\delta, f^S, \boldsymbol{c}^S)$ for the order $(\leq, \geq)^S$, when it exists. Finally, $\mathbf{0}$ and $\mathbf{0}^S$ are the null element of $\mathbb{R}^2$ and $\mathbb{R}^{2S}$, respectively.

The map $\boldsymbol{H}^S(\delta, f^S, \boldsymbol{c}^S)$ is simply the map $\boldsymbol{H}^S(\boldsymbol{c}^S)$ defined in the main text in (4) with an explicit reference to the preference distribution f^S and discount factor δ. The next two lemmas derive important properties of $\boldsymbol{H}^S$.

Lemma 1 *Using the conventions of Notation 1, for all $s \in S$, all $\boldsymbol{c}^s \in \mathbb{R}^2$, and all $k \neq k'$,*

$$0 \leq \frac{\partial G_k^s(\delta, f^s, \boldsymbol{c}^s)}{\partial c_k} \leq \delta, \text{ and } \frac{\partial G_k^s(\delta, f^s, \boldsymbol{c}^s)}{\partial c_{k'}} \leq 0,$$

and if g^S is more polarized than f^S (see definition),

$$G_i^s(\delta, f^s, \boldsymbol{c}) \leq G_i^s(\delta, g^s, \boldsymbol{c}) \text{ and } G_j^s(\delta, f^s, \boldsymbol{c}) \geq G_j^s(\delta, g^s, \boldsymbol{c}).$$

Proof. Using the Leibnitz integral rule on (8), we get

$$\begin{aligned}
\frac{\partial G_i^s(\delta, f^s, \boldsymbol{c}^s)}{\partial c_i} &= \delta\left(\int_{-\infty}^{c_j^s}\int_{c_i^s}^{\infty} f^s(\boldsymbol{\theta})\, d\theta_i d\theta_j + \int_{c_j^s}^{\infty}\int_{-\infty}^{c_i^s} f^s(\boldsymbol{\theta})\, d\theta_i d\theta_j\right), \\
\frac{\partial G_i^s(\delta, f^s, \boldsymbol{c}^s)}{\partial c_i} &= -\delta\int_{-\infty}^{+\infty}|\theta_i - c_i|\, f^s(\theta_i, c_j)\, d\theta_i,
\end{aligned}$$

which proves the first part.

To prove the second part, for all $s \in S$, using the notations of definition , let us denote by f_α^s the probability density function of the random variable $\theta^s + \alpha\varepsilon^s$. Therefore, $f_0^s = f^s$

and $f_1^s = g^s$. Moreover, if we denote by h^s the joint probability density function of θ^s and ε^s,

$$G_i^s\left(\delta, f_\alpha^s, \boldsymbol{c}^s\right) = \delta\left(\begin{array}{c} \int_{\boldsymbol{\theta}} \int_{-\infty}^{\frac{c_j-\theta_j}{\alpha}} \int_{\frac{c_i-\theta_i}{\alpha}}^{\infty} \left(c_i - \theta_i - \alpha\varepsilon_i\right) h^s\left(\boldsymbol{\theta}, \boldsymbol{\varepsilon}\right) d\varepsilon_i d\varepsilon_j d\theta_i d\theta_j \\ + \int_{\frac{c_j-\theta_j}{\alpha}}^{\infty} \int_{-\infty}^{\frac{c_i-\theta_i}{\alpha}} \left(c_i - \theta_i - \alpha\varepsilon_i\right) h^s\left(\boldsymbol{\theta}, \boldsymbol{\varepsilon}\right) d\varepsilon_i d\varepsilon_j d\theta_i d\theta_j \end{array}\right),$$

so using the Leibnitz integral rule, we obtain

$$\begin{aligned} \frac{\partial G_i^s\left(\delta, f_\alpha^s, \boldsymbol{c}^s\right)}{\partial \alpha} &= -\int_{\boldsymbol{\theta}} \int_{\boldsymbol{\varepsilon} \in \left]-\infty, \frac{c_i-\theta_i}{\alpha}\right[\times \left]\frac{c_j-\theta_j}{\alpha}, +\infty\right[\cup \left]-\infty, \frac{c_i-\theta_i}{\alpha}\right[\times \left]\frac{c_j-\theta_j}{\alpha}, +\infty\right[} \varepsilon_i^s h^s\left(\boldsymbol{\theta}, \boldsymbol{\varepsilon}\right) d\varepsilon_i d\varepsilon_j d\theta_i d\theta_j \\ &\quad - \int_{\boldsymbol{\theta}} \int_{\frac{c_i-\theta_i}{\alpha}}^{\infty} \frac{c_j - \theta_j}{\alpha^2} \left(c_i - \theta_i - \alpha\varepsilon_i\right) h^s\left(\boldsymbol{\theta}, \varepsilon_i, \varepsilon_j = \frac{c_j - \theta_j}{\alpha}\right) d\varepsilon_i d\theta_i d\theta_j \\ &\quad + \int_{\boldsymbol{\theta}} \int_{-\infty}^{\frac{c_i-\theta_i}{\alpha}} \frac{c_j - \theta_j}{\alpha^2} \left(c_i - \theta_i - \alpha\varepsilon_i\right) f^s\left(\boldsymbol{\theta}, \varepsilon_i, \varepsilon_j = \frac{c_j - \theta_j}{\alpha}\right) d\varepsilon_i d\theta_i d\theta_j \\ &= -\int_{\boldsymbol{\theta}} \int_{\boldsymbol{\varepsilon} \in \left]-\infty, \frac{c_i-\theta_i}{\alpha}\right[\times \left]\frac{c_j-\theta_j}{\alpha}, +\infty\right[\cup \left]-\infty, \frac{c_i-\theta_i}{\alpha}\right[\times \left]\frac{c_j-\theta_j}{\alpha}, +\infty\right[} \varepsilon_i^s h^s\left(\boldsymbol{\theta}, \boldsymbol{\varepsilon}\right) d\varepsilon_i d\varepsilon_j d\theta_i d\theta_j \qquad (10) \\ &\quad + \int_{\boldsymbol{\theta}} \left(\int_{-\infty}^{\infty} \frac{c_j - \theta_j}{\alpha^2} \left|c_i - \theta_i - \alpha\varepsilon_i\right| f^s\left(\boldsymbol{\theta}, \varepsilon_i, \varepsilon_j = \frac{c_j - \theta_j}{\alpha}\right) d\varepsilon_i\right) d\theta_i d\theta_j \qquad (11) \end{aligned}$$

By assumption, $\varepsilon_i \geq 0$ with probability 1, so (10) is negative, and $\varepsilon_j \leq 0$ with probability 1, so (11) is negative also. Therefore, $G_i^s\left(\delta, f_0^s, \boldsymbol{c}^s\right) \leq G_i^s\left(\delta, f_1^s, \boldsymbol{c}^s\right)$. A similar arguments shows that $G_j^s\left(\delta, f_0^s, \boldsymbol{c}^s\right) \geq G_j^s\left(\delta, f_1^s, \boldsymbol{c}^s\right)$. ■

Lemma 2 *Using the conventions of Notation 1, $\boldsymbol{H}^S\left(\delta, f^S, \boldsymbol{c}^S\right)$ is isotone in $\boldsymbol{c}^S$ the order $\left(\leq, \geq\right)^S$, and for all $k \in \{i, j\}$, $H_k^S\left(\delta, f^S, \boldsymbol{c}^S\right)$ is δ-Lipschitz continuous in c_k^S for the* sup *norm on $\mathbb{R}^S$. If we denote the set $\left(\left[-\frac{\delta\|\theta\|}{1-\delta}, \frac{\delta\|\theta\|}{1-\delta}\right]^2\right)^S$ by A, where $\|\theta\|$ is $\max_{s \in S, k \in \{i,j\}} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} |\theta_k| f^s(\boldsymbol{\theta}) d\boldsymbol{\theta}$, then all fixed points $\boldsymbol{c}^S$ of $\boldsymbol{H}^S\left(\delta, f^S, \boldsymbol{c}^s\right)$ are in A and $\boldsymbol{H}^S(A) \subseteq A$.*

Proof. That $\boldsymbol{H}^S\left(\delta, f^S, \boldsymbol{c}^S\right)$ is isotone is immediate from Lemma 1 and (9).

To show Lipschitz continuity, from (9), for all $s, s' \in S$, $\partial H_k^s / \partial c_k^{s'} = \pi(s, s') \partial G_k^{s'} / \partial c_k^{s'}$, so from lemma 1, $\sum_{s'} \left|\partial H_k^s / \partial c_k^{s'}\right| < \delta \sum_{s'} \pi(s, s') < \delta$.

To show the last point, for all $\boldsymbol{c}^S \in \mathbb{R}^{2S}$, let us denote $\max_{s \in S, k \in \{i,j\}} c_k^s$ by $\left\|c^S\right\|$. From (8), we see that for all $\boldsymbol{c} \in \mathbb{R}^2$ and all $s \in S$, $\left|G_k^s\left(\delta, f^S \boldsymbol{c}\right)\right|$ is bounded by $\delta\left(\|\theta\| + |c_k|\right)$, so from (9), $\left|H_k^s\left(\delta, f^S, \boldsymbol{c}^S\right)\right|$ is bounded by $\delta\left(\|\theta\| + \left\|c^S\right\|\right)$. Therefore, for all $\boldsymbol{c}^S \in A$,

$$\left|H_k^s\left(\delta, f^S, \boldsymbol{c}^S\right)\right| \leq \delta\left(\|\theta\| + \frac{\delta\|\theta\|}{1-\delta}\right) = \frac{\delta\|\theta\|}{1-\delta}$$

so $\boldsymbol{H}^S\left(\delta, f^S, \boldsymbol{c}^S\right) \in A$. If $\boldsymbol{c}^S$ is a fixed point of $\boldsymbol{H}^S$, $\left\|c^S\right\| \leq \delta\left(\|\theta\| + \left\|c^S\right\|\right)$, which implies that $\boldsymbol{c}^S \in A$. ■

Definition *In the game* $\Gamma^{en}_{q^0,s^0}$*, a stationary strategy* σ^S_k *is an element of* $[0,1]^{S\times\{R,L\}\times\mathbb{R}^2}$ *where for all* $s \in S$*,* $q \in \{R,L\}$ *and* $\boldsymbol{\theta} \in \mathbb{R}^2$*,* $\sigma^S_k(q,\boldsymbol{\theta})$ *is the probability that player* k *votes for* R *in any period* t *in which the current state is* s*, the status quo is* q*, and the preference realization is* $\boldsymbol{\theta}$*.*[18]

The next two lemmas characterize properties of the best response correspondence of the game $\Gamma^{en}_{q^0,s^0}$ which are key to characterizing its equilibria.

Lemma 3 *Let* σ^S_j *be a stationary strategy of player* j *in the game* $\Gamma^{en}_{q^0,s^0}$ *(see Definition).*

- *There exists a unique cutoff strategy for player* i *that is a best response to* σ^S_j*.*
- *This cutoff strategy is also the unique stage-undominated one given* σ^S_j*.*
- *These voting cutoffs are stationary and independent of the current status quo.*
- *Any other best response to* σ^S_j *must yield the same continuation value as this cutoff strategy.*
- *If we denote* c^S_i *this cutoff strategy and* $V^s_i(q)$ *the continuation value at the strategy profile* $\left(c^S_i, \sigma^S_j\right)$ *for player* i *at the beginning of a period in which the status quo is* $q \in \{R,L\}$*, the previous state was* $s \in S$*, but the current state and preferences have not been realized, then*
$$c^s_i = \frac{\delta}{2}\left(V^s_i(L) - V^s_i(R)\right). \tag{12}$$
- *The same results hold by switching the role of* i *and* j*.*

Proof. That $V^s_i(q)$ is stationary and the same in any best response σ_i to σ^S_j is a straightforward consequence of the stationarity of σ^S_j and the fact that player i is best responding.

Now let σ_i be a best response to σ^S_j (not necessarily stationary). For any history leading to period t, player i cannot do better than voting for the alternative that gives him the greatest intertemporal payoff from date t onward. So if the state and preferences in that period are s and θ_i, player i cannot do better than voting for R when

$$\theta_i + \delta V^s_i(R) > -\theta_i + \delta V^s_i(L), \tag{13}$$

and for L when the reverse inequality holds. Therefore, given the continuation play prescribed by $\left(\sigma_i, \sigma^S_j\right)$, an optimal action in period t is to use a voting cutoff is given by (13)

[18] If players do not know each other's preferences, $\sigma^S_k(q,.)$ is a function of θ_k only.

and since we have assumed that the marginal distribution of θ_i has full support in every state s, any other voting cutoff in that period would not be optimal. For the same reason, any undominated action of the stage game induced by the continuation value $V_i^s(.)$ should also be a cutoff strategy and should satisfy (13).

To complete the proof, observe that since changing the best response strategy σ_i in period t as described above should not change the continuation value before period t, by doing so in every period, we obtain a status quo independent, stationary cutoff strategy which is a best response to σ_j^S. Since any other best response cutoff strategy, or any stage undominated strategy would yield the same continuation value, and since such strategies must satisfy (13) in every period, they must coincide with the strategy we have constructed. ■

Lemma 4 *If player j plays a stationary, status quo independent cutoff strategy $c_j^S \in \mathbb{R}^S$, then the optimal cutoff strategy of player i is the unique solution of $c_i^S = H_i\left(c_i^S, c_j^S\right)$. The same results hold by switching the role of i and j.*

Proof. Suppose that player j plays a stationary, status quo independent cutoff strategy c_j^S, and let c_i^S be the best response of player i characterized in Lemma 3. Since the status quo in a given period affects the payoffs only when players vote for opposite alternatives in that period, we have that for all $s \in S$,

$$V_i^s(L)-V_i^s(R) = \delta \sum_{s'\in S} \pi(s,s') \left(\begin{array}{c} \int_{-\infty}^{c_j^{s'}} \int_{c_i^{s'}}^{\infty} \left(-\theta_i + \delta V_i^{s'}(L) - \left(\theta_i + \delta V_i^{s'}(R)\right)\right) f^{s'}(\boldsymbol{\theta})\, d\theta_i d\theta_j \\ + \int_{c_j^{s'}}^{\infty} \int_{-\infty}^{c_i^{s'}} \left(-\theta_i + \delta V_i^{s'}(L) - \left(\theta_i + \delta V_i^{s'}(R)\right)\right) f^{s'}(\boldsymbol{\theta})\, d\theta_i d\theta_j \end{array} \right). \tag{14}$$

Substituting (12) on both sides of (14), we get $c_i^S = H_i\left(c_i^S, c_j^S\right)$, which is simply the Bellman equation of the maximization problem of player i. From lemma 2 and the Banach fixed point theorem, this equation has a unique solution in c_i^S, so this solution must be the the best response we are looking for. ■

Lemma 5 *Let $\sigma_j^{S,n}$ be a sequence of totally mixed stationary strategy*[19] *for player j in the game Γ_q^{en} which tends to some σ_j^S (in the sense of the uniform convergence on $[0,1]^{S\times\{R,L\}\times\mathbb{R}^2}$, see Definition), and let $\sigma_i^{S,n}$ be a sequence of stationary best response to $\sigma_j^{S,n}$, then $\sigma_i^{S,n}$ tends to the best response cutoff strategy c_i^S characterized in Lemma 3.*

Proof. From Lemma 3, if $V_i^{S,n}$ are the continuation values of player i at the strategy profile $\left(\sigma_i^{S,n}, \sigma_j^{S,n}\right)$, $V_i^{S,n}$ are also the continuation values of player i at the strategy profile $\left(c_i^{S,n}, \sigma_j^{S,n}\right)$ where $c_i^{S,n}$ is the unique cutoff best response to $\sigma_j^{S,n}$. Moreover, it should be

[19] A stationary strategy σ_k^S is totally mixed if for all $s \in S$, $q \in \{R, L\}$, and $\boldsymbol{\theta} \in \mathbb{R}^2$, $0 < \sigma_k^S(q,\boldsymbol{\theta}) < 1$.

clear that since $\sigma_j^{S,n}$ is totally mixed, player i is always pivotal with a positive probability, so $\sigma_i^{S,n}$ can only be the cutoff strategy $c_i^{S,n}$.

Since $\sigma_j^{S,n}$ tends to σ_j^S and since player i is best responding, the maximum theorem on the (compact) space of cutoff strategies implies that $V_i^{S,n}$ must tend to the continuation values V_i^S given by the strategy profile $\left(c_i^S, \sigma_j^S\right)$. From (12), this implies that $c_i^{S,n}$ tends towards c_i^S. ■

Proof of proposition 1. From Lemma 3, stationary, stage undominated equilibria must be cutoff strategies. From Lemma 4, the equilibrium cutoffs are given by the fixed points of the map H. Using the notations of Lemma 2, A is a complete lattice for the order $(\leq,\geq)^S$, so Lemma 2 together with Tarski's fixed point theorem imply that the set of fixed points of the restriction of $\boldsymbol{H}^S$ on A (and hence the set of fixed points of $\boldsymbol{H}^S$ on $\mathbb{R}^{2S}$) is a complete lattice in the order $(\leq,\geq)^S$. ■

Proof of Propostion 2.

If f^S satisfies Assumption 1, for all $\boldsymbol{c} \in \mathbb{R}^2$, and all $s \in S$, $G_i^s\left(\delta, f^S, \boldsymbol{c}\right) - \delta c_i^s \leq G_j^s\left(\delta, f^S, \boldsymbol{c}\right) - \delta c_j^s$, so

$$H_i^s\left(\delta, f^S, \boldsymbol{c}\right) - \delta \sum_{s' \in S} \pi\left(s, s'\right) c_i^{s'} \leq H_j^s\left(\delta, f^S, \boldsymbol{c}\right) - \delta \sum_{s' \in S} \pi\left(s, s'\right) c_j^{s'}.$$

If $\boldsymbol{c}^S$ is an equilibrium, from Proposition 1, it is a fixed point of $\boldsymbol{H}^S$, so for all $s \in S$,

$$c_i^s - \delta \sum_{s' \in S} \pi\left(s, s'\right) c_i^{s'} \leq c_j^s - \delta \sum_{s' \in S} \pi\left(s, s'\right) c_j^{s'},$$

which, in matrix form, can be rewritten as $(I - \delta\pi)(c_i - c_j) \leq 0$ where I is the $|S| \times |S|$ identity matrix and $\leq$ is the product order on $\mathbb{R}^{|S|}$. The inverse of the matrix $I - \delta\pi$ is $\sum_{n\geq 0} \delta^n \pi^n$, which has all its entries positive. Therefore, $(I - \delta\pi)(c_i - c_j) \leq 0$ implies that $(c_i - c_j) \leq 0$, that is, for all s, $c_i^s \leq c_j^s$. Therefore, the event $\theta_i \leq c_i^s$ and $\theta_j \geq c_j^s$ has probability 0, so when players vote for opposite alternatives, player i always votes for R while player j always votes for L. From (12), this means that when players' intertemporal preferences disagree, player i always prefer R while player j always prefer L. Since the status quo matters only in case of disagreement, in any period, player i prefers status quo R while player j prefers status quo L, which means that for all $s \in S$, $c_i^s \leq 0 \leq c_j^s$. ■

The following lemma shows that under Assumption 1, if a player's best response is partisan for R, then she is better-off whenever her opponent votes less often for L.

Lemma 6 *Let σ_j^S and $\sigma_j'^S$ be two stationary strategy of player j (see definition), and let c_i^S be the best response cutoff strategy to σ_j^S (see Lemma 3). If Assumption 1 holds, if for all*

$s \in S$, $c_i^s \leq 0$, *and if for all status quo, state, and preference realization,*

(*i*) *the strategy* $\sigma_j'^S$ *votes* R *whenever* σ_j^S *does,*

(*ii*) *whenever* $\sigma_j'^S$ *votes for* R, $\theta_i \geq 0$,

then player i is weakly better off at the strategy profile $\left(c_i^S, \sigma_j'^S\right)$ than at $\left(c_i^S, \sigma_j^S\right)$.

Proof. Consider the strategy profile $\left(c_i^S, \sigma_j^S\right)$. Suppose that player j deviates from σ_j^S to $\sigma_j'^S$ only in the first period of Γ_{q^0,s^0}^{en}. This has two effects for player i. First, from assumption (i), for some preference profile, player j votes for R instead of L, which can only change the outcome in $t = 1$ from L to R. From assumption (ii), at all such preference profile, $\theta_i^1 \geq 0$, so the first effect is beneficial to player i.

The second effect of player j's deviation in $t = 1$ is that it affects the distribution of the status quo in $t = 2$: with some probability, it is R instead of L. Observe that the subgame starting from the second period onwards is simply $\Gamma_{q,s}^{en}$, but with a random initial status quo q and initial state s, and by construction, players play the strategy profile $\left(c_i^S, \sigma_j^S\right)$. Hence, the second effect boils down to shifting the distribution of the initial status quo towards $q = R$. Since for all $s \in S$, $c_i^s \leq 0$, from (12), this second effect is beneficial to player i.

To conclude the argument, observe that if player j also deviates in the second period, the same two effects will arise, and this second deviation will also be beneficial to player i. By induction on the number of periods in which j deviates from σ_j^S to $\sigma_j'^S$, the lemma follows. ■

Proof of Proposition 3. Let $\boldsymbol{c}^S$ and $\boldsymbol{d}^S$ be two equilibria such that $\boldsymbol{d}^S \left(\leq, \geq\right)^S \boldsymbol{c}^S$. Let us use Lemma 6 to compare the strategy profiles $\left(d_i^S, c_j^S\right)$ and $\boldsymbol{d}^S$. Strategy d_j^S votes for L whenever c_j^S does, so assumption (i) of Lemma 6 is satisfied. From Proposition 2 and Assumption 1, if $\theta_j \geq d_j^s$, then with probability 1, $\theta_i \geq \theta_j \geq d_j^s \geq 0$, so $\theta_i \geq 0$ and assumption (ii) of Lemma 6 is satisfied. Finally, from Proposition 2, for all $s \in S$, $d_i^S \leq 0$, so Lemma 6 implies that player i is weakly better-off at $\left(d_i^S, c_j^S\right)$ than at $\boldsymbol{d}^S$. Since $\boldsymbol{c}^S$ is an equilibrium, player i is weakly better-off at $\boldsymbol{c}^S$ than at $\left(d_i^S, c_j^S\right)$. A similar reasoning shows that player j is better-off at $\boldsymbol{c}^S$ than at $\boldsymbol{d}^S$. ■

The following Proposition establishes a slightly more general result than Proposition 4 (we do not use Assumption 1). To see why it implies Proposition 4 part a), notice that from Proposition 2, for any f^S which satisfies Assumption 1, for all $\delta \in (0,1)$, $\boldsymbol{c}^S\left(\delta, f^S\right) \left(\leq, \geq\right)^S \mathbf{0}^S$ and $\boldsymbol{H}^S\left(\mathbf{0}^S\right) \left(\leq, \geq\right)^S \mathbf{0}^S$.

Proposition 11 *Using the conventions in Notation 1,*

a) *If for some* $\delta_o > 0$, $\boldsymbol{H}^S\left(\delta_o, f^S, \mathbf{0}^S\right) \left(\leq, \geq\right)^S \mathbf{0}^S$, *and for all* $\delta \in [\delta_o, 1[$, $\boldsymbol{c}^S\left(\delta, f^S\right) \left(\leq, \geq\right)^S \mathbf{0}^S$, *then* $\boldsymbol{c}^S\left(\delta, f^S\right)$ *is increasing in* δ *on* $[\delta_o, 1[$ *in the order* $\left(\leq, \geq\right)^S$;

b) If g^S is more polarized than f^S (see definition), $\boldsymbol{c}^S\left(\delta, g^S\right)(\leq,\geq)^S \boldsymbol{c}^S\left(\delta, f^S\right)$.

Proof. Part (a): Clearly, if $\boldsymbol{H}^S\left(\delta_o, f^S, \mathbf{0}^S\right)(\leq,\geq)^S \mathbf{0}^S$ then for all $\delta \in [\delta_o, 1[$, $\boldsymbol{H}^S\left(\delta, f^S, \mathbf{0}^S\right)(\leq,\geq)^S \mathbf{0}^S$. Moreover, from Lemma 2, $\boldsymbol{H}^S$ is isotone in $\boldsymbol{c}^S$ in the order $(\leq,\geq)^S$, so $\boldsymbol{H}^S\left(\delta_o, f^S, (\mathbb{R}_- \times \mathbb{R}_+)^S\right) \subseteq (\mathbb{R}_- \times \mathbb{R}_+)^S$. From (4), for all $\boldsymbol{c}^S(\leq,\geq)^S \mathbf{0}^S$, $\frac{\partial \boldsymbol{H}^S\left(\delta_o, f^S, \boldsymbol{c}^S\right)}{\partial \delta} = \frac{\boldsymbol{H}^S\left(\delta_o, f^S, \boldsymbol{c}^S\right)}{\delta}(\leq,\geq)^S \mathbf{0}^S$. The result follows from Corollary 1 in Villas Boas (1997) applied to the restriction of $\boldsymbol{c}^S \to \boldsymbol{H}^S\left(\delta, f^S, \boldsymbol{c}^S\right)$ on $(\mathbb{R}_- \times \mathbb{R}_+)^S$ and to the order $(\leq,\geq)^S$.

Part (b): From Lemma 1 and (4), for all $s \in S$ and all $k \neq l$, $\frac{\partial H_k^s}{\partial m_k} \geq 0$ and $\frac{\partial H_l^s}{\partial m_k} \leq 0$. The result follows from Corollary 1 in Villas Boas (1997) applied to $\boldsymbol{c}^S \to \boldsymbol{H}^S\left(\delta, f^S, \boldsymbol{c}^S\right)$ and the order $(\leq,\geq)^S$. ■

Proof of Proposition 5. To prove Proposition 5, we will show that in the case $|S| = 1$, there exists a p.d.f. g on $\mathbb{R}^2$ such that, using Notation 1, $\lim_{\delta\to1} c^s(\delta, g) = (-\infty, +\infty)$. From Proposition 11 part b), for any finite state space S and any preference distribution f^S which is more polarized than g^S where for all $s \in S$, $g^s = g$, we must have $\lim_{\delta\to1} c^s\left(\delta, f^S\right) = (-\infty, +\infty)$.

Throughout this proof, $(\boldsymbol{m}^n)_{n\geq0}$ is an arbitrary sequence which tends to $(+\infty, -\infty)$, f is an arbitrary p.d.f. (in particular, it can have full support) and for all $\boldsymbol{m} \in \mathbb{R}^2$, $f_{\boldsymbol{m}}$ is defined by $f_{\boldsymbol{m}}(\boldsymbol{\theta}) = f(\boldsymbol{\theta} - \boldsymbol{m})$. So with a simple change of variable, for all $\boldsymbol{c} \in \mathbb{R}^2$,

$$\boldsymbol{G}(\delta, f_{\boldsymbol{m}}, \boldsymbol{c}) = \delta\left(\int_{-\infty}^{c_j-m_j}\int_{c_i-m_i}^{\infty}(\boldsymbol{c}-\boldsymbol{\theta}-\boldsymbol{m}) f^s(\boldsymbol{\theta})\, d\theta_i d\theta_j + \int_{c_j-m_j}^{\infty}\int_{-\infty}^{c_i-m_i}(\boldsymbol{c}-\boldsymbol{\theta}-\boldsymbol{m}) f^s(\boldsymbol{\theta})\, d\theta_i d\theta_j\right) \tag{15}$$

We will show that for n sufficiently large, $\lim_{\delta\to1} c^s(\delta, f_{\boldsymbol{m}^n}) = (-\infty, +\infty)$.

Step 1: For n sufficiently large, $\boldsymbol{G}(1, f_{\boldsymbol{m}^n}, \boldsymbol{c})$ has no fixed point in $\boldsymbol{c}$.
Let $s \in S$. From (15), for all $\boldsymbol{m}, \boldsymbol{c} \in \mathbb{R}^2$,

$$\begin{aligned} c_i - G_i(1, f_{\boldsymbol{m}}, \boldsymbol{c}) \; = \; & \int_{-\infty}^{c_j-m_j}\int_{-\infty}^{c_i-m_i} c_i f(\boldsymbol{\theta})\, d\theta_i d\theta_j + \int_{c_j-m_j}^{\infty}\int_{c_i-m_i}^{\infty} c_i f(\boldsymbol{\theta})\, d\theta_i d\theta_j \\ & + \int_{c_j-m_j}^{\infty}\int_{-\infty}^{c_i-m_i}(m_i+\theta_i) f(\boldsymbol{\theta})\, d\theta_i d\theta_j + \int_{-\infty}^{c_j-m_j}\int_{c_i-m_i}^{\infty}(m_i+\theta_i) f(\boldsymbol{\theta})\, d\theta_i d\theta_j. \end{aligned} \tag{16}$$

We denote by $A(\boldsymbol{m}, \boldsymbol{c})$, $B(\boldsymbol{m}, \boldsymbol{c})$, $C(\boldsymbol{m}, \boldsymbol{c})$ and $D(\boldsymbol{m}, \boldsymbol{c})$ the four integrals in the order they appear on the right-hand side of (16). Suppose by contradiction that for all n, $\boldsymbol{G}(1, \boldsymbol{m}^n, \boldsymbol{c})$ has a fixed point, which we denote by $\boldsymbol{c}^n$. From Proposition 11 part b), $\boldsymbol{c}^n$ is increasing in n in the order $(\leq,\geq)$. In particular, $\boldsymbol{c}^n - \boldsymbol{m}^n$ tends to $(-\infty, +\infty)$. Moreover, if h is the p.d.f.

of an integrable real random variable, $\int_{-\infty}^{x} |xh(u)|\, du \to 0$ as $x \to -\infty$, so

$$\begin{aligned} |A(\boldsymbol{m}^n, \boldsymbol{c}^n)| &\leq \int_{-\infty}^{c_i^n - m_i^n} |c_i^n| f_i(\theta_i)\, d\theta_i \to 0, \\ |C^s(\boldsymbol{m}^n, \boldsymbol{c}^n)| &\leq \int_{-\infty}^{c_i^n - m_i^n} (|m_i^n| + |\theta_i|) f_i(\theta_i)\, d\theta_i \to 0, \end{aligned} \tag{17}$$

and $D^s(\boldsymbol{m}^n, \boldsymbol{c}^n) \to +\infty$. Substituting $c_i^n = G_i(1, f_{\boldsymbol{m}^n}, \boldsymbol{c}^n)$, (17), and $D^s(\boldsymbol{m}^n, \boldsymbol{c}^n) \to +\infty$ in (16), we get that that $B(\boldsymbol{m}^n, \boldsymbol{c}^n) \to \infty$. However,

$$|B(\boldsymbol{m}^n, \boldsymbol{c}^n)| \leq |c_i^n| \int_{c_j^n}^{\infty} f_j(\theta_j)\, d\theta_j = \frac{|c_i^n|}{|c_j^n|} \times |c_j^n| \int_{c_j^n}^{\infty} f_j(\theta_j)\, d\theta_j,$$

so $B(\boldsymbol{m}^n, \boldsymbol{c}^n) \to \infty$ implies that $|c_i^n| / |c_j^n| \to +\infty$. The symmetric argument for j implies that $|c_j^n| / |c_i^n| \to +\infty$, a contradiction.

Step 2: For n sufficiently large, $c(\delta, f_{\boldsymbol{m}^n})$ tends to some limit, denoted $c(1, f_{\boldsymbol{m}^n})$, as δ tends to 1, *such that $c_i(1, f_{\boldsymbol{m}^n}) \in [-\infty, 0]$ and $c_k(1, f_{\boldsymbol{m}^n}) \in [0, +\infty]$.*

Recall that from Lemma 2 and Tarski's theorem, $\boldsymbol{c}(\delta, f_{\boldsymbol{m}^n})$ exists for all $\delta < 1$. For n sufficiently large, $\boldsymbol{c}(\delta, f_{\boldsymbol{m}^n})(\leq, \geq)\mathbf{0}$, and $\boldsymbol{H}(\delta_o, f_{\boldsymbol{m}^n}, \mathbf{0})(\leq, \geq)\mathbf{0}$ for some δ_o. Therefore, from Proposition 4 part a), $\boldsymbol{c}(\delta, f_{\boldsymbol{m}^n})$ is monotonic in δ in the order $(\leq, \geq)^S$, which shows the existence of $\boldsymbol{c}^S(1, f_{\boldsymbol{m}^n})$.

Step 3: for some $k \in \{i, j\}$, $c_k(1, f_{\boldsymbol{m}^n})$ is infinite.

If $\boldsymbol{c}(1, \boldsymbol{m}^n)$ was finite, then by continuity of $\boldsymbol{G}(\delta, f_{\boldsymbol{m}}, \boldsymbol{c})$ in δ and in $\boldsymbol{c}$, $\boldsymbol{c}(1, \boldsymbol{m}^n)$ would be a fixed point of $\boldsymbol{H}(1, \boldsymbol{m}^n, \boldsymbol{c})$, which is impossible from step 1.

Step 4: For all $s \in S$, $c_i(1, \boldsymbol{m}^n) = -\infty$ and $c_j(1, \boldsymbol{m}^n) = +\infty$.

Suppose that $c_k(1, \boldsymbol{m}^n)$ is finite for all n and for some k. To fix ideas, let $k = j$ (the proof in the case $k = i$ is identical). From step 3, for n sufficiently large, $c_i(1, f_{\boldsymbol{m}^n}) = -\infty$. By continuity, for all n, $c_j(1, f_{\boldsymbol{m}^n})$ must be a fixed point the map $G_j^n(-\infty, c_j)$ is defined by:

$$G_j^n(-\infty, c_j) = \lim_{c_i \to -\infty} G_j(1, \boldsymbol{m}^n, c_i, c_j) = \int_{-\infty}^{c_j - m_j^n} \left(c_j - \theta_j - m_j^n\right) f_j(\theta_j)\, d\theta_j.$$

Observe that

$$G_j^n(-\infty, c_j) - c_j = -m_j^n + \left(c_j - m_j^n\right) \int_{c_j - m_j^n}^{+\infty} f_j(\theta_j)\, d\theta_j - \int_{-\infty}^{c_j - m_j^n} \theta_j f_j(\theta_j)\, d\theta_j. \tag{18}$$

The last two terms of the right-hand side of (18) are bounded for all $m_j^n \leq 0$ and $c_j \geq 0$. Therefore, for n sufficiently large, $G_j^n(-\infty, c_j) - c_j$ is bounded above 0 as c_j tends to $+\infty$.

Moreover, simple calculus shows that $\frac{dG_j^n(-\infty,c_j)}{dc_j} \leq 1$. Therefore, $G_j^n(-\infty, c_j)$ has no fixed point, a contradiction. ■

Proof of Propostion 6. Let $\boldsymbol{c}^S$ be an equilibrium of $\Gamma^{en}_{q^0,s^0}$. We shall compare the equilibrium payoffs in every period t in $\Gamma^{en}_{q^0,s^0}$ and in $\Gamma^{ex}_{q^S,s^0}$, where $q^S \in \{L, R\}^S$ is the state dependent exogenous status quo. If we denote s the state in period t, there are 5 possible cases:

Case $\theta_i^t < c_i^s$ In this case, necessarily, $\theta_j^t < \theta_i^t < c_i^s < 0 < c_j^s$ so both players vote for L in $\Gamma^{en}_{q^0,s^0}$ and in $\Gamma^{ex}_{q^S,s^0}$. Therefore, the payoffs in the two games are the same.

Case $\theta_j^t > c_j^s$ In this case, necessarily, $c_i^s < 0 < c_j^s < \theta_j^t < \theta_i^t$ so both players vote for R in $\Gamma^{en}_{q^0,s^0}$ and in $\Gamma^{ex}_{q^S,s^0}$. Therefore, the payoffs in the two games are the same.

Case $c_i^s < \theta_i^t < 0$ In this case, necessarily, $\theta_j^t < \theta_i^t < 0 < c_j^s$ so both players vote for L in $\Gamma^{ex}_{q^S,s^0}$ but they disagree in $\Gamma^{en}_{q^0,s^0}$. Since $\theta_i^t + \theta_j^t < 0$, the sum of players' payoff is weakly higher in $\Gamma^{ex}_{q^S,s^0}$ than in $\Gamma^{en}_{q^0,s^0}$.

Case $0 < \theta_j^t < c_j^s$ In this case, necessarily, $c_i^s < 0 < \theta_j^t < \theta_i^t$ so both players vote for R in $\Gamma^{ex}_{q^S,s^0}$ but they disagree in $\Gamma^{en}_{q^0,s^0}$. Since $\theta_i^t + \theta_j^t > 0$, the sum of players' payoff is weakly higher in $\Gamma^{ex}_{q^S,s^0}$ than in $\Gamma^{en}_{q^0,s^0}$.

Case $\theta_j^t < 0 < \theta_i^t$ In this case, necessarily, $c_i^s < \theta_i^t$ and $\theta_j^t < c_i^s$ players disagree in both games, so which game yields the highest social welfare depends on the distribution of the status quo χ^t and the sign of $E\left(\theta_i + \theta_j / \theta_j^t < 0 < \theta_i^t\right)$ in the current state s.

In the first four cases, the sum of players' payoff is higher in $\Gamma^{ex}_{q^S,s^0}$ than in $\Gamma^{en}_{q^0,s^0}$. In the last case, it depends on q^S. Given the strategy $\boldsymbol{c}^S$, for all $t \geq 1$, let $\pi^t(s|s^0)$ denote the ex-ante probability of being in state s in period t given the first period's state s^0 and for all $s \in S$, let $\chi^{t,s} \in (0,1)$ be the distribution of the status quo (i.e., the probability that the status quo is R) in t conditional on the state being s (in the game $\Gamma^{en}_{q^0,s^0}$). Let $\Gamma^{ex}_{\chi^0,s^0}$ be the game with a stochastic, state-dependent, exogenous status quo $\chi^{0,S} \in (0,1)^S$, where for all $s \in S$, $\chi^{0,s}$ is the average, discounted frequency of status quo R in $\Gamma^{en}_{q^0,s^0}$ at $\boldsymbol{c}^S$:

$$\chi^{0,s} = \frac{\sum_{t \geq 1} \delta^t \pi^t(s|s^0)\, \chi^{t,s}}{\sum_{t \geq 1} \delta^t \pi^t(s|s^0)}.$$

Then in expectation, in the last case, $\Gamma^{ex}_{\chi^0,s^0}$ and $\Gamma^{en}_{q^0,s^0}$ yield the same payoff for both players.

Now observe that the players' equilibrium payoffs in $\Gamma^{ex}_{\chi^{0,S},s^0}$ are linear in $\chi^{0,S}$, so if the sum of equilibrium payoffs is higher in $\Gamma^{ex}_{\chi^{0,S},s^0}$ than in $\Gamma^{en}_{q^0,s^0}$ for some $\chi^{0,S} \in [0,1]^S$, then the same is true for some $\chi^{0,S} \in \{0,1\}^S$. ■

Proof of Proposition 7. One can easily check that lemma 3 and its proof hold unchanged for the game $\Gamma^{en}_{q^0,s^0}(\Omega)$ if we replace player i and j by player $n \in N$ and all the other players, respectively. This shows that a stationary, stage undominated equilibrium must be a cutoff strategy $\boldsymbol{c}^S$, and that c_n^s must satisfy (12) for all $n \in N$ and all $s \in S$.

Let $\boldsymbol{V}^S(L)$ and $\boldsymbol{V}^S(R)$ denote the continuation values for the strategy profile $\boldsymbol{c}^S$. For all $\boldsymbol{c} \in \mathbb{R}^N$, let $D(\boldsymbol{c}) \subseteq \mathbb{R}^N$ be the set of preference realizations $\boldsymbol{\theta}$ such that if players vote according to the strategy profile $\boldsymbol{c}$, the outcome of the vote is different with the voting rule Ω_L and status quo L than with the voting rule Ω_R and status quo R. The status quo matters in some period t with state s only if $\boldsymbol{\theta}^t \in D(\boldsymbol{c}^s)$, so

$$V_n^s(L) - V_n^s(R) = \delta \sum_{s' \in S} \pi(s, s') \left(\int_{D\left(\boldsymbol{c}^{s'}\right)} \left(-\theta_n + \delta V_n^{s'}(L) - \left(\theta_n + \delta V_n^{s'}(R) \right) \right) f^{s'}(\boldsymbol{\theta})\, d\boldsymbol{\theta} \right).$$

If we substitute (12) on both sides of the above equation, we get

$$c_n^s = \delta \sum_{s' \in S} \pi(s, s') \int_{D\left(\boldsymbol{c}^{s'}\right)} \left(-\theta_n + c_n^{s'} \right) f^{s'}(\boldsymbol{\theta})\, d\boldsymbol{\theta}. \tag{19}$$

Since $\theta_1 \geq .. \geq \theta_N$ with probability one, for all $s \in S$, $\int_{D(\boldsymbol{c}^s)} \theta_n f^s(\boldsymbol{\theta})\, d\boldsymbol{\theta}$ is weakly decreasing in n. Together with (19), this implies that $c_n^s - \delta \sum_{s' \in S} \pi(s, s')\, c_n^{s'}$ is weakly decreasing in n. As shown in the proof of Proposition 2, this implies in turn that c_n^s is weakly increasing in n.

For all $\boldsymbol{c} \in \mathbb{R}^N$, $D(\boldsymbol{c})$ can be rewritten as the union of $D'(\boldsymbol{c})$ and $D''(\boldsymbol{c})$, where:

$$\begin{aligned} D'(\boldsymbol{c}) &= \left\{ \boldsymbol{\theta} \in \mathbb{R}^N : \{ i \in N : \theta_i \geq c_i \} \notin \Omega_L \text{ and } \{ i \in N : \theta_i \leq c_i \} \notin \Omega_R \right\}, \\ D''(\boldsymbol{c}) &= \left\{ \boldsymbol{\theta} \in \mathbb{R}^N : \{ i \in N : \theta_i \geq c_i \} \in \Omega_L \text{ and } \{ i \in N : \theta_i \leq c_i \} \in \Omega_R \right\}. \end{aligned}$$

Condition (iv) in Definition implies that $D''(\boldsymbol{c}) = \emptyset$ when c_n^S is weakly increasing in n. From what precedes, for all state s, $\theta_1 - c_1^s \geq .. \geq \theta_N - c_N^s$ with probability one. So with probability 1, there exists $n \in \{0, ..N\}$ such that $\{ i \in N : \theta_i \geq c_i^s \}$ and $\{ i \in N : \theta_i \leq c_i^s \}$ coincide with $\{1, ..., n\}$ and $\{n+1, ..., N\}$. Therefore, up to a zero measure set,

$$D'(\boldsymbol{c}^s) = \left\{ \boldsymbol{\theta} \in \mathbb{R}^N : \theta_{n_L} \leq c_{n_L}^s \text{ and } \theta_{n_R} \geq c_{n_R}^s \right\},$$

which proves (5) and shows that players n_L and n_R are always pivotal. The lattice structure and Pareto ordering for the pivotal player follows then from the two player case. ■

Proof of Proposition 8. The inequalities $c_{n_L}(\Omega) \leq 0 \leq c_{n_R}(\Omega)$ are established in Proposition 7.

Since Ω' yields more veto power than Ω,

$$\begin{aligned} \{1,..,n\} &\in \Omega \Rightarrow \{1,..,n\} \in \Omega', \\ \text{and } \{n,..,N\} &\in \Omega \Rightarrow \{n,..,N\} \in \Omega', \end{aligned}$$

so it follows from Definition that $n'_L \leq n_L$ and $n_R \leq n'_R$. Proposition 7 implies then that $c_{n'_L}(\Omega) \leq c_{n_L}(\Omega)$ and $c_{n_R}(\Omega) \leq c_{n'_R}(\Omega)$.

To complete the proof, it remains to show that $c_{n'_L}(\Omega') \leq c_{n'_L}(\Omega)$ and $c_{n'_R}(\Omega) \leq c_{n'_R}(\Omega')$. Since $\theta_1 \geq ... \geq \theta_N$ with probability 1, the distribution of $(\theta_{n'_L}, \theta_{n'_R})$ is more polarized than the distribution of $(\theta_{n_L}, \theta_{n_R})$ in the sense of Definition . Proposition 4 implies then that for all $s \in S$,

$$c^s_{n'_L}(\Omega') \leq c^s_{n_L}(\Omega) \text{ and } c^s_{n_R}(\Omega) \leq c^s_{n'_R}(\Omega'). \tag{20}$$

From Proposition 7,

$$c^s_{n'_L}(\Omega') = \delta \sum_{s' \in S} \pi(s,s') \int_{\left\{\boldsymbol{\theta} \in \mathbb{R}^N : \theta_{n'_L} \geq c^{s'}_{n'_L}(\Omega') \text{ and } \theta_{n'_R} \leq c^{s'}_{n'_R}(\Omega')\right\}} \left(c^{s'}_{n'_L}(\Omega') - \theta_{n'_L}\right) f^{s'}(\boldsymbol{\theta})\, d\boldsymbol{\theta}.$$

Hence, $c^s_{n'_L}(\Omega')$ is a sum of integrals whose integrands are nonpositive on their respective domains. Moreover, from (20), with probability one, for all $s' \in S$, $\theta_{n_L} \geq c^{s'}_{n_L}(\Omega)$ implies $\theta_{n'_L} \geq c^{s'}_{n'_L}(\Omega')$ and $\theta_{n_R} \leq c^{s'}_{n_R}(\Omega)$ implies $\theta_{n'_R} \leq c^{s'}_{n'_R}(\Omega')$. Therefore,

$$c^s_{n'_L}(\Omega') \leq \delta \sum_{s' \in S} \pi(s,s') \int_{\left\{\boldsymbol{\theta} \in \mathbb{R}^N : \theta_{n_L} \geq c^{s'}_{n_L}(\Omega) \text{ and } \theta_{n_R} \leq c^{s'}_{n_R}(\Omega)\right\}} \left(c^{s'}_{n'_L}(\Omega') - \theta_{n'_L}\right) f^{s'}(\boldsymbol{\theta})\, d\boldsymbol{\theta}.$$

From Proposition 7, the right hand-side of the above equation is simply $c^s_{n'_L}(\Omega)$. A similar proof shows that $c^s_{n'_R}(\Omega) \leq c^s_{n'_R}(\Omega')$, which establishes (6). ■

Proof of Proposition 9. Let (n_L, n_R) and (n'_L, n'_R) be the pivotal players of $\Gamma^{en}_{q^S,s^0}(\Omega)$ and $\Gamma^{en}_{q^S,s^0}(\Omega')$, respectively. As shown in the proof of Proposition 8, since Ω' yields more veto power than Ω, $n'_L \leq n_L \leq n_R \leq n'_R$, so with probability one,

$$\theta_{n'_L} \geq \theta_{n_L} \geq \theta_{n_R} \geq \theta_{n'_R}. \tag{21}$$

and from Proposition 7 and 8,

$$c^S_{n'_L}(\Omega') \leq c^S_{n_L}(\Omega) \leq 0 \leq c^S_{n_R}(\Omega) \leq c^S_{n'_R}(\Omega'). \tag{22}$$

Consider the 2-player game $\Gamma^{en}_{q^S,s^0}$ defined in section 2 in which player i is player n_L. Let c^S_i and c'^S_i denote the strategy of player i in which she behaves as player n_L with cutoff $c^S_{n_L}(\Omega)$

and as player n_L' with cutoff $c^S_{n_L'}(\Omega')$, respectively, and let c^S_j and c'^S_j denote the strategy of player j in which player j behaves as player n_L with cutoff $c_{n_R}(\Omega)$ and as player n_L' with cutoff $c_{n_R'}(\Omega')$, respectively. Finally, let γ^S_i denotes the best response cutoff of player i to the strategy c'^S_j. From Proposition 7, the strategy profiles $\boldsymbol{c}^S(\Omega)$ and $\boldsymbol{c}^S(\Omega')$ in the games $\Gamma^{en}_{q^S,s^0}(\Omega)$ and $\Gamma^{en}_{q^S,s^0}(\Omega')$ are outcome equivalent to the strategy profiles $\left(c^S_i, c^S_j\right)$ and $\left(c'^S_i, c'^S_j\right)$ in the game $\Gamma^{en}_{q^S,s^0}$. So to prove that the pivotal players at Ω are better-off with Ω than with Ω', we need to show that player i is better-off at $\left(c^S_i, c^S_j\right)$ than at $\left(c'^S_i, c'^S_j\right)$.

By definition of γ^S_i, player i is better-off at the strategy profile $\left(\gamma^S_i, c'^S_j\right)$ than at the strategy profile $\left(c'^S_i, c'^S_j\right)$. From Proposition 7, c^S_i is the best response of player i to c^S_j, so she is better-off at $\left(c^S_i, c^S_j\right)$ than at $\left(\gamma^S_i, c^S_j\right)$. Therefore, to complete the proof, it suffices to show that player i is better-off at $\left(\gamma^S_i, c^S_j\right)$ than at $\left(\gamma^S_i, c'^S_j\right)$.

By construction, c^S_j votes R in a given period with state s when $\theta_{n_R} \geq c^s_{n_R}(\Omega)$ while c'^S_j votes R when $\theta'_{n_R} \geq c^s_{n_R'}(\Omega')$. Using (21) and (22), we see that c^S_j votes R whenever c'^S_j does. Moreover, if c^S_j votes R in that period, then $\theta_{n_R} \geq c^s_{n_R}(\Omega)$ together with (21) and (22) imply that $\theta_{n_L} \geq \theta_{n_R} \geq c^s_{n_R}(\Omega) \geq 0$, so $\theta_i \geq 0$. Finally, since $\theta_{n_L} \geq \theta_{n_R'}$ with probability 1, Proposition 2 implies that for all $s \in S$, $\gamma^s_i \leq 0$. Therefore, Lemma 6 implies that player i is better-off at $\left(\gamma^S_i, c^S_j\right)$ than at $\left(\gamma^S_i, c'^S_j\right)$. ■

Proof of Corollary 2. It follows from definition and the definition of Ω^α that $n_L(\alpha) = N + 1 - n_R(\alpha)$.

For convenience, denote $y^t = -1$ when the policy is L and $y^t = 1$ when the policy is R. Let $\Pi_n\left(\left(y^t\right)_{t\geq1}, \left(s^t\right)_{t\geq1}, \left(\varepsilon^t\right)_{t\geq1}\right)$ be the discounted payoff of player $n \in \{1, ..., N\}$ of the sequence of alternatives $\left(y^t\right)_{t\geq1} \in \{-1, 1\}^{\mathbb{N}^*}$ for the sequence of states $\left(s^t\right)_{t\geq1} \in S^{\mathbb{N}^*}$ and of shock realizations $\left(\varepsilon^t\right)_{t\geq1} \in \mathbb{R}^{\mathbb{N}^*}$. Then:

$$\Pi_n\left(\left(y^t\right)_{t\geq1}, \left(s^t\right)_{t\geq1}, \left(\varepsilon^t\right)_{t\geq1}\right) = \sum_{t\geq1} \delta^t v^{s^t}_n y^t + \sum_{t\geq1} \delta^t \varepsilon^{s^t} y^t.$$

Since for all $s \in S$, $\left(v^s_n\right)_{s\in S}$ is symmetric, and since $n_L(\alpha) = N + 1 - n_R(\alpha)$, the above equation implies that for all sequences of alternatives, states and shock realization,

$$\frac{\Pi_{n_L(\alpha)} + \Pi_{n_R(\alpha)}}{2} = \frac{\sum_{n\in\{1,...,N\}} \Pi_n}{N},$$

so the pivotal voters are representative of utilitarian social welfare. To conclude the proof, observe that for all $\alpha \leq \alpha'$, the concentration of power under Ω^α is greater than under $\Omega^{\alpha'}$. ■

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