Federalism and Ideology*

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Abstract

Scholars have long considered the implications of the centralization and decentralization of political power on policy learning and externalities. This paper takes a different approach by focusing on the relationship between federalist arrangements and ideology. We model an infinite horizon interaction between an elected central executive and two local units for which policies can be set at either level. The executive decides how to allocate policy-making power between central and local governments to achieve current policy goals, control externalities, and protect against future policy reversals. The model shows that higher levels of decentralization can insure against bad electoral outcomes, and thus centralization is increasing in an incumbent's electoral prospects. It also shows that allowing politicians to reallocate centralization over time can reduce welfare relative to fixing one centralization regime.

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1 Introduction

Writers of regulations, laws, and constitutions have long prioritized the issue of centralization versus decentralization. The concern is natural, as the assignment of authority is obviously consequential for policy outcomes across geographical units and over time. Many of the trade-offs are by now familiar. Decentralization can encourage the discovery of good policies and adaption to local conditions, while centralization can control externalities, implement best practices, and prevent a wasteful "race to the bottom."

The stakes involved in centralization choices are evident in some of the most important policy arenas. The Clean Air Act of 1970 and its amendments provide the foundation for air quality regulations in the United States. Two provisions pertaining to automobile emissions are of particular interest. Section 209(a) of the law *preempted* state-level regulations; in other words, it centralized authority at the federal level by superseding state standards. Section 209(b) gave California the authority to adopt standards at least as stringent as prevailing federal standards. Other states could choose whether to use the California or federal standards. This decentralizing exemption allowed California and other states to address long-standing air quality issues in an aggressive manner, but in 2019 the Trump administration reinterpreted the section in a way that revoked the state's powers.

Rollbacks of decentralized authority have become increasingly commonplace throughout the U.S. Following recent trends, cities such as Austin, Birmingham, and Oklahoma City mandated paid sick leave or minimum wages exceeding state or federal levels. State governments have responded by preempting these policies over the past decade. Figure 1 shows that these preemptions have occurred predominantly in states governed by Republican 'trifectas,' or unified GOP control over the legislature and the governorship.

These examples strongly suggest that ideology is a central consideration in centralization policies. The rationale for reducing California's 209(b) authority has seemingly little to do with the failure of its "experiment." If anything, the adoption of California's standards by 15 other states is evidence of the opposite. Likewise, the preemption of common and generally popular local sick leave and minimum wage laws was perfectly consistent with the well-established policy views of the governing party. Both examples also highlight the fact that changes in political preferences over time can affect the allocation of policy authority. Accordingly, forward-looking politicians must anticipate the durability of their chosen arrangements.

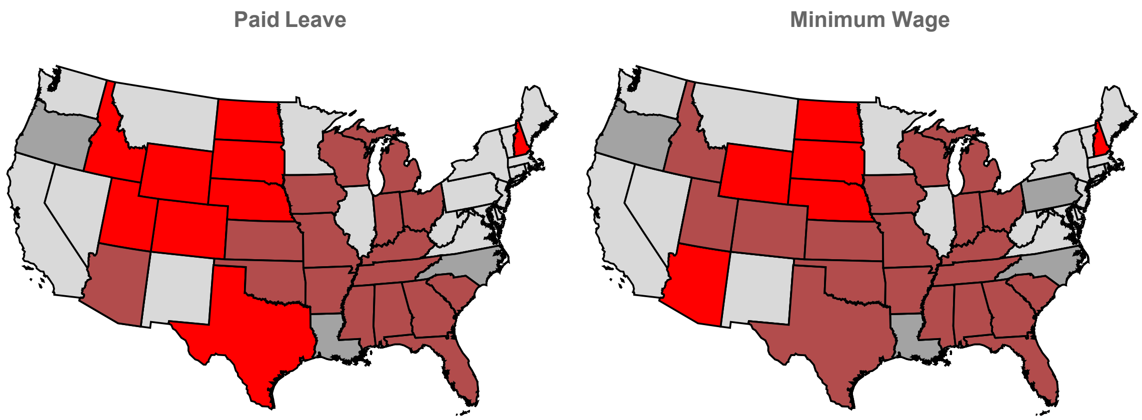


Figure 1: Preemption and GOP Trifectas. Darker shades denote the presence of preemption laws for municipal paid leave and minimum wage ordnances. Red shades denote Republican control of all legislative chambers and the governorship in 2017. Neither Alaska nor Hawaii had unified Republican control or preemption laws. Source: von Wilpert (2017).

This paper theoretically considers the role of ideology in the centralization or decentralization of policy authority. The main question is how a politician assigns authority across levels of government in the face of electoral uncertainty over the preferences of future policy-makers. We intentionally suppress uncertainty over the quality of policies, and thus learning plays no role. We do this in part for tractability, but also because a rich and productive literature has explored policy learning in federal systems. In these models, policy trials can produce useful information for future politicians, and thus centralization choices are driven by their equilibrium information-revelation properties (e.g., Strumpf 2002, Volden, Ting, and Carpenter 2008, Cai and Treisman 2009, Callander and Hårstad 2015, Cheng and Li 2018).[1] These papers do not uniformly ignore ideology, but to our knowledge this model is the first to focus primarily on the role of ideological heterogeneity over both political subunits and time.

Our basic model features policy-making in two localities over an infinite horizon. Policies are

[1]Supreme Court Justice Louis Brandeis' famous 1932 quotation in *New State Ice Co. v. Liebmann* about states acting as a "laboratory" for democracy (which need not be repeated here) is a staple in this literature.

located on a unidimensional ideological policy space, and one locality is right-leaning while the other is left-leaning. Policies can have spillovers whereby localities can benefit from coordination. In each period a central or "federal" politician may centralize or decentralize each locality's policy-setting. We refer to this politician as an *executive*. Executives care about social welfare but also belong to either a right or left party and are therefore biased in favor of one locality. Under centralization, the executive chooses policy, while under decentralization, the locality chooses. Full centralization does not bind the executive to choose the same policies across both localities, and the executive can choose a mix of centralization and decentralization.

Before each period, an election determines the executive's party. Newly elected executives can be re-elected at most once and care about policies in their second period of life even if they lose. Thus, as is standard in models of federalism, executives have a two period time horizon. A key parameter in the model is institutional *rigidity*, which produces inertia in centralization decisions. With some probability, executives cannot change the polity's profile of centralization and decentralization and policy-making proceeds according to the previous period's arrangement. As the trifecta examples suggest, resolving fundamental (and perhaps constitutional) questions about the allocation of political authority requires strong political consensus. Our rigidity assumption thus captures the idea that opportunities for addressing centralization arrangements are rarer than those for standard policy choices. High rigidity might correspond to a strong checks and balances systems, while Westminster parliamentary systems might have lower rigidity.

Electoral uncertainty and rigidity produce the central tension in the model. Centralization allows an executive to impose her ideal policy, which additionally helps to internalize policy externalities. However with high rigidity it also raises the risk of centrally-mandated policies set by the opposition. Centralization is therefore the clear choice for a re-elected executive. A less risky option is to centralize the ideologically distant locality while decentralizing the closer locality. This provides some insurance in the event of inertia and a bad electoral outcome. The least risky option is complete decentralization, which insulates policy completely from election outcomes.

The basic model shows that elite polarization and political competition lead to more decentralized institutional arrangements. Generally, higher levels of centralization will be adopted as incumbents feel more electorally secure. But complete decentralization can be the result only under high polarization, where executives are ideologically more extreme than the localities. In equilibrium, the executive will often choose a mix of centralization and decentralization. This is consistent with the Clean Air Act example, as well as the extensive U.S. federal practice of selectively granting waivers for alternatives to various federal programs. Recent examples of such waivers include work requirements by recipients of the Medicaid health insurance program in Arkansas and Kentucky.[2] This contrasts with many experimentation-based federalism models, which either assume that complete centralization or decentralization are the only policy options, or derive conditions under which these options are optimal.

In addition to models of policy experimentation in federal systems, our model is related to two significant lines of research. First, a series of important papers address centralization and its effects on public goods provision (e.g., Oates 1999, Besley and Coate 2003, Hafer and Landa 2007, Crémer and Palfrey 2006, Kessler 2014). These papers examine a variety of institutional settings, but share a primary concern with the control of spillovers across units. Second, while our model does not contain any policy learning, the extent to which policies diffuse across units relates directly to the relative benefits of centralization (Bednar 2011, Graham, Shipan, and Volden 2012). Grossback, Nicholson-Crotty, and Peterson (2004) and Volden (2015), among others, show empirically that ideology can affect policy diffusion across units.

The paper proceeds as follows. Section 2 describes the basic model. Next, section 3 presents our main results on centralization choices. Section 5 concludes.

2 Model

We consider an infinite horizon game of policy-making across two localities. In each period of the game the players are two localities, denoted by $i \in \{1, 2\}$, and a central "executive" player. In each period t, a policy $x_{i,t}$ is chosen for each locality i. Each locality i has an ideal point y_i, where $y_1 \leq y_2$ and, for tractability, $y_2 \equiv -y_1$. Executives have a time horizon of two periods, while

[2] The Obama administration largely forced states to adopt the standard Medicaid program, without work requirements.

localities can live for any finite number of periods. There is no discounting.

All players derive utility from policy choices. The per period utility that an actor with ideal point y derives from a policy $x_{i,t}$ implemented in locality i is given by

$$u\left(x_{i,t}, y\right) = -\left(x_{i,t} - y\right)^2 .$$

The one period preferences of any locality over a policy vector $\mathbf{x}_t = (x_{1,t}, x_{2,t})$ containing its own policy and the policy implemented in the other locality at any time are given by

$$U_i(\mathbf{x}_t, y_i) \equiv \alpha u\left(x_{i,t}, y_i\right) + (1-\alpha) u\left(x_{-i,t}, y_i\right), \tag{1}$$

where $\alpha \in (0, 1]$ is the weight that localities put on deviations of their own policies from their ideal point. Deviations of the policy implemented in the other locality from i's ideal point are weighted by $1-\alpha$. Thus α allows for localities to suffer from negative externalities of the policies implemented in other localities. We assume that localities choose policies myopically in each period. One way to interpret this assumption is that decision-makers on the locality level are replaced by identical versions of themselves in each period.

There are two types of executives, each of which is closer ideologically to one of the localities. Executives of type or party $j \in \{L, R\}$ have a time-invariant ideal point z_j. We assume that executive ideal points are symmetrically distributed around 0: $z_L \leq 0$ and $z_L = -z_R$. As a consequence, more extreme values of z_L imply more extreme values of z_R, and hence an increase in elite ideological polarization. In a given period party j executives earn the following utility from a policy vector $\mathbf{x}_t$:

$$U_j^e(\mathbf{x}, \mathbf{y}) \equiv \omega \sum_{i=1}^{2} u(x_i, z_j) + (1-\omega) \sum_{i=1}^{2} U_i(\mathbf{x}, y_i) \tag{2}$$

This utility function combines the executive's pure policy utility with her concern for locality-level welfare, where $\omega \in (0, 1)$ is the common weight on the former. Note that the concern for welfare internalizes externalities across localities.

Every newly elected executive has a lifespan of two periods and automatically becomes her party's candidate in the subsequent election. Executives receive the utility given in equation (2) regardless of whether they are in power. Whenever a party does not have an incumbent, a new party j candidate who may become the next executive is born. We denote the age of the executive in power in period t by $a_t \in \{1, 2\}$.

Parties' electoral prospects vary across periods. Specifically, at the beginning of each period t, nature determines the probability p_t that a party L executive will be voted into office in the subsequent election, where $p_t \sim F(\cdot)$ is drawn randomly from non-degenerate distribution $F(\cdot)$ that has support $[0, 1]$. The complimenting probability that a party R executive will come into office in the following period is $1 - p_t$.

The incumbent executive observes p_t and may attempt to alter the status of centralization and decentralization across the polity. Each locality can be either *centralized* or *decentralized*. Centralization means that policy for this locality is chosen by the executive in power, while decentralization means that the locality itself chooses its policy. We denote the centralization status of each locality i in period t by $c_{i,t} \in \{0, 1\}$, where 0 corresponds to decentralization and 1 corresponds to centralization. A *centralization profile* $\mathbf{c}_t = (c_{1,t}, c_{2,t})$ for period t is the set of centralization statuses for the localities. Let $\mathcal{C} = \{0, 1\} \times \{0, 1\}$ represent the set of possible centralization profiles.

Whether the executive in power in period t is able to change the centralization profile depends on institutional features and political conditions. With known probability $q > 0$, the executive in any given period is *weak* and unable to change the centralization profile, and thus $\mathbf{c}_t = \mathbf{c}_{t-1}$. With probability $1-q$, the executive is *strong* and free to choose $\mathbf{c}_t$. We refer to q as *rigidity*. For example, a highly rigid polity may be one with many institutional veto players or "checks and balances" that prevent rapid institutional changes. A consequence of such features is that centralization decisions made by one executive may persist over multiple periods. Once $\mathbf{c}_t$ has been determined, the actors that have policy-making authority simultaneously choose local policies. The period ends with an election.

The timing of the stage game can be summarized as follows:

1. Nature draws $p_t \sim F(\cdot)$.
2. With probability q the executive in power becomes *weak*, otherwise she becomes *strong*.
3. If the executive in power is *strong* she chooses $\mathbf{c}_t$, otherwise $\mathbf{c}_t = \mathbf{c}_{t-1}$.

4. Localities and the executive in power simultaneously choose $\mathbf{x}_t$ according to $\mathbf{c}_t$.
5. With probability p_t a party L executive is elected; otherwise a party R executive is elected.

We assume that in period 1 a party L executive is in office, and that the *status quo* centralization profile at the beginning of the game is $\mathbf{c}_0 = (0, 0)$ (full decentralization). Neither assumption affects the results.

We derive the unique subgame perfect Nash equilibrium in stage-optimal policy strategies. This requires that in each period, all players choose policies that are optimal for that period, and rules out contingent policy strategies.[3] Let H_t represent the history of play up to period t. In each period, a strong executive chooses a centralization profile $H_t \times \{1, 2\} \times (0, 1) \mapsto \mathcal{C}$ according to her age a_t and realized election probability p_t. Additionally, the executive in power chooses a policy for each centralized locality, represented by the mapping $H_t \times \{1, 2\} \times (0, 1) \times \{weak, strong\} \times \mathcal{C} \mapsto \mathbb{R}$. The mappings are analogous for policies that decentralized localities choose for themselves.

3 Equilibrium

3.1 Stage Preferences

We begin by characterizing the policy preferences of each actor in the stage game. For a locality, maximizing equation (1) simply produces its ideal point:

$$x_i^* = \arg\max_{x_i} U_i(\mathbf{x}, y_i) = y_i. \tag{3}$$

Next, maximizing equation (2) produces an executive's optimal policy for a centralized locality:

$$x_i^* = \arg\max_{x_i} U_j^e(\mathbf{x}, \mathbf{y}) = \omega z_j + (1 - \omega) \left[\alpha y_i + (1 - \alpha) y_{-i}\right]. \tag{4}$$

Unlike the locality's optimal policy, the executive's takes externalities into account and thereby deviates from her ideal point. Additionally, the executive's optimal policy for each locality is

[3] For the localities, this is equivalent to living for only one period.

independent of policies in the other locality, and thus does not depend on whether the other locality is centralized.

An important observation is that while centralization profiles may persist across periods, there is no policy persistence. Policy choices in a given period therefore have no implications for any player's future payoffs. Combined with stage-optimal strategies, this implies that conditional upon $\mathbf{c}_t$, the myopic optimal policies given in equations (3) and (4) fully describe all policy choices.

These policies shape the trade-off that a newly-elected party j executive faces when choosing a centralization profile. Substituting the optimal policies from equations (3) and (4) into equation (2) yields the utility of executive j under the optimal policy vector $\mathbf{x}_t^*$ chosen by the two localities and by an executive with ideal point z_k (where k may not be the same as j), given a centralization profile $\mathbf{c}_t$. We denote this utility by $U^e_{j,k}(\mathbf{x}_t^*(z_k, \mathbf{c}_t))$. Comparing the expressions for $U^e_{j,k}(\mathbf{x}_t^*(z_k, \mathbf{c}_t))$ across different centralization profiles and different executives provides two important facts that are summarized in Lemmas 1 and 2.

Lemma 1 shows how party control affects an executive's utility under each centralization profile. Its proof, along with all other proofs, are in the Appendix.

Lemma 1 (Party Control)**.** *The differences between the stage utility of a party j executive when she is in power as opposed to when an executive from party $k \neq j$ is in power are as follows:*

$$U^e_{j,j}\left(\mathbf{x}_t^*(z_j, \mathbf{c}_t)\right) - U^e_{j,k}\left(\mathbf{x}_t^*(z_k, \mathbf{c}_t)\right) = \begin{cases} 0 & \textit{if } \mathbf{c}_t = (0,0) \\ 4z_L^2\omega^2 & \textit{if } \mathbf{c}_t = (0,1) \\ 4z_L^2\omega^2 & \textit{if } \mathbf{c}_t = (1,0) \\ 8z_L^2\omega^2 & \textit{if } \mathbf{c}_t = (1,1) \end{cases} \tag{5}$$

Party control of the executive makes no difference under complete decentralization (i.e., when $\mathbf{c}_t = (0,0)$). This is obviously the case because when both localities choose policies themselves, the executive becomes irrelevant. When at least one of the localities is centralized, the stakes of an election increase as executives become more polarized (lower z_L) and more ideologically- as opposed to welfare-motivated (higher ω). The benefits of winning elections are the same under the two partial centralization profiles and are maximized under full centralization, i.e. when $\mathbf{c}_t = (1,1)$.

Thus *centralization raises the cost of losing the elections*, and decentralization can potentially play an insurance role for the age 1 executive.

The next lemma characterizes the executive's preferences over centralization profiles in a single period. We state the result from the perspective of a party L executive; a symmetric result holds for a party R executive. The result depends on the following threshold values of z_L:

$$\underline{z}_L = \left(2\alpha + \frac{2(1-\alpha)}{\omega} - 1\right) y_1, \tag{6}$$

$$\overline{z}_L = \frac{1}{3}\left(2\alpha + \frac{2(1-\alpha)}{\omega} - 1\right) y_1. \tag{7}$$

Note that the term in parentheses is grater than 1 and decreases in ω and α. It is straightforward to verify that $\underline{z}_L < \overline{z}_L < 0$.

Lemma 2 (Executive Stage Preferences)**.** *For a party L executive:*

(i) When a party L executive is in power, $(1,1) \succ (0,1) \succ (1,0) \succ (0,0)$.

(ii) When a party R executive is in power,

$$(1,1) \succ (0,1) \succ (1,0) \succ (0,0) \text{ if } \overline{z}_L \leq z_L \leq 0,$$

$$(0,1) \succ (1,1) \succ (1,0), (0,1) \succ (0,0) \succ (1,0) \text{ if } \underline{z}_L \leq z_L \leq \overline{z}_L,$$

$$(0,0) \succ (0,1) \succ (1,0) \succ (1,1) \text{ if } z_L \leq \underline{z}_L.$$

Lemma 2 shows that an executive in power has a unique preference ordering over centralization profiles, with more centralization preferred to less. An executive can always increase her stage utility by centralizing a locality. Thus, an age 2 executive will attempt complete centralization. At the same time any executive prefers centralizing the more ideologically distant locality to centralizing the more ideologically close one. In what follows, we use the following terms for such localities:

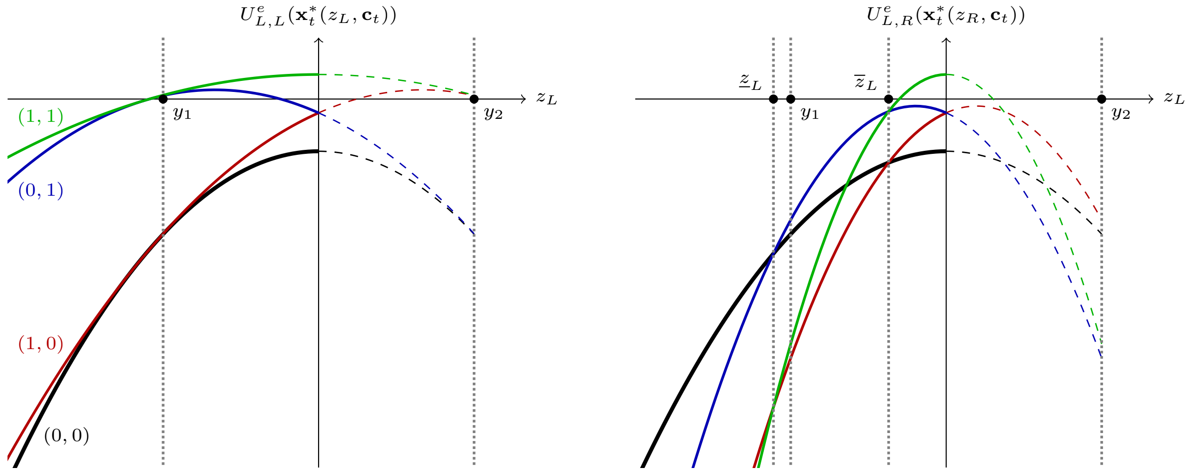
Definition 1 (Ideological ally and opponent)**.** *The ideological ally of an executive j is the locality with the smallest ideological distance from z_j. Analogously, the ideological opponent of an executive j is the locality with the largest ideological distance from z_j.*

The preference ordering is ambiguous when the other party's executive is in power. As before, the executive prefers centralizing the ideological opponent to centralizing her ally. All other comparisons depend on the degree of elite polarization, as given by the location of z_L relative to $\underline{z}_L$ and $\overline{z}_L$. When polarization is low ($\overline{z}_L \leq z_L \leq 0$), the executive out of power prefers full centralization, and when it is high ($z_L \leq \underline{z}_L$), she prefers full decentralization. This suggests that as executives become more extreme relative to localities, they become increasingly inclined to let localities choose policies to guard against the prospect of being out of power.

Several observations about the cutoffs $\underline{z}_L$ and $\overline{z}_L$ follow directly from equations (6) and (7). First, $\underline{z}_L = 3\overline{z}_L$: Higher $\underline{z}_L$ shrinks the range of elite polarization in which at least partial centralization is supported by executives out of power. Second, it is straightforward to see that full decentralization is supported by executives out of power only if the elites are more polarized than localities, i.e. $\underline{z}_L < y_1$. Finally, full centralization can always be preferred by moderate executives, $z_L > y_1 > \overline{z}_L$, if they are sufficiently welfare-motivated: $\omega < \frac{1-\alpha}{2-\alpha}$.

In sum, higher welfare motivation of the executives (lower ω) and localities (lower α) imply a higher range of elite polarization under which even if the opposing party executive holds power, executives from party j will support at least partial centralization. This is to say that there is an alignment between the party preferences, since both of them will value social welfare over their own ideology or their preferred locality. On the contrary, if both executives and localities are more ideologically motivated (high ω and α) then there is high disagreement between the preferences of executives from different parties. As a consequence, executives have incentives to "lock in" full decentralization or centralization of the *unfriendly* locality when they are of age 1, especially if both the probability of winning the upcoming elections, p_t, and the probability of the next executive being *strong*, $1-q$, are low.

Both observations are illustrated in Figure 2 for a party L executive. Stage preferences for party R executives are symmetric with $(0,1)$ replaced by $(1,0)$ and *vice versa*. Panel (a) shows that executive L has a strict preference ordering over the centralization profiles if she is in power. On the contrary, it is evident from panel (b) that executive L's preference ordering changes as she becomes more extreme, i.e. z_L decreases. Recall, that since $z_R = -z_L$, a decrease in z_L implies more party polarization. We can see that only if parties are more extreme than the localities they represent, executive L prefers full decentralization, $(0,0)$, when her opponent is in power.



(a) $(1,1) \succ (0,1) \succ (1,0) \succ (0,0)$ **(b)** $(0,1) \succ (1,0)$

Figure 2: Stage preferences of an executive from party L given the executive in power and centralization profile, and $\alpha = 5/6, \omega = 3/4, y_1 = -3$. In both panels for the relevant domain of z_L: Solid black line depicts executive L's stage utility from centralization profile $\mathbf{c}_t = (0,0)$, red – from $\mathbf{c}_t = (1,0)$, blue – from $\mathbf{c}_t = (0,1)$, and green – from $\mathbf{c}_t = (1,1)$. $U^e_{L,R}(\mathbf{x}^*_t(z_R, \mathbf{c}_t))$ stands for utility of executive L if the executive R is in power and implements policy under centralization profile $\mathbf{c}_t$.

3.2 Infinite Horizon

In the full game, a party j executive who comes into power in period t faces the possibility that she may be replaced in the following period by an executive from the opposing party. If she is re-elected, then given the single period preferences of executives derived in the previous section, any strong executive of age 2 will choose full centralization ($\mathbf{c}_{t+1} = (1,1)$) and will implement her optimal policy (4) for both localities. If she is not re-elected, then the opposing party's executive will choose a new centralization profile if she is strong. This produces a distribution of possible centralization profiles in $t+1$, where $\mathbf{c}_{t+1}$ depends on the realization of p_{t+1}. We denote the period t executive's expected utility of this lottery by $\mathbb{E}_{p_{t+1}}\left[U^e_{j,k}(\mathbf{x}^*_{t+1}(z_k, \mathbf{c}_{t+1}))\right]$.

These elements allow us to fully describe the dynamic objective, $V_j(\mathbf{c}_t, p_t)$. By the symmetry of the game, we focus on a party L executive's problem. The expected lifetime utility of a strong party L executive who comes into power in period t for the first time and observes her probability of re-election p_t can be written as follows:

$$V_L(\mathbf{c}_t, p_t) = U^e_{L,L}(\mathbf{x}^*_t(z_L, \mathbf{c}_t)) + p_t\Big[qU^e_{L,L}(\mathbf{x}^*_t(z_L, \mathbf{c}_t)) + (1-q)U^e_{L,L}(\mathbf{x}^*_t(z_L,(1,1)))\Big] + (1-p_t)\Big[qU^e_{L,R}(\mathbf{x}^*_t(z_R, \mathbf{c}_t)) + (1-q)\,\mathbb{E}_{p_{t+1}}\left[U^e_{L,R}(\mathbf{x}^*_{t+1}(z_R, \mathbf{c}_{t+1}))\right]\Big]. \quad (8)$$

The expected lifetime utility of a party R executive can be expressed analogously by switching L and R subscripts and switching p_t and $1-p_t$ in the expression above.

An important observation is that the utility that an executive of age 1 in period t will earn in period $t+1$ if the executive in that period is strong does not depend on the centralization profile $\mathbf{c}_t$ that the age 1 executive chooses in period t. If tomorrow's executive is strong, her choice of centralization profile will not be constraint by the centralization profile that the age 1 executive chooses today. What matters for the age 1 executive's choice of centralization profile in period t is the case in which the $t+1$ executive is weak and thus constraint to choose policy under the centralization profile $\mathbf{c}_t$ implemented by the age 1 executive.

Recall from Lemma 2 that $(1,0)$ is dominated for party L in the stage game. Hence, it can never be optimal for a first-period executive. In a similar fashion, $(0,1)$ is dominated for party R. Consequently, a party L executive of age 1 effectively chooses between three "increasing" levels of centralization ($(0,0)$, $(0,1)$, and $(1,1)$). The first-period executive can maximize her utility in period t by implemeting full centralization $(1,1)$. In period $t+1$, however, the first-period executive may no longer be in office, and, as we know from Lemma 1, higher levels of centralization increase the stakes of losing the election. Hence in deciding how much to centralize today, the first-period executive trades off the benefit of being able to choose policy today and potentially tomorrow with the risk of her opponent being able to set policies in centralized localities tomorrow.

How the age 1 executive resolves this trade-off will depend on her probability of re-election p_t. An executive that has high chances of being in office tomorrow may find it optimal to choose more centralized institutional arrangements, while decentralization will be appealing to a first-period executive that faces an adverse electoral environment. In line with this reasoning, the expected lifetime utility of a strong age 1 executive increases linearly with p_t and more so, the higher the level of centralization that the executive chooses in period t. In other words, *the benefits of* *greater centralization are increasing in the executive's electoral prospects*, and thus in equilibrium centralization must be monotonically increasing in p_t.

To derive conditions under which a party j executive switches between centralization profiles, we find the values of p_t at which she is indifferent between centralization profiles. Equating different values of $V_j(\mathbf{c}_t, p_t)$ produces two important cut-offs on the probability of re-election. We denote these cut-offs $\underline{p}$ and $\overline{p}$.

The executive from party L is indifferent between $(0,0)$ and $(0,1)$, and the executive from party R is indifferent between $(0,0)$ and $(1,0)$ when their probability of re-election is:

$$\underline{p} = 1 - \frac{1+q}{q}\left(\frac{z_L + (2\alpha + 2(1-\alpha)/\omega - 1)\, y_1}{2z_L}\right)^2. \tag{9}$$

Analogously, the executive from party L is indifferent between $(1,1)$ and $(0,1)$, and the executive from party R is indifferent between $(1,1)$ and $(1,0)$, when their probability of re-election is:

$$\overline{p} = 1 - \frac{1+q}{q}\left(\frac{z_L - (2\alpha + 2(1-\alpha)/\omega - 1)\, y_1}{2z_L}\right)^2. \tag{10}$$

It is clear from equations (9) and (10) that $\underline{p} < \overline{p} < 1$.

The following result summarizes the optimal choice of centralization profile by *strong* party j executives given the electoral uncertainty they face.

Proposition 1 (Optimal Centralization)**.** *The optimal centralization profile for the* strong *age* 1 *executive from party L is:*

$$\mathbf{c}_L^* = \begin{cases} (0,0) & \textit{if } p_t < \underline{p} \\ (0,1) & \textit{if } \underline{p} \leq p_t < \overline{p} \\ (1,1) & \textit{if } p_t \geq \overline{p}. \end{cases} \tag{11}$$

For a strong age 1 party R executive, the optimal decision on the centralization profile $\mathbf{c}_R^*$ is symmetric, replacing $(0,1)$ by $(1,0)$ and p_t by $1 - p_t$.

Proposition 1 confirms our earlier intuition about the insurance value of decentralization: When strong executives face a low probability of re-election, they respond in equilibrium by decentralizing the locality that is ideologically close to them ($\mathbf{c}_t = (0, 1)$ for executive L) or even both localities ($\mathbf{c}_t = (0, 0)$). With some rigidity, this prevents their opponent from having policy-making power in the future. By contrast, a high probability of re-election makes executives more "greedy": They might attempt full centralization, anticipating that they are likely to be in office in the future but might not be able to change the level of centralization because of rigidity.

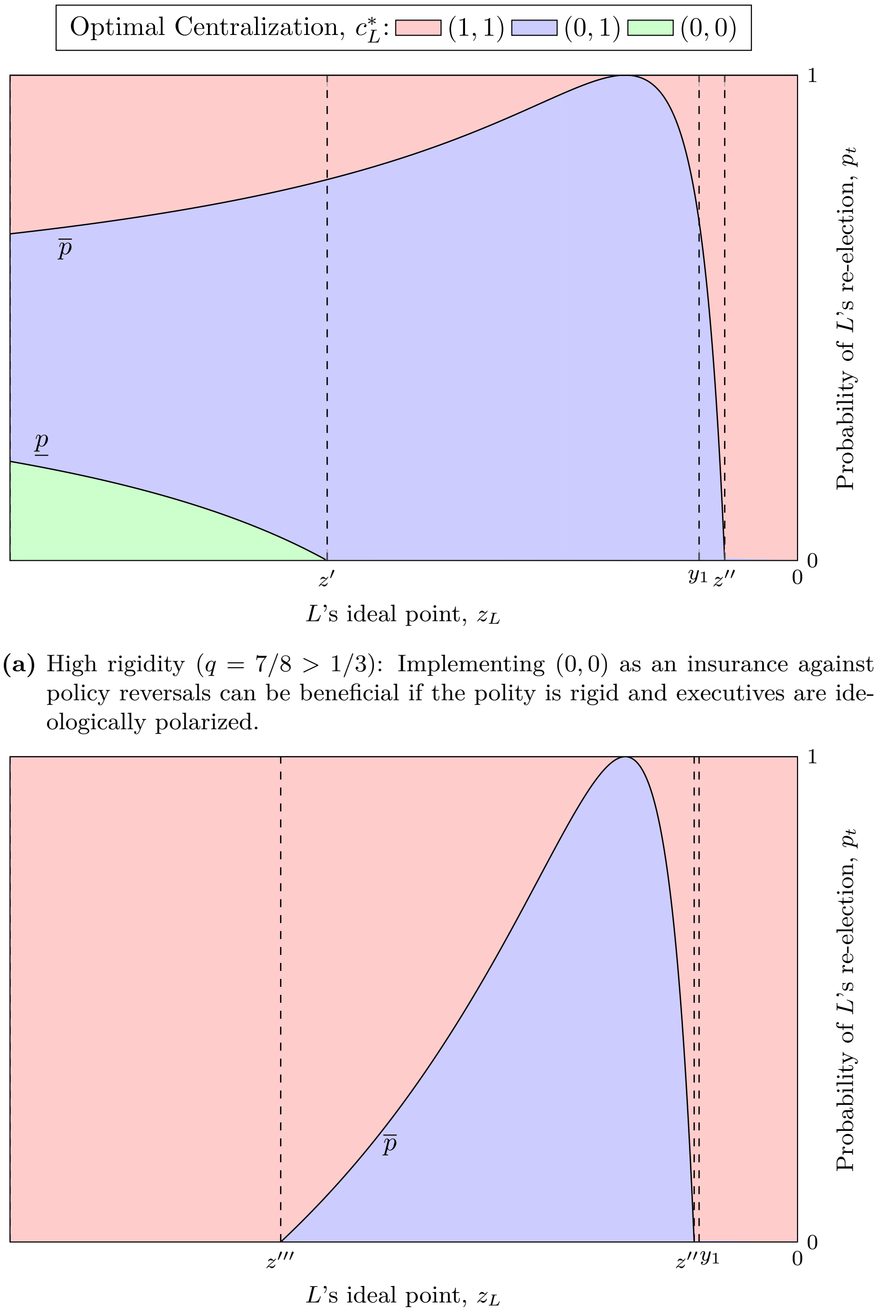
Under what conditions can full centralization and decentralization arise? The answer requires considering the conditions under which the thresholds $\overline{p}$ and $\underline{p}$ fall into the relevant range from 0 to 1. It is easy to show that $\overline{p} \leq 1$, i.e., there always exists an election probability for which strong executives from either party will at least weakly prefer full centralization. Intuitively, full centralization has few downsides for an executive who is certain of re-election. We can furthermore find conditions under which *only* full centralization obtains in equilibrium, which occurs if $\overline{p} \leq 0$. By comparison, decentralization is more difficult. For the executive in power to prefer full decentralization we need $\underline{p} > 0$, which is not guaranteed to hold.

Subsequently, we discuss how $\overline{p}$ and $\underline{p}$ change with elite polarization and rigidity. In doing so, it will be helpful to distinguish between two kinds of polities:

Definition 2 (Rigidity)**.** *A polity has* <u>*high rigidity*</u> *if* $q > \frac{1}{3}$ *and* <u>*low rigidity*</u> *if* $q < \frac{1}{3}$.

Figure 3 plots $\overline{p}$ and $\underline{p}$ as a function of z_L, the ideal point of a left executive. The upper panel considers a high and the lower panel considers a low rigidity environment. As can be seen in the upper panel, $\underline{p}$ decreases with z_L. Recall that executives' ideal points are symmetric around zero. An increase in z_L thus corresponds to a decrease in z_R and moves executive ideal points closer together. As her ideal point moves closer to that of her opponent, a given age 1 executive becomes less concerned about the possibility of having her opponent executive set policy in centralized states. The value of implementing full decentralization to ensure against adverse electoral outcomes drops and partial centralization becomes more attractive. We denote by z' the value of z_L for which $\underline{p} = 0$. If executives are so moderate that z_L is located to the right of z', full decentralization will never arise in equilibrium.

The relationship between $\overline{p}$ and z_L is more complicated. Both panels of the Figure 3 show that $\overline{p}$ first increases and then decreases with z_L. Put differently, as executives become less polarized, par-



(a) High rigidity ($q = 7/8 > 1/3$): Implementing $(0, 0)$ as an insurance against policy reversals can be beneficial if the polity is rigid and executives are ideologically polarized.

(b) Low rigidity ($q = 1/8 < 1/3$): Implementing $(0, 0)$ as an insurance against policy reversals is not beneficial if institutional arrangement is not stable, so $(0, 1)$ becomes a "middle ground."

Figure 3: Rigidity, polarization and centralization preferences. Colors represent optimal centralization profile that maximizes lifetime expected utility of age 1 L executive. Here $\alpha = 5/8$, $\omega = 1/2$, and $y_1 = -5/4$. Solid black lines represent $\underline{p}$ and $\overline{p}$.

tial centralization (**blue** regions) gains in attractiveness relative to full centralization (**red** regions) at first, but ultimately loses its value. This non-linearity stems from changes in the trade-off that age 1 executives face in deciding whether to centralize the locality on their side of the ideological spectrum. On the one hand, decentralizing her ideological ally prevents the executive from setting policy in this locality today and potentially also in the future if she remains in power. On the other hand, decentralizing her ideological ally can benefit the executive by preventing her opponent from setting potentially extreme policies in the future. As executives that are more extreme than their ideological allies become more moderate, i.e. move towards their ideological allies, the ideological costs of decentralizing the ally decrease. Partial centralization becomes more attractive relative to full centralization. This dynamic reverses as executives become ideologically close to and ultimately more moderate than their ideological allies. A move towards the center now moves the executive further away from her ideological ally, thereby making decentralizing the ally more costly. As executives become very moderate, they may be closer to each other than to their respective ideological allies, which completely removes any motive for implementing partial centralization.

Given this non-linearity, it is possible for $\overline{p}$ to be equal to zero at two different values of z_L as is the case in the lower panel in the Figure 3. We denote these two values by, respectively, z''' and z''. The relevance of these different cutoffs on z_L will depend on the level of rigidity q. In high rigidity environments (upper panel), both $\underline{p}$ and $\overline{p}$ cross the horizontal axis once, i.e., only z' and z'' fall into the relevant range. As q decreases, the locus of $\underline{p}$ shifts downwards. Intuitively, the insurance value of decentralization depends on it being likely that a decentralized arrangement chosen today will survive into the next period. Where rigidity is low, future executives will likely be able to change the centralization profile and so there is no point for a current executive to give up policy making authority in order to "lock in" decentralization. In low rigidity environments (lower panel), $\underline{p}$ is thus negative across the entire range of z_L, complete decentralization is never optimal and z' is irrelevant. $\overline{p}$, on the other hand, can be positive and partial centralization optimal even under low rigidity. The reason is that decentralizing her ideological ally will be almost costless for the executive in power if this locality's ideal point is very close to the executive's own preferred policy. As executives become more extreme than their ideological allies, however, the value of partial centralization dissipates rapidly if rigidity is low. Given that partial centralization is unlikely to survive into the future, extreme executives are hesitant to give up policy-making authority even to moderate localities on their side of the ideological spectrum. As the curve that represents the locus of $\overline{p}$ becomes steeper, it ends up crossing the horizontal axis twice at both z''' and z''.

Proposition 2 summarizes the relationship between rigidity, elite polarization and optimal centralization decisions. The main result is that full decentralization requires both high rigidity and elite polarization ($z_L < z'$). Full centralization across the range of p_t is possible under the combination of high rigidity and low polarization ($z_L > z''$). Under low rigidity, the relationship between full centralization and polarization becomes non-monotonic. As before, symmetric statements hold for a newly elected party R executive, replacing $(0,1)$ by $(1,0)$ and p_t by $1 - p_t$.

Proposition 2 (Elite Polarization and Centralization)**.** *There exist z', z'', and z''' such that:*

(i) Under high rigidity, $\mathbf{c}_L^*$ is

$$\begin{cases} \in \{(0,0),(0,1),(1,1)\} & \text{if } z_L < z' \\ \in \{(0,1),(1,1)\} & \text{if } z_L \in [z', z'') \\ = (1,1) & \text{otherwise} \end{cases}$$

(ii) Under low rigidity, $\mathbf{c}_L^*$ is

$$\begin{cases} \in \{(0,1),(1,1)\} & \text{if } z_L \in [z''', z'') \\ = (1,1) & \text{otherwise} \end{cases}$$

Using the calculated values of z', z'', and z''' in the proof of Proposition 2, we can be more specific about the polarization levels required for different centralization profiles of interest. Take for example the case where rigidity is high. It is easily shown that full decentralization requires $z_L < y_1$: Executives must be *more* extreme than the localities.

What do the combination of Propositions 1 and 2 imply about the equilibrium strategies of executives from different parties? As shown in Figure 3, the main scenarios depend on the level of institutional rigidity q. First consider the case of a polity with high rigidity. In this case high elite polarization ($z_L < z' < y_1$) leads to three possible scenarios for a strong executive:

1. If the probability of re-election is low, she will try to "lock in" full decentralization, depriving her possible successor of an opportunity to impose policies.
2. If the probability of re-election is moderate, she will only centralize the ideologically opposing locality. This middle ground balances insurance against defeat with the likelihood of retaining office and not having an opportunity to change the centralization.
3. If the probability of re-election is high, she will choose full centralization, anticipating high chances of her retaining the office.

The picture differs in the case of a polity with low rigidity. Here the "lock in" strategy described above is not sufficiently beneficial to executives in power. Even if they anticipate leaving office, they will attempt to grab as much as possible while in power by choosing more centralized profiles. This means that full centralization becomes more likely even when elites are highly polarized ($z_L < z''' < y_1$). In addition, executives still use full centralization if they are sufficiently welfare-motivated and/or elite polarization is low ($z_L > z''$).

In sum, given the distributional assumptions on p_t, high rigidity will generate variation across all centralization profiles in the long run. Low rigidity will result in more stability, but also more centralization. Under low rigidity, there will never be complete decentralization, and in some cases even partial centralization will be absent.

4 Welfare

Our preceding results do not answer the question of when policy outcomes are socially optimal. This section presents two results that evaluate the welfare consequences of endogenous centralization choices. The first looks at the optimal policy choices within a given period. The second provides some sense of equilibrium performance over time, at least for parts of the parameter space and under the assumption that election probabilities are drawn from a standard uniform distribution.

An initial issue is the selection of a welfare standard. Consistent with the executive's valuation of locality utility in the basic model, we use the sum of utilities of the two localities, defined as follows:

$$
\begin{aligned}
W\left(\mathbf{x}_t\right) &= \sum_i U_i(\mathbf{x}_t, y_i) \\
&= \alpha \sum_i u\left(x_{i,t}, y_i\right) + (1-\alpha)\sum_i u\left(x_{i,t}, y_{-i}\right).
\end{aligned}
$$

The expression for $W(\mathbf{x}_t)$ makes clear that welfare is independent of election probabilities. Since equilibrium strategies in our game depend on election prospects, deviations from welfare-maximizing centralization profiles will be inevitable. Welfare can depend on the executive's preferences, as x_t might depend on z_L when there is some centralization.

4.1 One Period

As in the preceding analysis, we focus without loss of generality on the case of a party L executive. For each centralization profile, we can substitute the equilibrium policy choices into the localities' utility functions to arrive at the following welfare values.

$$
W_c\left(\mathbf{x}_t^*\right) = \begin{cases}
8(\alpha-1)y_1^2 & \mathbf{c}_t = (0,0) \\
-\left(4\alpha^2(\omega^2-1) - 4\alpha\omega^2 + \omega^2 + 4\right) y_1^2 + 2(1-2\alpha)\omega^2 y_1 z_L - \omega^2 z_L^2 & \mathbf{c}_t = (0,1) \\
-\left(4\alpha^2(\omega^2-1) - 4\alpha\omega^2 + \omega^2 + 4\right) y_1^2 - 2(1-2\alpha)\omega^2 y_1 z_L - \omega^2 z_L^2 & \mathbf{c}_t = (1,0) \\
-2\left(4\alpha^2(\omega^2-1) - 4\alpha(\omega^2-1) + \omega^2\right) y_1^2 - 2\omega^2 z_L^2 & \mathbf{c}_t = (1,1)
\end{cases} \tag{12}
$$

Independently of the centralization profile, the "first best" policies that maximize $W(\mathbf{x}_t)$ are $-y_1(1-2\alpha)$ and $y_1(1-2\alpha)$ for localities 1 and 2, respectively, which result in $W(\mathbf{x}_t) = -8y_1^2(1-\alpha)\alpha$. The values of $W_c\left(\mathbf{x}_t^*\right)$ can only attain the first best if $\alpha = 1$.

The optimal centralization profile from a welfare perspective depends on two thresholds for α. First, when spillovers are very low ($\alpha > (2+\omega)/(2+2\omega)$), full decentralization dominates full centralization. Low spillovers reduce the value of coordination and thus the benefit of centralization. This threshold depends on the extent to which the executive values local policy utility (ω), since an executive who cares more about her own utility reduces the scope for welfare improvements from centralization.

Second, when $\alpha > 1/2$, welfare is higher under centralization profile $(1, 0)$ than under $(0, 1)$. This ordering is reversed when $\alpha < 1/2$. Centralizing an opposed locality (i.e., locality 2) under low spillovers reduces welfare because it allows the executive to manipulate its policy excessively. By contrast, high spillovers attenuate the welfare loss from setting locality 2's policy closer to the locality 1's policy.

The expressions in Equation (12) allow us to derive the following result on welfare-maximizing centralization profiles.

Proposition 3 (Static Welfare)**.** *If* $\alpha > \frac{2+\omega}{2+2\omega}$*, then the welfare maximizing centralization profile in a single period is:*

$$\mathbf{c}^*_W = \begin{cases} (0,0) & \text{if } z_L < \frac{y_1(2\alpha(\omega-1)-\omega+2)}{\omega} \\ (1,0) & \text{otherwise.} \end{cases}$$

If $\alpha \in \left(\frac{1}{2}, \frac{2+\omega}{2+2\omega}\right]$*, the welfare maximizing centralization profile in a single period is:*

$$\mathbf{c}^*_W = \begin{cases} (0,0) & \text{if } z_L < \frac{y_1(2\alpha(\omega-1)-\omega+2)}{\omega} \\ (1,0) & \text{if } z_L \in \left[\frac{y_1(2\alpha(\omega-1)-\omega+2)}{\omega}, \frac{y_1(-2\alpha(\omega+1)+\omega+2)}{\omega}\right) \\ (1,1) & \text{otherwise.} \end{cases}$$

If $\alpha \leq \frac{1}{2}$*, then welfare maximizing centralization profile in a single period is:*

$$\mathbf{c}^*_W = \begin{cases} (0,0) & \text{if } z_L < \frac{y_1(2\alpha(1-\omega)+\omega+2)}{\omega} \\ (0,1) & \text{if } z_L \in \left[\frac{y_1(-2\alpha(\omega+1)+\omega+2)}{\omega}, \frac{y_1(2\alpha(1-\omega)+\omega-2)}{\omega}\right) \\ (1,1) & \text{otherwise.} \end{cases}$$

Complete decentralization always maximizes welfare when z_L is sufficiently extreme. This coincides with the necessary condition for equilibrium complete decentralization in Proposition 2. And for all but very high values of α, welfare-maximizing complete centralization is also possible when elite polarization is low, as Proposition 2 also suggests. However, by Proposition 1, these profiles are only chosen under specific electoral conditions, and it is always possible for an executive not to choose the welfare maximizing profile.

The biggest distortions to welfare occur when $\alpha > 1/2$. In these cases, welfare maximization calls for centralizing the "friendlier" locality over a range of z_L, but the party L executive never does this in equilibrium. Thus, roughly speaking, welfare-maximizing profiles are more likely when $\alpha < 1/2$, as high spillovers ensure the existence of some realized re-election probabilities that will result in the choice of $\mathbf{c}_W^*$. Unfortunately, $\alpha < 1/2$ seems unlikely in a two-locality world, as it implies that each locality cares about the other locality's policy more than its own.

4.2 Dynamic Welfare

Finally, we provide an exploratory analysis of welfare performance over time. To do so, we make the simplifying assumption that re-election probabilities are drawn from a standard uniform distribution, i.e. $p_t \sim \mathrm{U}[0,1]$. This assumption allows us to derive an expression for the average level of welfare that results in equilibrium over the infinite horizon. Restricting attention to the part of the parameter space in which full, partial and no centralization are possible, we then compare equilibrium welfare to three benchmark scenarios. The benchmarks correspond to institutional arrangements that fix the centralization profile over time. In other words, we compare welfare in our equilibrium to welfare in a world in which (i) policies in both states are always set by the executive in power ($\mathbf{c}_t = (1,1)$ for all t), (ii) executives always set policy in one state but not the other ($\mathbf{c}_t = (0,1)$ for all t or $\mathbf{c}_t = (1,0)$ for all t) and (iii) both localities always set policies for themselves ($\mathbf{c}_t = (0,0)$ for all t).

If both states are always centralized or never centralized, the same level of welfare results in every period. Long-run average welfare under (i) and (iii) is thus simply given by, respectively, $\Omega_{11} = W_{11}(\mathbf{x}_t^*)$ and $\Omega_{00} = W_{00}(\mathbf{x}_t^*)$. For the case in which one state is centralized and the other is not, welfare may change from period to period as the executive in power changes. The reason is that the policy that an executive chooses for her ideological ally differs from the policy that an executive implements in a centralized state that is her ideological opponent. Under the assumption that p_t is drawn from a standard uniform distribution, either executive is in power half of the time in expectation. Long-run average welfare under partial centralization is thus given by

$$\Omega_{10} = \Omega_{01} = \frac{1}{2} * W_{10}\left(\mathbf{x}_t^*\right) + \frac{1}{2} * W_{01}\left(\mathbf{x}_t^*\right).$$

Now that we have expressions for welfare under our three benchmarks, how do we derive long run average welfare in equilibrium? To do so, we note that we can conceive of equilibrium play as a Markov chain that moves through states that are defined by the type $j \in \{L, R\}$ of the executive in power, the age $a_t \in \{1, 2\}$ of the executive, by whether the executive is strong or weak, and, if the executive is weak, by the centralization profile $\mathbf{c}_t \in \mathcal{C}$ under which policy is being chosen. Conditional on the executive's age and type, all periods in which the executive is strong can be grouped together as one state. To see why, recall that the centralization profile that executives implement when they are strong depends only on their age, their type and the realization of p_t but not on the centralization profile chosen in the previous period. Considering that there are four possible centralization profiles, the Markov chain thus moves through twenty possible states, $2 \times 2 \times 4 = 16$ possible states in which the executive is weak and $2 \times 2 = 4$ possible states in which the executive is strong.

Our characterization of equilibrium behavior allows us to derive the probability that equilibrium play moves from any given state to any other of the twenty states. Several facts facilitate this exercise. First, the probability that equilibrium play moves from any state into a state in which the executive is weak is simply q. Conversely, the probability that equilibrium play moves from any state into a state in which the executive is strong is $1 - q$. Moreover, since weak executives cannot change the centralization profile, equilibrium play can never move from a state in which a given centralization profile has been implemented to a state in which the executive is weak but policy is chosen under a different centralization profile. Finally, if the executive today is of age 2, equilibrium play must subsequently move to a state with an age 1 executive. Conversely, if the executive today is of age 1, equilibrium play can move to a state in which the executive is of age 1 or 2 depending on whether the current executive is re-elected. Re-election happens, in expectation, with probability $\frac{1}{2}$.

Taken together, these considerations make it easy to determine the probability of transitioning from any state in which the executive is weak to any other state. Where a transition between two states in which the executive is weak is possible, it happens with probability $\frac{1}{2}q$. Possible transitions from states in which the executive is weak to states in which the executive is strong happen with probability $\frac{1}{2}(1-q)$. Transitions from a state in which the executive is strong to another state in which the executive is strong also happen with probability $\frac{1}{2}(1-q)$ where they are possible.

Things are slightly more complicated for transitions from states in which the executive is strong to states in which the executive is weak. From a state with a strong age 2 executive, play can only transition to a state with a weak executive if this state features full centralization $\mathbf{c}_t = (1,1)$. A possible transition of this kind happens with probability $\frac{1}{2}q$. From a state with a strong age 1 executive, however, transitions can happen to states with weak executives and different centralization profiles, depending on the realization of p_t that determines which centralization profile the strong age 1 executive chooses. Finding the probabilities of transitioning from states with a strong age 1 executive to states with a weak executive of a particular age and type and with a particular centralization profile thus requires expressions for the probability that p_t falls into the range that makes it optimal for a strong age 1 executive of that type to implement that particular centralization profile. Moreover, it also requires taking into account the expected probability of re-election of the executive in power *conditional* on p_t falling into a particular range.

Fortunately, these probabilities can easily be computed under the assumption that p_t is drawn from a standard uniform distribution. For example, if in equilibrium strong age 1 executive L chooses $\mathbf{c}_t = (0,1)$, the probability of moving from this state to a state with a weak age 1 executive R that has to choose policy under $\mathbf{c}_t = (0,1)$ is given by

$$(\overline{p} - \underline{p})\left(1 - \frac{\underline{p} + \overline{p}}{2}\right),$$

where the first term represents the probability that p_t falls in the range in which a strong age 1 executive from the left party finds it optimal to implement $\mathbf{c}_t = (0,1)$. The second term corresponds to the conditional probability that the executive loses the election.

Recall that parameter values can be such that a strong age 1 executive would never choose decentralization or always choose centralization in equilibrium. In principle, we would thus have to consider three different versions of this Markov process that correspond to the three possible scenarios that can occur in equilibrium. In the first, strong age 1 executives with some probability choose to implement no, partial or full centralization. In the second, strong age 1 executives with some probability choose to implement partial or full centralization. The final possibility is a degenerate process in which full centralization is implemented in every period. Hence, under parameter values that result in this third case, the long run average welfare under the equilibrium is the same as the benchmark welfare W_{11}. In what follows, we restrict attention to the first case–the only case where full decentralization, $c_t = (0,0)$ is implemented in equilibrium with non-zero probability.

With the transition probabilities in hand, we calculate the long run probability of the system being in each of the twenty states. Given that welfare in any particular period depends only on the centralization profile implemented in that period, we can use the resulting twenty probabilities to calculate the long-run probability of being in a state with full centralization, ϕ_c, a state with full decentralization, ϕ_d, a state with partial centralization where the ideological ally of the executive in power is centralized, ϕ_a, and a state with partial centralization where the ideological opponent of the executive in power is centralized, ϕ_e. These long-run probabilities are given by[4]

$$\begin{aligned}
\phi_c &= 1 - \frac{2}{3}\overline{p} \\
\phi_d &= \frac{2}{3}\underline{p} \\
\phi_a &= \frac{1}{3}(\overline{p} - \underline{p})\left((2 - \overline{p} - \underline{p})q + (\overline{p} + \underline{p} - 1)q^2\right) \\
\phi_e &= \frac{1}{3}(\overline{p} - \underline{p})\left(2 - (2 - \overline{p} - \underline{p})q - (\overline{p} + \underline{p} - 1)q^2\right).
\end{aligned}$$

Finally, long-run equilibrium welfare can be calculated as

$$\Omega_e = \phi_c W_{11}\left(\mathbf{x}_t^*\right) + \phi_d W_{00}\left(\mathbf{x}_t^*\right) + \phi_a W_{10}\left(\mathbf{x}_t^*\right) + \phi_e W_{01}(\mathbf{x}_t^*). \tag{13}$$

[4]The long-run probabilities for the case in which only full and partial centralization are possible can be found by setting $\underline{p} = 0$ in the above expressions. Note that if we set $\underline{p} = \overline{p} = 0$, then these long-run probabilities simplify to $\phi_c = 1$ and $\phi_d = \phi_a = \phi_e = 0$, i.e., the case in which only full centralization is possible.

A comparison of long-run equilibrium welfare to the three benchmarks that fix the centralization profile over time yields the following proposition.

Proposition 4 (Dynamic Welfare)**.** *Under high rigidity and* $z_L < z'$*, the following holds:*

$$\Omega_{00} > \Omega_{10} = \Omega_{01} > \Omega_e > \Omega_{11}$$

Proposition 4 states that in the case where all three centralization profiles are possible (i.e. both rigidity and executive polarization are high), fixing full decentralization brings the highest social welfare, while fixing full centralization brings the lowest. The long-run equilibrium welfare is always bounded by partial centralization and full centralization.

These results seem intuitive when taking into account that this case requires executives to be more extreme than localities. Under high elite polarization, full centralization leads to extreme policies. The equilibrium performs better than full centralization, since other centralization profiles will be implemented in equilibrium with non-zero probability. At the same time, on the equilibrium path full centralization will be observed more frequently than other centralization profiles, since all age 2 executives implement $c_t = (1, 1)$. Hence, equilibrium welfare is lower than welfare under the other two benchmarks.

5 Discussion

The allocation of policy-making authority is a key factor in determining policy outcomes, and therefore the question of centralization versus decentralization has long been a concern to institution designers. An extensive literature has addressed the role of decentralization in producing externalities, generating information, and diffusing policies. However, as recent examples make clear, ideology is often a primary driver of such decisions. This paper isolates the roles of ideology and electoral turnover to generate a purely political account of centralization choices.

Using a simple infinite horizon policy-making model, we show that ideological polarization and re-election prospects play important roles in pushing politicians away from fully centralized policy.

The central intuition is that decentralization can allow current politicians to insure against future politicians' efforts at imposing unfavorable policies. For this mechanism to work, institutional rigidities are crucial. In a system without rigidities or under unified government, majorities can easily undo decentralization and insurance is impossible. But in an environment with rigidities, centralization is increasing in an incumbents' likelihood of re-election. We show that partial decentralization is the norm, with complete decentralization predicted only when polarization is very high. These comparative statics contrast sharply with those of models based on experimentation, in which central policies ultimately reflect good experimental results.

Our framework is simple enough to allow the exploration of many institutional features that we have so far suppressed. Two directions immediately stand out. First, many political systems feature asymmetries in either ideologies or partisan balance. The "trifecta" states mentioned in the introduction illustrate the dilemma of liberal cities in persistently conservative states in the U.S. Second, election probabilities could be endogenized by allowing a median voter to arise from one of the two localities in each period. The need to design policies to cater to this voter might help to discipline central politicians. Both features could further illustrate how the interaction between institutions and ideology on policy centralization could have important effects on the quality of policies and citizen welfare.

Appendix

Proof of Lemma 1. Using the expressions for $U^e_{j,k}(\mathbf{x}^*_t(z_k, \mathbf{c}_t), \mathbf{y})$ and substituting for $y_2 = -y_1$ and $z_R = -z_L$ yields

For executive L:

$$U^e_{L,L}(\mathbf{x}^*_t(z_L, \mathbf{c}_t)) = \begin{cases} y_1^2(-8\alpha(\omega-1)+6\omega-8) - 2\omega z_L^2, & \text{if } \mathbf{c}_t = (0,0) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2 + 2(\omega-2)\right) + \\ \qquad 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2) + (\omega-2)\omega z_L^2, & \text{if } \mathbf{c}_t = (0,1) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2 + 2(\omega-2)\right) + \\ \qquad 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2) + (\omega-2)\omega z_L^2, & \text{if } \mathbf{c}_t = (1,0) \\ 2(\omega-1)\left(y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega) + \omega z_L^2\right), & \text{if } \mathbf{c}_t = (1,1) \end{cases}$$

$$U^e_{L,R}(\mathbf{x}^*_t(-z_L, \mathbf{c}_t)) = \begin{cases} y_1^2(-8\alpha(\omega-1)+6\omega-8) - 2\omega z_L^2, & \text{if } \mathbf{c}_t = (0,0) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2 + 2(\omega-2)\right) + \\ \qquad 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2) - \omega(3\omega+2) z_L^2, & \text{if } \mathbf{c}_t = (0,1) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2 + 2(\omega-2)\right) + \\ \qquad 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2) - \omega(3\omega+2) z_L^2, & \text{if } \mathbf{c}_t = (1,0) \\ 2(\omega-1)y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega) - 2\omega(3\omega+1) z_L^2, & \text{if } \mathbf{c}_t = (1,1) \end{cases}$$

For executive R:

$$U^e_{R,R}(\mathbf{x}^*_t(-z_L,\mathbf{c}_t)) = \begin{cases} y_1^2(-8\alpha(\omega-1)+6\omega-8)-2\omega z_L^2, & \text{if } \mathbf{c}_t=(0,0) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right)+ & \\ \qquad 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2)+(\omega-2)\omega z_L^2, & \text{if } \mathbf{c}_t=(0,1) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right)+ & \\ \qquad 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2)+(\omega-2)\omega z_L^2, & \text{if } \mathbf{c}_t=(1,0) \\ 2(\omega-1)\left(y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega)+\omega z_L^2\right), & \text{if } \mathbf{c}_t=(1,1) \end{cases}$$

$$U^e_{R,L}(\mathbf{x}^*_t(z_L,\mathbf{c}_t)) = \begin{cases} y_1^2(-8\alpha(\omega-1)+6\omega-8)-2\omega z_L^2, & \text{if } \mathbf{c}_t=(0,0) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right)+ & \\ \qquad 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2)-\omega(3\omega+2)z_L^2, & \text{if } \mathbf{c}_t=(0,1) \\ y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right)+ & \\ \qquad 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2)-\omega(3\omega+2)z_L^2, & \text{if } \mathbf{c}_t=(1,0) \\ 2(\omega-1)y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega)-2\omega(3\omega+1)z_L^2, & \text{if } \mathbf{c}_t=(1,1) \end{cases}$$

Subtracting expressions for particular executive and centralization profile when executives from different parties are in power implies equation (5).

Proof of Lemma 2. The preference orderings for each type of executive and for cut-offs directly follow from comparison of relevant expressions in the proof of Lemma 1.

Proof of Proposition 1. It will be useful to denote the difference between the terms that correspond to the age 1 period t executive's utility from a strong executive in period $t+1$ as:

$$\forall j \in \{L,R\}: \ \Delta \equiv U^e_{j,j}(\mathbf{x}^*_t(z_j,(1,1))) - \mathbb{E}_{p_{t+1}}\left[U^e_{j,-j}(\mathbf{x}^*_{t+1}(z_{-j},\mathbf{c}_{t+1}))\right].$$

It is straightforward to see that due to symmetrical ideal points of executives and localities, Δ does not depend on the executive's party. In addition $\Delta > 0$, since $U^e_{j,j}(\mathbf{x}^*_t(z_j,(1,1)))$ is the maximum possible stage utility a party j executive can receive and no lottery over other possible policy choices can bring higher utility.

To see how the electoral environment changes the incentives to adopt different centralization profiles, we take the derivative of $V_L(\mathbf{c}_t, p_t)$ with respect to p_t at each possible profile:

$$\frac{\partial V_L(\mathbf{c}_t, p_t)}{\partial p_t} = \begin{cases} (1-q)\,\Delta & \text{if } \mathbf{c}_t = (0,0) \\ q\,4\omega^2 z_L^2 + (1-q)\,\Delta & \text{if } \mathbf{c}_t = (0,1) \\ q\,4\omega^2 z_L^2 + (1-q)\,\Delta & \text{if } \mathbf{c}_t = (1,0) \\ q\,8\omega^2 z_L^2 + (1-q)\,\Delta & \text{if } \mathbf{c}_t = (1,1). \end{cases} \tag{14}$$

It is clear that $V_L(\mathbf{c}_t, p_t)$ is linear and increasing in p_t, and furthermore

$$\frac{\partial V_L((1,1), p_t)}{\partial p_t} > \frac{\partial V_L((1,0), p_t)}{\partial p_t} = \frac{\partial V_L((0,1), p_t)}{\partial p_t} > \frac{\partial V_L((0,0), p_t)}{\partial p_t} > 0.$$

The corresponding derivatives for a party R executive's objective are identical. Since higher levels of centralization have higher slopes with respect to p_t, centralization must be monotonically increasing in p_t.

The existence of the cut-off values of p_t, $\underline{p}$ and $\overline{p}$, for which there are unique most preferred centralization profile for executive from party j can be proven directly by comparison of expressions for $V_j(\mathbf{c}_t, p_t)$ for each executive across different centralization profiles. The expressions are as follows

$$V_L(\mathbf{c}_t, p_t) =$$

$$\begin{cases} (1-q)(U^e_{L,L}(\mathbf{x}^*_t(z_L,(1,1))) - (1-p_t)\Delta) - \\ \qquad q\left(y_1^2(8\alpha(\omega-1)-6\omega+8)+2\omega z_L^2\right) + y_1^2(-8\alpha(\omega-1)+6\omega-8) - 2\omega z_L^2, \text{ if } \mathbf{c}_t = (0,0) \\ (1-q)(U^e_{L,L}(\mathbf{x}^*_t(z_L,(1,1))) - (1-p_t)\Delta) + \\ \qquad q\left(\omega z_L^2((4p_t-3)\omega-2) + y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2)\right) + \\ \qquad y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2) + (\omega-2)\omega z_L^2, \text{ if } \mathbf{c}_t = (0,1) \\ (1-q)(U^e_{L,L}(\mathbf{x}^*_t(z_L,(1,1))) - (1-p_t)\Delta) + \\ \qquad q\left(\omega z_L^2((4p_t-3)\omega-2) + y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2)\right) + \\ \qquad y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2) + (\omega-2)\omega z_L^2, \text{ if } \mathbf{c}_t = (1,0) \\ (1-q)(U^e_{L,L}(\mathbf{x}^*_t(z_L,(1,1))) - (1-p_t)\Delta) + \\ \qquad q\left(2\omega z_L^2((4p_t-3)\omega-1) + 2(\omega-1)y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega)\right) + \\ \qquad 2(\omega-1)\left(y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega)+\omega z_L^2\right), \text{ if } \mathbf{c}_t = (1,1) \end{cases}$$

$$V_R(\mathbf{c}_t, p_t) =$$

$$\begin{cases} (1-q)(U^e_{R,R}(\mathbf{x}^*_t(z_R,(1,1))) - (1-p_t)\Delta) - \\ \qquad q\left(y_1^2(8\alpha(\omega-1)-6\omega+8)+2\omega z_L^2\right) + y_1^2(-8\alpha(\omega-1)+6\omega-8) - 2\omega z_L^2, \text{ if } \mathbf{c}_t = (0,0) \\ (1-q)(U^e_{R,R}(\mathbf{x}^*_t(z_R,(1,1))) - (1-p_t)\Delta) + \\ \qquad q\left(\omega z_L^2((4p_t-3)\omega-2) + y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2)\right) + \\ \qquad y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(-2\alpha(\omega-1)+\omega-2) + (\omega-2)\omega z_L^2, \text{ if } \mathbf{c}_t = (0,1) \\ (1-q)(U^e_{R,R}(\mathbf{x}^*_t(z_R,(1,1))) - (1-p_t)\Delta) + \\ \qquad q\left(\omega z_L^2((4p_t-3)\omega-2) + y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2)\right) + \\ \qquad y_1^2\left((\omega-2\alpha(\omega-1))^2+2(\omega-2)\right) + 2\omega y_1 z_L(2\alpha(\omega-1)-\omega+2) + (\omega-2)\omega z_L^2, \text{ if } \mathbf{c}_t = (1,0) \\ (1-q)(U^e_{R,R}(\mathbf{x}^*_t(z_R,(1,1))) - (1-p_t)\Delta) + \\ \qquad q\left(2\omega z_L^2((4p_t-3)\omega-1) + 2(\omega-1)y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega)\right) + \\ \qquad 2(\omega-1)\left(y_1^2(4(\alpha-1)\alpha(\omega-1)+\omega)+\omega z_L^2\right), \text{ if } \mathbf{c}_t = (1,1) \end{cases}$$

The resulting cut-offs that define the most preferred centralization profile in infinite horizon game are given in equations (9) and (10) and are the same for both executives for their respective probabilities of re-election. It is straightforward to see that the difference between these cut-offs is

$$\overline{p} - \underline{p} = \frac{1+q}{q} \frac{(2\alpha + 2(1-\alpha)/\omega - 1)\, y_1}{z_L}.$$

Since $z_L < 0$ and $y_1 < 0$, and $2\left[\alpha + (1-\alpha)\frac{1}{\omega})\right] - 1 > 0$, this expression is always positive, and thus $\overline{p} > \underline{p}$.

Proof of Proposition 2. The proof directly follows from solving for $\overline{p} = 0$ and $\underline{p} = 0$ using the expressions in equations (9) and (10).

Solving $\underline{p} = 0$ for z_L produces one negative root that simplifies to:

$$z' = -\frac{1+q+2\sqrt{q(1+q)}}{1-3q}\left(2\alpha + \frac{2(1-\alpha)}{\omega} - 1\right) y_1. \tag{15}$$

For $z_L < z'$, Proposition 1 implies that $(0,0)$ is the preferred profile for $p_t < \underline{p}$. This cut-point exists (i.e., is negative) if and only if $q > \frac{1}{3}$. In addition, it is straightforward to proof that $z' < y_1$ when $q > \frac{1}{3}$: Executives have to be more polarized than localities for $(0,0)$ to be implementable.

Solving $\overline{p} = 0$ for z_L yields the roots z'' and z'''. The first is:

$$z'' = \frac{1+q-2\sqrt{q(1+q)}}{1-3q}\left(2\alpha + \frac{2(1-\alpha)}{\omega} - 1\right) y_1. \tag{16}$$

For $z_L > z''$, $(1,1)$ is the preferred profile for all p_t. It can be shown that when $q > \frac{1}{3}$, $\overline{p} = 0$ can hold only if $z_L > y_1$.

The second root can be negative only when $q < \frac{1}{3}$:

$$z''' = \frac{1+q+2\sqrt{q(1+q)}}{1-3q}\left(2\alpha + \frac{2(1-\alpha)}{\omega} - 1\right) y_1. \tag{17}$$

For $z_L < z'''$, $(1,1)$ is the preferred profile for all p_t.

Proof of Proposition 3. We first provide the condition under which profile $(0,0)$ dominates profile $(1,1)$. From equation (12), it is obvious that $W_{00}(\mathbf{x}_t^*)$ is constant in z_L and $W_{11}(\mathbf{x}_t^*)$ is maximized at $z_L = 0$. Evaluating both at $z_L = 0$ yields that $W_{00}(\mathbf{x}_t^*)$ is always higher than $W_{11}(\mathbf{x}_t^*)$ if:

$$\alpha > \frac{2+\omega}{2+2\omega}.$$

Next, we provide the condition under which profile $(1,0)$ dominates profile $(0,1)$. From equation (12), it is straightforward to verify that $W_{01}(\mathbf{x}_t^*)$ and $W_{10}(\mathbf{x}_t^*)$ are parabolas that are symmetric around $z_L = 0$ and maximized at $y_1(1-2\alpha)$ and $-y_1(1-2\alpha)$ respectively, but are otherwise identical. Thus $(1,0)$ dominates profile $(0,1)$ if and only if $-y_1(1-2\alpha) < y_1(1-2\alpha)$. Since $y_1 < 0$, this is equivalent to $\alpha > 1/2$.

Now consider three cases. (i) If $\alpha > (2+\omega)/(2+2\omega)$, then $(1,1)$ is never welfare maximizing and $(1,0)$ dominates $(0,1)$. Solving for z_L, the welfare under $(1,0)$ is higher than under $(0,0)$ if:

$$\begin{aligned} W_{10}(\mathbf{x}_t^*) &> W_{00}(\mathbf{x}_t^*) \\ z_L &\in \left(\frac{y_1(2\alpha(\omega-1)-\omega+2)}{\omega}, \frac{y_1(2\alpha(\omega+1)-\omega-2)}{\omega}\right) \end{aligned} \tag{18}$$

Since $y_1(2\alpha(\omega+1)-\omega-2)/\omega > 0$ and $y_1(2\alpha(\omega-1)-\omega+2)/\omega < 0$, $(1,0)$ is welfare maximizing for $z_L > y_1(2\alpha(\omega-1)-\omega+2)/\omega$ and $(0,0)$ is welfare maximizing otherwise.

(ii) If $\alpha \in (1/2, (2+\omega)/(2+2\omega)]$, then $(0,0)$, $(1,0)$, and $(1,1)$ may all be welfare maximizing. The condition for $W_{10}(\mathbf{x}_t^*) > W_{00}(\mathbf{x}_t^*)$ is given by (18). The condition for $W_{11}(\mathbf{x}_t^*) > W_{10}(\mathbf{x}_t^*)$ evaluates to:

$$z_L \in \left(\frac{y_1(-2\alpha(\omega+1)+\omega+2)}{\omega}, \frac{y_1(-2\alpha(\omega-1)+\omega-2)}{\omega}\right).$$

Since $y_1(-2\alpha(\omega-1)+\omega-2)/\omega > 0$ and $y_1(-2\alpha(\omega+1)+\omega+2)/\omega < 0$ for these values of α, $W_{11}(\mathbf{x}_t^*) > W_{10}(\mathbf{x}_t^*)$ for $z_L > y_1(-2\alpha(\omega+1)+\omega+2)/\omega$. Observe finally that:

$$\frac{y_1(-2\alpha(\omega+1)+\omega+2)}{\omega} - \frac{y_1(2\alpha(\omega-1)-\omega+2)}{\omega} = \frac{y_1(2-4\alpha)}{\omega} > 0,$$

so the interval of z_L for which $(1,0)$ is welfare maximizing is non-empty.

(iii) If $\alpha \leq 1/2$, the analysis is identical to case (ii), but (since $(0,1)$ dominates $(1,0)$) substituting in profile $(0,1)$ for $(1,0)$.

Proof of Proposition 4. To calculate the long run probability of the system being in each of the twenty states, we solve the following system of equations:

$$
\begin{aligned}
\pi_{1Ls} &= \frac{1}{2}(1-q)\left(\pi_{1Rs}+\pi_{2Ls}+\pi_{2Rs}+\pi_{1Rw00}+\pi_{1Rw10}+\pi_{1Rw01}+\pi_{1Rw11}\right.\\
&\quad \left.+\pi_{2Lw00}+\pi_{2Rw00}+\pi_{2Lw10}+\pi_{2Rw10}+\pi_{2Lw01}+\pi_{2Rw01}+\pi_{2Lw11}+\pi_{2Rw11}\right)\\
\pi_{1Rs} &= \frac{1}{2}(1-q)\left(\pi_{1Ls}+\pi_{2Ls}+\pi_{2Rs}+\pi_{1Lw00}+\pi_{1Lw10}+\pi_{1Lw01}+\pi_{1Lw11}\right.\\
&\quad \left.+\pi_{2Lw00}+\pi_{2Rw00}+\pi_{2Lw10}+\pi_{2Rw10}+\pi_{2Lw01}+\pi_{2Rw01}+\pi_{2Lw11}+\pi_{2Rw11}\right)\\
\pi_{2Ls} &= \frac{1}{2}(1-q)\left(\pi_{1Ls}+\pi_{1Lw00}+\pi_{1Lw10}+\pi_{1Lw01}+\pi_{1Lw11}\right)\\
\pi_{2Rs} &= \frac{1}{2}(1-q)\left(\pi_{1Rs}+\pi_{1Rw00}+\pi_{1Rw10}+\pi_{1Rw01}+\pi_{1Rw11}\right)\\
\pi_{1Lw00} &= \pi_{1Rs}q\underline{p}(1-\frac{\underline{p}}{2})+\frac{1}{2}q\left(\pi_{1Rw00}+\pi_{2Lw00}+\pi_{2Rw00}\right)\\
\pi_{1Rw00} &= \pi_{1Ls}q\underline{p}(1-\frac{\underline{p}}{2})+\frac{1}{2}q\left(\pi_{1Lw00}+\pi_{2Lw00}+\pi_{2Rw00}\right)\\
\pi_{1Lw10} &= \pi_{1Rs}q\left(\overline{p}-\underline{p}\right)(1-\frac{\underline{p}+\overline{p}}{2})+\frac{1}{2}q\left(\pi_{1Rw10}+\pi_{2Lw10}+\pi_{2Rw10}\right)\\
\pi_{1Rw10} &= \frac{1}{2}q\left(\pi_{1Lw10}+\pi_{2Lw10}+\pi_{2Rw10}\right)\\
\pi_{1Lw01} &= \frac{1}{2}q\left(\pi_{1Rw01}+\pi_{2Lw01}+\pi_{2Rw01}\right)\\
\pi_{1Rw01} &= \pi_{1Ls}q\left(\overline{p}-\underline{p}\right)(1-\frac{\underline{p}+\overline{p}}{2})+\frac{1}{2}q\left(\pi_{1Lw01}+\pi_{2Lw01}+\pi_{2Rw01}\right)\\
\pi_{1Lw11} &= \pi_{1Rs}q(1-\overline{p})(1-\frac{1+\overline{p}}{2})+\frac{1}{2}q\left(\pi_{1Rw11}+\pi_{2Ls}+\pi_{2Rs}+\pi_{2Lw11}+\pi_{2Rw11}\right)\\
\pi_{1Rw11} &= \pi_{1Ls}q(1-\overline{p})(1-\frac{1+\overline{p}}{2})+\frac{1}{2}q\left(\pi_{1Lw11}+\pi_{2Ls}+\pi_{2Rs}+\pi_{2Lw11}+\pi_{2Rw11}\right)\\
\pi_{2Lw00} &= \pi_{1Ls}q\frac{\underline{p}^2}{2}+\frac{1}{2}q\pi_{1Lw00}\\
\pi_{2Rw00} &= \pi_{1Rs}q\frac{\underline{p}^2}{2}+\frac{1}{2}q\pi_{1Rw00}\\
\pi_{2Lw10} &= \frac{1}{2}q\pi_{1Lw10}\\
\pi_{2Rw10} &= \pi_{1Rs}q\left(\overline{p}-\underline{p}\right)\frac{\underline{p}+\overline{p}}{2}+\frac{1}{2}q\pi_{1Rw10}\\
\pi_{2Lw01} &= \pi_{1Ls}q\left(\overline{p}-\underline{p}\right)\frac{\underline{p}+\overline{p}}{2}+\frac{1}{2}q\pi_{1Lw01}\\
\pi_{2Rw01} &= \frac{1}{2}q\pi_{1Rw01}\\
\pi_{2Lw11} &= \pi_{1Ls}q\left(1-\overline{p}\right)\frac{1+\overline{p}}{2}+\frac{1}{2}q\pi_{1Lw11}\\
\pi_{2Rw11} &= \pi_{1Rs}q\left(1-\overline{p}\right)\frac{1+\overline{p}}{2}+\frac{1}{2}q\pi_{1Rw11},
\end{aligned}
$$

where π_{ajwc} refers to the long-run probability of being in a state characterized by a weak executive of age a from party j and by centralization profile c, while π_{ajs} denotes the long-run probability of being in a state characterized with a strong executive of age a from party j.

This system provides a unique solution for the twenty long-run probabilities. These long-run probabilities can be used to calculate the four probabilities used in equation 13 as follows:

$$\phi_c = \pi_{1Lw11} + \pi_{1Rw11} + \pi_{2Lw11} + \pi_{2Rw11} + \pi_{2Ls} + \pi_{2Rs} + (\pi_{1Ls} + \pi_{1Rs})(1 - \overline{p})$$

$$\phi_d = \pi_{1Lw00} + \pi_{1Rw00} + \pi_{2Lw00} + \pi_{2Rw00} + (\pi_{1Ls} + \pi_{1Rs})\underline{p}$$

$$\phi_a = \pi_{1Lw10} + \pi_{1Rw01} + \pi_{2Lw10} + \pi_{2Rw01}$$

$$\phi_e = \pi_{1Lw01} + \pi_{1Rw10} + \pi_{2Lw01} + \pi_{2Rw10} + (\pi_{1Ls} + \pi_{1Rs})(\overline{p} - \underline{p}).$$

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