Fail-Safe Federalism[1]

Sanford C. Gordon
Department of Politics
New York University
sanford.gordon@nyu.edu

Dimitri Landa
Department of Politics
New York University
dimitri.landa@nyu.edu

January 7, 2015

[1]Preliminary and Incomplete. Please do not cite without permission of the authors. An earlier version of this paper was presented at the political economy workshop of the Stanford Graduate School of Business, where the authors received valuable feedback.

Abstract

We explore the consequences for social welfare and national political conflict of several key institutional features of federalism in the United States: supermajoritarian national institutions and permeable boundaries in the provision of public goods by national and state governments, where the actions by the former can crowd out the latter. States with high demand for public good provision are better positioned to adjust state-level policies to accommodate local demand in the presence of low national provision than corresponding states with low demand in the presence of high national provision. This asymmetry implies that the level of federal provision preferred by moderate-demanders may be socially inefficient, and can exacerbate political conflict when national provision is gridlocked at a high level. Symmetric cross-state negative externalities can *reduce* conflict at the national level by generating consensus for national action; whereas positive externalities, or asymmetric negative externalities, can increase it. We demonstrate that the main intuitions of the model extend to a regulatory environment in which national standards partially preempt state ones. We also explore how, in a dynamic setting, exogenous shocks to demand can create inefficiencies while expanding the "gridlock interval" of national policies.

1 Introduction

A characteristic feature of many democracies that operate over an extensive territory is federalism: the constitutional apportionment of sovereignty between central and constituent governments. Federalism, along with the separation of powers at the national level, is a core opponent of the United States' constitutional design. Indeed, an enormous proportion of the political conflict of the United States has centered on the proper roles, responsibilities, and limitations of different levels of government – from the Virginia and Kentucky Resolutions of 1798 (and the vociferous responses thereto) to the Supreme Court's recent jurisprudence regarding gun control, violence against women, and gay marriage. How does shared responsibility for governance across multiple levels, in a world where decisions at one level might affect decisions at the other, constrain or exacerbate national political conflict?

The answer to this question has profound importance for the stability and governability of federal democracies. A successful federal institutional structure may diffuse or channel conflict in a way that avoids unproductive standoffs or (in more extreme cases) threats to the constitutional order itself (e.g., threats of secession). An unsuccessful structure may fail to diffuse, or even exacerbate, the conflicts that produce these challenges.

We develop a model whose purpose is to facilitate a better understand the relationship between the federal constitutional structure and national political conflict. While the main substantive focus of the model is the U.S. political system, many of the results generalize to other political systems. The key features of the model are: (1) overlapping provision of public goods by the national and state governments with "crowding out" of state provision; and (2) gridlock at the national level, brought about by supermajoritarian legislative procedures. Our primary focus is the consequences of these features and their interactions for social welfare and political polarization at the national level.

In the model, the magnitude of the national government's policy-making presence affects the ability of the federation's constituent states to raise revenue. The anticipated crowding out effect that results from this distortion affects the preferences of state actors over national provision. As long as the magnitude of the distortion is not too large, and in the absence of cross-state externalities, all states prefer a mix of federal and state provision. When the level of federal provision is relatively small, the system can function smoothly even in the presence of heterogeneous demand: when the differences in demand for public good are too great to move federal provision from the status quo level, states adjust their state-level provision up and/or down, respectively. In effect, when, from the state's perspective, there is a failure at the federal level, the state "fails safely" into the state-level action. We refer to this system as *fail-safe federalism* to evoke the design principle that potentially dangerous devices should contain features that automatically correct for the failure of a component part by reverting to a harmless state rather than a hazardous one.

One of the key aspects of the functioning of the federal system we analyze is the limits of its "safe" performance. A sufficiently large level of national provision will eventually crowd out states with low demand for public goods, making it hard for those states to adjust their state-level provision to meed local demand in response to what they would perceive as overprovision at the federal level. For these states, further increases in the level of national provision hurt more than they help states with high demand. This asymmetry has a number of implications for political conflict at the national level: first, it leads to a normative bias for a small national government. At first glance, this would seem to justify the supermajoritarian constraints in the original U.S. constitution. Indeed, when the status quo level of national public goods provision is low (as it was at the moment of ratification), these supermajoritarian constraints can be calibrated to yield the social welfare optimum (holding the demand for public goods constant). However, in a dynamic environment where shocks to the demand for public good provision may occur, the political system may find itself in a position where the status quo national provision is too generous. The baseline model also yields novel results concerning the extent of ideal-point polarization in the political system.

We then consider three extensions to the baseline model. First, we embed our baseline model in a dynamic two-period framework to analyze how exogenous shocks to the national preference profile affect the national-level political conflict resulting from heterogeneous state-level demands. We show that the expectation of the future preference shock increases the present-period gridlock by pushing both boundaries of the gridlock interval out in the direction of extreme demands, but does so asymmetrically – low demanders of public good provision become relatively more conservative than high demanders become liberal.

Second, we introduce negative and positive cross-state externalities of state actions. Counterintuitively, an increase in the magnitude of symmetric negative externalities actually tends to *decrease* polarization at the national level, because it will endogenously generate consensus regarding the need for national solutions. Asymmetric externalities can either increase or decrease national polarization: it can increase polarization when the negative externality is imposed by the low-demander state on the high-demander; and decrease polarization if the high-demander is imposing the costs. By contrast, an increase in the magnitude of positive externalities will tend to increase polarization, because states with low demand for public goods provision will find there demand satiated by the activities of other states at a faster rate than similarly-situated high-demander states.

Third, we describe a regulatory version of the model in which the task of government is to remedy negative externalities, and the federal government imposes a floor level of remediation. States can impose a more, but not less, stringent regulation than the federal mandate (cf., Crémer and Palfrey 2000). We demonstrate that the core intuitions of the baseline model carry through to the regulatory environment.

2 Background

2.1 The Object of Study

Although it may be applied to some federal systems outside of the United States, the model we present endeavors to capture three aspects of the federal structure of the U.S. political system. The first, which is of course not unique to federalism, is the existence of heterogeneity in the demand for public good provision. In the presence of significant heterogeneity, federalism may be a particularly useful way to permit government to tailor government provision to variation in local demand, rather than subject each subordinate community to the same national, uniform rule (or, alternatively, delegate policy making to the executive to tailor its application to local circumstances.)

The second is the existence of antimajoritarian institutions for lawmaking at the national level. The federal constitution contains a number of important antimajoritarian features. These include, for example, institutions that grant some degree of insulation for elected officials, e.g., six year terms for senators; formal constraints on the powers of national government (e.g., the enumerated powers and restrictions on Congress listed in Article I, sections 8 and 9 and the Bill of Rights);

and institutions such as bicameralism, the presidential veto, the filibuster, and any legislative rules that limit proposal rights to a restricted group of public officials.

The third critical aspect of the federal system we wish to capture in our model is the presence of *de facto* shared sovereignty between the national and state governments with permeable boundaries (Rose-Ackerman 1981). To be sure, spheres of autonomy between the state and national governments are necessary for a coherent federal structure to exist; and the enumerated and reserved powers of the national and state governments listed in the constitution and interpreted of two centuries of judicial precedent to a large extent define these boundaries. However, we follow much of the qualitative literature on federalism since Grodzins (1966) in departing from the principle of "dual federalism" (Corwin 1950), by arguing that these boundaries do not represent a clean partition;[1] and moreover, that the boundaries, when they do exist, are defined much more by practical politics and the exigencies of the day than normative theories about the appropriate division of authorities between levels of government.

Notwithstanding the fact that the Supreme Court has devoted considerable effort over its history to policing those boundaries,[2], the framers arguably anticipated that these boundaries would be fuzzy. This is not simply a point about the ambiguity of language. The existence of the supremacy clause, for example, implies the potential for federal and state laws to come into conflict (which would be impossible if the spheres were truly separate). Madison, writing in the *National Gazette* in February, 1792, pointed to relative ease of distinguishing executive, judicial, and legislative power, noting of the national and state governments, "the powers being of a more kindred nature, their boundaries are more obscure and run more into each other.[3] Related to the permeable boundaries feature is the fact crowding out. As noted above, in our model we assume that increases in the size of the national government have a direct effect on the ability of the states to raise revenue.

In focusing on these three features of federalism, we necessarily abstract away from several others. First, to focus on *across*-state preference heterogeneity, we abstract away from *within*-state heterogeneity. Having abstracted away from within-state heterogeneity, we also do not consider

[1] In describing his famed "marble-cake" metaphor of federalism, Grodzins (1966, 8) writes, "No important activity of government in the United States is the exclusive province of one of the levels, not even what may be regarded as the most national of national functions ... nor even the most local of local functions."

[2] See, e.g., *Tarble's Case*, 80 U.S. 397 (1871); *Hammer v. Dagenhart*, 247 U.S. 251 (1918); and, more recently, *U.S. v. Lopez*, 514 U.S. 549 (1995); and U.S. v. Morrison, 529 U.S. 598.

[3] Madison goes on to admonish, "if the task be difficult, however, it must by no means be abandoned.

representation failure at the state level. The interaction between within- and across-state heterogeneity is clearly important, but beyond the scope of the current inquiry.

Second, we adopt the approach, common in the literature, in which the national government imposes a uniform policy across all states. While in reality, provision by the national government need not be completely homogeneous, one can think of the assumption of a uniform policy as a reduced form representation of an expectation that a policy implemented exclusively by the national government across states will be *more* homogeneous than one implemented exclusively by the states within their own borders. Relatedly, there is an extensive literature on fiscal federalism that considers the various instruments a centralized government has to mitigate the distortions induced by local taxation (e.g., Gordon 1983; Myers 1990; Krelove 1992; for reviews see Inman and Rubinfeld 1996 and Oates 1999). While our model allows us to consider how action by the central government can mitigate (or exacerbate) interjurisdictional spillovers, we abstract away from the relative efficacy of different policy instruments that may be used to achieve this goal.

2.2 Related Research

The current research relates to the literature on fiscal federalism dating to Oates (1972), whose "decentralization theorem" posits that in the absence of externalities and scale economies, social welfare will be at least as high if public goods are provided at Pareto efficient levels locally than if they are provided via a uniform national policy. With spillovers, free-rider problems will lead to a suboptimal level of local provision, and so whether a centralized or decentralized system is to be preferred on social welfare grounds will depend on the severity of the spillovers and the degree of preference heterogeneity in the polity. Rose-Ackerman (1981) considers the effects of spillovers and status quo policies at the state level on demand for, and feasibility of, national policies. Besley and Coate (2003) relax the assumption of a uniform national policy under different assumptions about behavior in a national legislature, demonstrating that centralization can still be inefficient owing to misallocation and uncertainty (in a Baron-Ferejohn [1989] style bargaining environment) or because voters face incentives to elect high-demanders to the legislature, leading to inefficient overprovision (see also Inman and Rubinfeld 1997; and Lockwood 2002).

Recent work on political economy of federations has focused on the strategic analysis of the implications of the inter-state spillovers in the provision of public goods. Thus, Crémer and Palfrey

(2000, 2006) analyze the federal systems in which federal policy comes in the form of public goods provision floors (mandates) that must be met by the state-level public good provision with positive spillovers. Bolton and Roland (1997) consider the effects of interregional income heterogeneity, factor mobility, and efficiency gains from centralization on the incentives of nations to unify or go their separate ways. Closer to the present model, Alesina et al. (2005) and Hafer and Landa (2006) analyze "dual provision" models of federalism, in which public goods provision with spillovers across states takes place both at state and federal levels. Hafer and Landa induce differences in state demand endogenously from the interaction between the differences in state incomes (wealth), the costs of public good provision, and the relative efficiency of providing the public good at the federal as opposed to the state level. Unlike the current paper, the focus of that work is on the the effect of redistributive tensions and externalities on coalition formation at the national level. As in the current paper, Alesina et al. posit primitive differences in states' in demand for the public good. Whereas the focus of that work is on the decisions of (potential) member states to join or enlarge an international union to take advantage of the positive cross-state spillovers of its members, our model takes the union as a given and is chiefly concerned with the consequences of the interaction of the supermajoritarian procedures of the central government with the fiscal consequences of shared policy making on political conflict at the national level.

A central focus of our analysis is on the implications of the "crowding out" of state expenditures by federal expenditures. Early work on the economics of federalism hypothesized crowding out to be a straightforward consequence of exogenous nonmatching federal grants from to states and localities (Bradford and Oates 1971), but empirical research starting with Courant, Gramlich, and Rubinfeld (1979) has documented a "flypaper effect" wherein state and local expenditures appear to increase in response to intergovernmental aid (but see Knight 2002). The crowding out we consider below (in reduced form) is more akin to an economic distortion induced by the overall size of the national government – an approach similar to Bolton and Roland (1997). The latter authors model the distortion as a consequence of a deadweight economic cost of taxation, whereas in our model, it is the effect of increasing taxation at the national level on the cost of raising revenue at the state level.

Our model also explores the consequences of gridlock-inducing procedures (e.g., supermajority requirements; gatekeeping opportunities); in the context of U.S. lawmaking, canonical work on the subject includes Krehbiel (1996, 1998), who focuses on the filibuster and veto override pivots; Cox and McCubbins (2005); who examine majority party gatekeeping.

3 The Baseline Model

3.1 Primitives

In the baseline environment, we model policy making as corresponding to public good provision decisions taking place at two levels: the national and the state. There is a continuum of states with measure one.[4] Each state i is characterized by a preference parameter whose support is a compact, convex subset of the positive real line, $\alpha_i \in [\underline{\alpha}, \overline{\alpha}]$, with probability density function $p(\alpha)$. The parameter represents the value to the state of public good consumption relative to income. Each state has exogenous income y_i, and each pays a lump sum for a given level of state government activity, $S_i \in \mathbb{R}_+$, and a lump sum for federal activity, $F \in \mathbb{R}_+$. We assume that the costs of these respective activities are quadratic in the level of service provided.

We model the distortionary effect of federal taxation (the size of the federal government) on state revenue collection by a product $\gamma F S_i$, with $\gamma \in \mathbb{R}_{++}$ scaling the magnitude of the distortion. Federal-level public good provision may be more or less production efficient than the state-level provision. For mathematical convenience, we model these potential differences on the cost side, by parameterizing the relative inefficiency of raising revenue at the federal rather than at the state level of provision. Let $\theta \in \mathbb{R}_{++}$ be the corresponding parameter.[5] Note that a high θ may stem from diseconomies of scale, or it may capture constitutional restrictions on the federal government involvement in that particular domain of public policy. State i's utility is expressed as

$$y_i + \alpha_i(F + S_i) - \frac{\theta F^2}{2} - \frac{S_i^2}{2} - \gamma F S_i. \tag{1}$$

Before proceeding further, we add three interpretive comments: first, we model states' demand for public good provision as primitive in order to focus our analysis on specific properties of collective

[4] Continuity is a mathematical convenience and has no bearing on the substantive results that follow.

[5] One may, reasonably, maintain that one of the sources of inefficiency of raising revenue at the federal level is precisely the distortion that it creates for raising revenue at the state level. However, the revenue-raising distortion we envision is two-directional, whereas the efficiency of provision we would like to highlight is one that may favor one level of provision over the other, potentially in spite of the revenue-raising distortion. With this in mind, we abstract away from modeling a specific relationship between γ and θ, keeping the two notions distinct.

choices in a federal setting. In practice, state demand is a function of a variety of economic antecedents (i.e., derived from comparisons of the marginal values of public good and private consumption in a redistributive setting [e.g., Hafer and Landa 2006]) and socio-cultural factors (e.g., prior immigrant group experiences with oppressive governments [Fischer 1989], or modernization-induced liberalism [Ingelhart and Welzel 2005]). The relationship between a state's preference parameter α_i and its average income must, thus, depend on an underlying preference-generating mechanism: for an economics-focused redistributive mechanism, high-demanders may be relatively poor states; for a socio-cultural mechanism, relatively rich ones. Recognizing these possibilities, we do not commit ourselves to a particular correlation between the state's endowment and its demand for public good provision.[6]

Second, note that when γ is positive, the federal-state provision bundles move smoothly in response to federal policy. An alternative approach to capturing the relationship between federal and state policy would be to impose a budget constraint that binds the states discontinuously. While both approaches are empirically plausible, our choice to model the effect through the utility function makes for a less cumbersome analysis mathematically, and has no qualitative effect on our main results.

Finally, the choice to model the cost of public good provision as quadratic is instrumental. Our analysis focuses on asymmetries in outcomes brought about by the structure of federal institutions. The symmetry of the quadratic functional form allows us to capture the institutional sources of these asymmetries in isolation from other sources.

Returning now to the formal description of the environment, let B represent the federal bargaining protocol, which maps states' preference profile and the (exogenously given) status quo federal level of provision into a level of federal provision F.[7] Rather than commit ourselves to a particular bargaining protocol, we simply restrict our attention to protocols that, given single-peaked preferences, generate a *gridlock interval*, that is, a compact and convex set of policies that cannot be beaten by another policy under the protocol. Such protocols include q-rules (Austen-Smith and Banks 1999, Banks and Duggan 2006) and bargaining protocols with gatekeepers or veto players (Krehbiel 1996, 1998; Cox and McCubbins 2005), which are of particular relevance to

[6] A similar approach is taken in Alesina, Angeloni, and Etro 2005.

[7] Formally, let $\tilde{F} \in \mathbb{R}_+$ be the status quo federal policy; $\mathcal{U}(p(\cdot|\underline{\alpha}, \overline{\alpha}))$ be the preference profile within the federation given the distribution of the α_is, $p(\cdot|\underline{\alpha}, \overline{\alpha})$, and $\boldsymbol{\mathcal{U}}$ be the set of all preference profiles. Then $B := \boldsymbol{\mathcal{U}} \times \mathbb{R}_+ \to \mathbb{R}_+$.

the supermajoritarian federal decision-making that is one of our motivations in this paper.

The game unfolds as follows:

1. The Federation decides on a level of federal provision F via bargaining protocol B;

2. Each state decides on its own level of state provision, S_i;

3. Payoffs are realized.

3.2 Equilibrium

The equilibrium concept is subgame perfect Nash equilibrium. We proceed by backward induction and begin by considering the state policy-making subgame.

State-level policy making. In the last stage of the game, federal policy F has been set, and the states condition their choices on F. Cursory inspection of the expression in (1) reveals that it is globally concave in S_i. Solving state i's first-order condition yields the optimal state policy

$$S_i^*(F) \equiv \max\{0, \alpha_i - \gamma F\}. \tag{2}$$

This expression immediately gives rise to the following remark:

Remark 1 (Crowding Out) *A state's level of provision is weakly decreasing in the level of federal provision.*

That the state's provision should be decreasing in the level of federal provision is natural: imagine a counterfactual world in which the federal government eliminated a major policy like social security or medicaid. In such circumstances, we might reasonably expect at least some states to compensate by substituting state-level policies in the absence of the federal policy.

Federal policy making. Moving backward in the game, we next consider federal policy making. Anticipating the policy it will set in the second stage, each state seeks to maximize

$$y_i + \alpha_i(F + S_i^*(F)) - \frac{\theta F^2}{2} - \frac{(S_i^*(F))^2}{2} - \gamma F S_i^*(F) \tag{3}$$

The substantive focus of our paper is on federalism as a mixed provision of public goods by both the national and state governments; thus, we wish to focus on conditions under which such a mix is feasible. The following lemma establishes those conditions.

Lemma 1 (Preference for Mixed Provision) *The following statements are true if and only if* $\gamma < \min\{1, \theta\}$*:*

1. *all states have single-peaked preferences over federal provision with ideal point* $\hat{F}(\alpha_i; \gamma, \theta) = \left(\frac{1-\gamma}{\theta-\gamma^2}\right) \alpha_i > 0$*;*

2. *a state's ideal federal policy induces a strictly positive level of state provision in that state.*

Proof. All proofs appear in the Appendix. ■

This result establishes conditions under which the preferences over federal policy are "well-behaved." If federal provision is "too efficient" (θ too low), or if state provision is crowded out too quickly, then states will have non-single-peaked preferences over federal provision that entail a preference for exclusive federal or exclusive state provision. Because our interest is in situations where a mix of both federal and state provision is preferred by at least some states, we will focus on situations in which the restriction on parameters given in the Lemma is met.

Having established single-peakedness over federal policy making, we note that the federal bargaining protocol B will induce a nonempty gridlock interval (Krehbiel 1996,1998). Let α_L represent the demand parameter of the pivotal actor at the extreme low-end of the gridlock region, and $\hat{F}(\alpha_L)$ that actor's ideal federal policy; likewise, let α_H represent the demand parameter of the actor at the extreme right, and $\hat{F}(\alpha_H)$ its associated ideal point. In the context of Krehbiel's pivotal politics model, these actors might represent the filibuster and veto override pivots; in the context of Cox and McCubbins, it might represent the floor median and its reflection about the majority caucus median. The point is that any status quo federal policy between $\hat{F}(\alpha_L)$ and $\hat{F}(\alpha_H)$ will be gridlocked, whereas any status quo policy outside of $[\hat{F}(\alpha_L), \hat{F}(\alpha_H)]$ will be, given the federal bargaining protocol, amended to a point in that interval.

To summarize, in equilibrium, the national government chooses a federal policy $F^* \in [\hat{F}(\alpha_L), \hat{F}(\alpha_H)]$ via bargaining protocol B; then each state i chooses a state-level policy $S_i^* = \max\{0, \alpha_i - \gamma F\}$.

Lemma 1 establishes conditions under which, at a state's *optimal* level of federal provision, that state will continue to provide locally. A decrease in federal provision below the state's ideal point hurts the state, but the state can partially mitigate the associated loss in its welfare via a compensating increase in the level of state provision. For each state, however, there exists a level of federal provision higher than its own federal ideal point, $\frac{\alpha_i}{\gamma} > \hat{F}(\alpha_i)$, such that for all $F > \frac{\alpha_i}{\gamma}$, state i's provision is fully crowded out. For federal provision above the state's ideal point but below this quantity, an upward departure from the state's ideal policy can be compensated for by a *reduction* in the level of state provision. However, when federal provision exceeds $\frac{\alpha_i}{\gamma}$, the state provision is already fully crowded out, meaning that mitigation is not possible. This places an additional burden on the state, which can be thought of as the *shadow cost of the zero lower bound* on state provision. The following proposition describes some important features of this shadow cost and its effect on a state's welfare, by comparing it to a counterfactual world in which negative taxation and public good provision were feasible.

Proposition 1 (Shadow Cost of Crowding Out) *The following conditions hold if and only if* $\gamma < \min\{1, \theta\}$ *and* $F > \frac{\alpha_i}{\gamma}$*:*

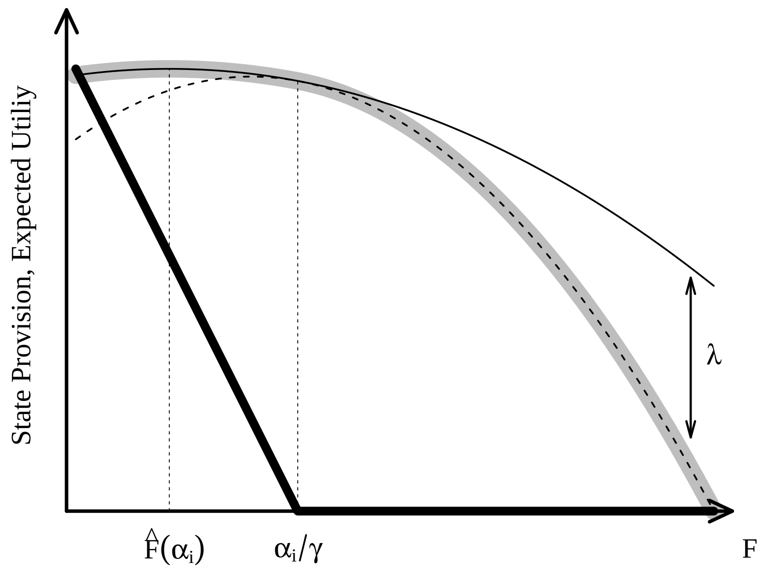
1. *the state's expected utility is strictly lower, and decreasing in the level of federal provision* F *at a faster rate, than it would be in the absence of a zero lower bound; and*

2. *the shadow cost of the zero lower bound is increasing in the rate of crowding out* γ *and decreasing in the extent to which* i *values public good consumption,* α_i*.*

The first part of Proposition 1 implies a kink in a state's utility function strictly to the right of the state's ideal point. At the kink, the rate of decline in the state's welfare associated with additional increases in federal provision experiences a discontinuous jump. This implies that although, given the restrictions on parameters described above, a state's utility function is single-peaked, it is not symmetric. This asymmetry will play a key role in the substantive results that follow. The second part of the Proposition establishes the conditions under which the constraint bites more strongly. In particular, the more quickly a state is crowded out, the greater the cost, for a given level of federal provision, associated with having been crowded out.

A natural way to interpret this shadow cost is with reference to the possibility of debt-financed tax credits: states can conceivably borrow money to offset the high (from their perspective) level of federal taxation in the form of rebates to citizens. In this setting, the shadow cost of crowding out is simply the cost of borrowing: the larger the hypothetical rebate, the higher the cost. Imposing the zero lower bound simply captures this effect in reduced form.

Figure 1: The Effect of the Zero Lower Bound for State Provision on Induced Preferences over Federal Policy



When the level of state provision (the thick black line) is fully crowded out ($F > \frac{\alpha_i}{\gamma}$), the state's induced utility over federal provision (the shaded gray curve) falls faster than it would if zero state provision were not a lower bound. For a full description, see text.

Figure 1 displays the Proposition's intuition graphically. The horizontal axis depicts the level of federal provision F. The thick black curve represents a state's equilibrium level of state provision, which is decreasing in F until it reaches the zero lower bound at $F = \frac{\alpha_i}{\gamma}$. The thin, solid black curve represents the state's induced utility over federal provision *if zero were not a lower bound on state provision.* The dashed curve represents the state's induced utility *if state provision is constrained to zero.* Overall, the state's induced utility over provision is defined by the solid curve below $\frac{\alpha_i}{\gamma}$, and the dashed curve above that value – for reference, we shade the overall induced utility in gray. Note that consistent with Lemma 1, the state provides locally at its own ideal level of federal provision, $\hat{F}$. Finally, the gap between the dashed and solid curves to the right of $\frac{\alpha_i}{\gamma}$, labeled λ, represents the shadow cost of the zero lower bound. As is evident from the figure, it is increasing in the level of federal provision.

3.3 Welfare, Polarization, and Conflict

Having characterized the equilibrium of the baseline model, we now move to our analysis of three important measures of social outcomes. The first is *aggregate welfare*, a standard utilitarian metric. The second, which we describe in greater detail below, is *implicit policy conflict*, a measure that captures the difference in expected payoffs to two states associated with a particular status quo federal policy. The third measure is *polarization*, defined conventionally in terms of the distance between ideal points (e.g., Poole and Rosenthal 1985; McCarty, Poole, and Rosenthal 2006).

We will assume throughout this section that $p(\alpha)$, the distribution of overall demand for public goods provision, is *symmetric*. As with the quadratic cost assumption above, the motivation for this assumption is not strict verisimilitude; rather, we adopt it to clarify how the strategic incentives of the states yield important asymmetries that deviate from canonical models, even in the absence of asymmetries in the distribution of preferences.

Aggregate Welfare. Our first result in this regard concerns the aggregate welfare of the polity:

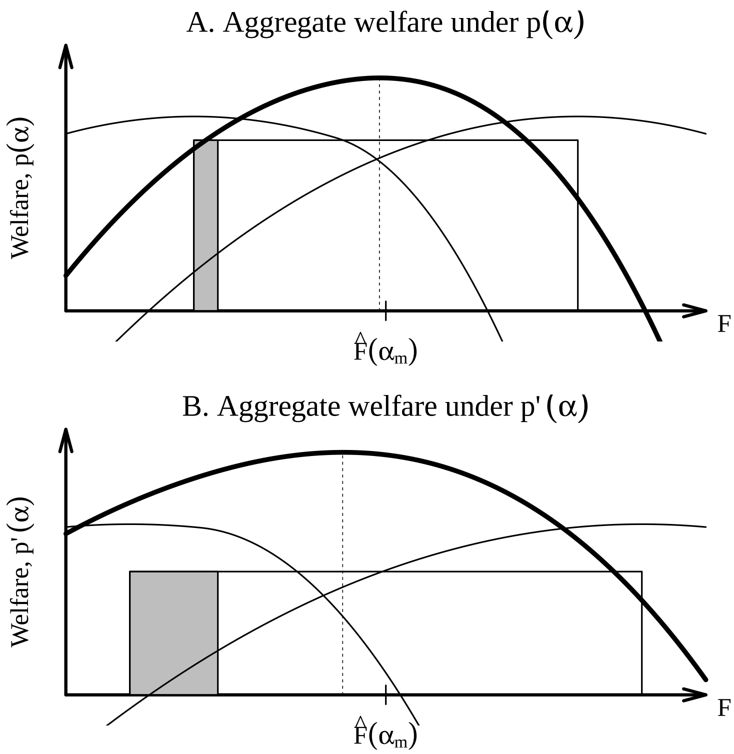
Proposition 2 (Aggregate Welfare and Federal Policymaking) *Suppose* $p(\alpha)$ *is symmetric. Then the socially optimal level of federal provision is strictly less than the median ideal policy if and only if at least some states are fully crowded out at the median's ideal policy. Otherwise, the socially optimal level of provision is the median ideal policy.*

To understand the intuition behind this result, let m index the median state, and suppose the federal policy is greater than or equal to $\hat{F}(\alpha_m)$, and imagine two states: a "low-demander" state whose demand α' is less than α_m, and a corresponding "high-demander" state whose value of public good consumption α'' is higher than, but equidistant to, α_m (i.e., $\alpha'' = 2\alpha_m - \alpha'$). If the low-demander state is fully crowded out at $\hat{F}(\alpha_m)$, it will be crowded out for any federal policy greater than $\hat{F}(\alpha_m)$. Similarly, by Lemma 1, the median state will not be fully crowded out at its own ideal point, and so neither will the high-demander state. By part 1 of Proposition 1, the marginal benefit of a reduction in F for the low-demander state will be larger than the marginal cost of the high-demander state for that reduction. The sum of the welfare of these two states will be maximized when the marginal benefit to the low-demander of a further reduction equals the marginal cost to the high-demander, which must occur at a point lower than $\hat{F}(\alpha_m)$. If, by contrast, neither the low-demander nor the high-demander is crowded out at $\hat{F}(\alpha_m)$, their joint welfare is maximized at the midpoint of their ideal points, which is $\hat{F}(\alpha_m)$. The proposition simply extends this two-state intuition to the continuum of states, exploiting the symmetry of the distribution.

Panel A of Figure 2 displays the intuition behind the result graphically. The rectangle depicts a uniform (and thus symmetric) distribution of ideal points corresponding to a uniform $p(\alpha)$. The gray region depicts states crowded out at the median's ideal point. Also depicted in the figure (in thin black lines) are the payoff functions for the state with lowest demand $\underline{\alpha}$ and the payoff for the state with highest demand $\overline{\alpha}$. Note the kink in the low-demander state's utility function. The kink implies that a crowded-out low-demander state is worse off at a moderate policy than its counterpart on the opposite side of the median. The thick black line depicts aggregate welfare for the entire distribution of states; it is maximized at a point just to the left of the median's ideal point.

A corollary to this proposition concerns institutional design, and in particular the extent to which democratic political institutions yield normatively appealing results. Given single-peaked preferences with an open agenda on the single-dimensional policy space, the ideal point of the median voter must be unbeatable in pairwise competition between alternatives. Thus, in our model, pure majority rule with an open agenda yields the median state's ideal point as an equilibrium policy. However, whereas in canonical spatial models, this result has an appealing normative utilitarian implication, it does not have that implication in our federalist setting. Specifically, if utility functions are Euclidean (i.e., a function of the absolute distance between an actor's ideal policy and the enacted policy), then the welfare maximizing policy corresponds to a central tendency of the distribution of ideal points: for example, the median (in the case of absolute-value preferences) or mean (in the case of quadratic preferences). If the distribution is symmetric, as we have assumed here, these central tendencies correspond, and so majority rule with an open agenda and Euclidean preferences would yield the socially optimal level of federal provision. The asymmetry induced by the crowding out effect of federalism, however, undermines this normative implication, because the induced preferences are no longer strictly Euclidean. The consequence here is that the median voter's preferred policy is not necessarily the social welfare-maximizing (and so the institutional configuration that results in it may not be justified on utilitarian grounds). More precisely:

Figure 2: Aggregate Welfare, Preference Heterogeneity, and the Optimal Federal Policy



When some states (in the shaded gray region) are fully crowded out at the median state's ideal point $\hat{F}(\alpha_m)$, social welfare is maximized at a point to the left of of that point because of the shadow cost of the zero lower bound. This effect is compounded for the more heterogeneous demand distribution depicted in Panel B. For a full description, see text.

Corollary 1 *Pure majority rule with an open agenda yields a socially suboptimal level of provision if and only if at least some states are fully crowded out at the median's ideal policy.*

Our next result relates aggregate welfare to the degree of preference heterogeneity across the states. In particular, suppose heterogeneity in the demand for federal provision increased, while the mean and median of the distribution remained unchanged. If preferences were Euclidean, as it is standard to assume, the social welfare maximizing policy would remain at the ideal point of the median/mean, $\hat{F}(\alpha_m)$. Proposition 2 suggests that the welfare maximizing policy is strictly less than $\hat{F}(\alpha_m)$. The next proposition goes further, however, by documenting a relationship between the extent of heterogeneity and that policy. We consider a very simple form of increasing heterogeneity: let $\alpha' = \xi\alpha - (\xi - 1)\alpha_m$ for $\xi > 1$, so that $E[\alpha'] = E[\alpha] = \alpha_m$ and $\text{var}(\alpha') > \text{var}(\alpha)$. We will call the density of α' a *simple stretch* of α. Let $p(\cdot)$ and $p'(\cdot)$ be the corresponding density functions. Then:

Proposition 3 (Aggregate Welfare and Preference Heterogeneity) *Suppose $p(\alpha)$ is symmetric, and let $p'(\alpha')$ be the density of a simple stretch of α. Then the socially optimal level of federal provision is weakly lower under $p'(\alpha')$ than $p(\alpha)$, and strictly lower if and only if some states are fully crowded out at the median's ideal policy under $p'(\alpha)$.*

The logic underlying Proposition 3 is similar to that underlying Proposition 2. The spread described in the proposition results in a strictly larger contingent of states that are fully crowded out. Moreover, the concavity of utility functions implies that the lowest demanders among them are particularly disadvantaged relative to the high demanders. In the aggregate, this effect increases the aggregate benefit associated with a reduction in the federal policy, relative to the cost to the set of high-demander states.

A comparison of Panels A and B in Figure 2 conveys the intuition behind Proposition 3 graphically. In Panel B, preference heterogeneity has increased while the mean/median of the distribution remains unchanged. The increase in preference heterogeneity exacerbates the disparity between low-demander and high-demander states at moderate levels of federal provision relative to the situation in Panel A; accordingly, aggregate welfare (the dark black line) is maximized at a point strictly lower than its maximum with lower heterogeneity.

Implicit Policy Conflict. Our next result concerns implicit policy conflict, which we define as the absolute difference in (normalized) expected payoffs between i and j for a given status quo level of federal provision, F:

$$\left|\Big(E[u_i(F|\alpha_i;\theta,\gamma)] - E[u_i(\hat{F}|\alpha_i;\theta,\gamma)]\Big) - \Big(E[u_j(F|\alpha_j;\theta,\gamma)] - E[u_i(\hat{F}|\alpha_j;\theta,\gamma)]\Big)\right|.$$

A core intuition behind concerns about political conflict is the burden it creates on policy-making – broadly put, the inefficiencies it imposes on collective outcomes. One can think of the size of these inefficiencies as increasing the size of this status-quo contingent utility differential: ceteris paribus, the greater this difference, the more difficult it will be to bridge disagreements, e.g., via transfers or mutually beneficial logrolls.[8] We normalize expected payoffs for this measure by subtracting from each state's payoff its utility evaluated at its own ideal point, to insure that all states have the same payoff (zero) at their respective ideal points.[9]

The following result concerning implicit policy conflict closely tracks the above results on aggregate welfare:

Proposition 4 (Implicit Policy Conflict in the Baseline Model) *Suppose $\alpha_i < \alpha_j$ and preferences are single-peaked. Then, implicit policy conflict is minimized at $\hat{F}(\frac{\alpha_i+\alpha_j}{2})$ if and only if neither state is crowded out at that point, and otherwise at a point strictly less than $\hat{F}(\frac{\alpha_i+\alpha_j}{2})$. If and only if i is crowded out at $\frac{\alpha_i+\alpha_j}{2}$, then the level of federal provision that minimizes implicit policy conflict is decreasing in the distance between α_i and α_j, holding $\frac{\alpha_i+\alpha_j}{2}$ constant.*

The intuition behind the first part of the result is simple: when neither state is crowded out, then their induced utilities over federal policy are identical up to a location shift. Thus, the absolute deviation in their payoffs from federal provision is zero at the midpoint between their ideal points. If both states are crowded out, then the level of federal provision must exceed the high-demander state's ideal point. If the low-demander state is crowded out and the high-demander is not, then the associated kink in the former's utility function implies that their utilities will cross below the

[8] In a bargaining framework with transfers, this differential has an intuitive interpretation: it is simply the difference in the payoffs of two parties from failing to reach an agreement.

[9] The normalization, which takes the form of an intercept shift to each state's induced utility function, affects neither the aggregate welfare nor the polarization measures. It enters into the implicit policy conflict measure by affecting the point at which the two states' payoff functions cross (and where the measure is thus minimized).

midpoint. The second part of the proposition suggests that as the two states pull apart from one another, the point of intersection will decrease.

Polarization. Polarization between states i and j is simply the absolute difference in their ideal points,

$$\left|\hat{F}(\alpha_i) - \hat{F}(\alpha_j)\right|.$$

The next result describes the effect of changes in the relative efficiency of federal provision and the magnitude of fiscal distortion on ideal point polarization.

Proposition 5 (Ideal Point Polarization in the Baseline Model) *Suppose preferences are single-peaked. Then polarization between any two states is*

1. *strictly increasing with the efficiency of federal provision;*
2. *strictly decreasing in the magnitude of the fiscal distortion when federal provision is less efficient than, or just slightly more efficient than, state provision, and otherwise increasing in the magnitude of the fiscal distortion; and*
3. *independent from the location of the equilibrium federal provision.*

The first part of the proposition may, at first, appear puzzling. Indeed, as a price effect, greater federal efficiency does increase the demand for federal provision across the board. However, this does not imply greater demand congruence. While the rising tide here does lift all ships, it lifts them unequally: as the cost or providing at the national level decreases, all states want more national provision proportionately, and the effect is to increase the distance between the ideal levels of provision of different states. Note, however, that the implications of this change for governance depends on the location of the status quo policy. In particular, if the status quo is sufficiently close to extreme low-end of the gridlock interval ($\hat{F}(\alpha_L)$), an increase in the efficiency of federal provision will increase polarization but also result in the status quo policy falling outside of the gridlock interval. In other words, an increase in the gridlock interval is not equivalent to a corresponding increase in gridlock. By contrast, if the status quo is sufficiently high, then the policy will be gridlocked both before and after the change in federal efficiency. By the second part of Proposition 4, however, implicit policy conflict between the extreme low and high ends of the gridlock interval will have increased.

To understand the intuition behind the second part of the proposition, note that when federal provision is relatively inefficient, any increase in the fiscal distortion compounds the desire of all parties not to rely on it – thus producing a compression of ideal points. When federal provision is efficient relative to that of the states (perhaps because of scale economies), a second effect comes into play: the willingness of all states to tolerate being largely crowded out to take advantage of the more efficient federal provision. This effect dominates for very high levels of federal efficiency (low θ). Because the states differ in the rate at which they wish to substitute from state to federal provision, however, their ideal points will pull diverge as γ increases.

The third part of the proposition is immediate: obviously, one's ideal level of provision cannot depend on the level of provision. We insert this as a point of comparison with the result above concerning implicit policy conflict.

4 Extensions

4.1 Dynamics

In this section, we consider a two-period extension of our model that captures some of the key dynamic implications of the federal politics discussed above. The basic intuition is two-fold. First, and most obviously, if the states aniticipate future shocks that may make a candidate policy less attractive to them, then they are likely to resist that policy (to a greater extent) in the current period, but also, anticipating the possibility of future (stronger) opposition from others to a policy that they may turn out to like a great deal, they should be more willing to incur a current-period hit to give themselves a greater opportunity with respect to that policy in the future. For the low-demand states, this means preferring a lower federal policy still, because in the future, they are pivotal in adjusting it upward if necessary, and for the high-demand states, it means preferring a still higher federal policy because they are pivotal in adjusting it downward, if necessary. The second part of the intution is related more closely to the specific details of the politics of federalism. Because the low- and high- demand states are asymmetric in their abilities to adjust their state-level provision, they will respond asymmetrically to the possibility of future shocks, with the low-demand states becoming relatively more extreme than the high-demand states in their induced preferred federal policy.

To capture these intuitions in a simple way, suppose that at the beginning of the second period, all agents' parameters α are shocked by some σ symmetrically distributed around 0, with pdf $p(\sigma)$. Thus, $\alpha_i^2 = \alpha_i + \sigma$. We will show that, in expectation of these shocks and in aniticipation of equilibrium behavior, the existence of the second period leads the right bound of the first-period gridlock interval to move to the right, and the left bound to move, by a still greater amount, to the left, thus asymmetrically increasing the size of the gridlock interval in the first period relative to the baseline one-period game. In other words, *the weight of the future will increase the present-day disagreement and will do so by making the low-demand states disproportionately less willing to compromise.*[10]

Recall that α_L and α_H are types defining lower and upper bounds of the gridlock interval, respectively and that $S(\alpha_i^t, F^t)$ is chosen optimally each period t, dependent only on the current period's values of α_i^t and F^t. Let $\hat{F}^2(\alpha_i^2, F^1)$ be the optimal federal policy choice in $t = 2$ for α_i^2 given the status quo F^1 and anticipating optimal $S^2(\alpha_i + \sigma, F^2)$, and let $\hat{F}^1(\alpha_i, \tilde{F})$ be optimal choice in $t = 1$ for α_i, given the initial federal status quo $\tilde{F}$ and aniticpating optimal subsequent play. For mathematical convenience, we are going to assume that if the status quo is low (below $\hat{F}^2(\alpha_L^2, F^1)$), then the new policy is then $F^2 = \hat{F}^2(\alpha_L^2, F^1)$, and if the status quo is high, then the new policy is $F^2 = \hat{F}^2(\alpha_H^2, F^1)$. That is, if the status quo is below the induced optimal preference of the state defining the left bound of the second period's gridlock interval, then the policy will be pulled up to that lower bound, and if it is above the induced optimal preference of the state defining the right bound of the second period's gridlock interval, then the policy will be pulled down to that upper bound. If $F^1 \in [\hat{F}^2(\alpha_L^2, F^1), \hat{F}^2(\alpha_H^2, F^1)]$, then the second period's status quo policy F^1 persists as the federal policy in the second period. We will retain the notation $\hat{F}(\cdot)$ (without superscript) to refer to the equilibrium policy in a single-period environment. Our result in this section is the following proposition:

Proposition 6 *The following properties describe the relationship between the gridlock intervals in the first and the second periods of the two-period environment:*

1. *In the first period, the left boundary of the gridlock interval is lower, and the right boundary*

[10] A recent working paper by Dziuda and Loeper (2014), which shows that a result similar to the first part of this claim obtains in a standard spatial setting (outside of the dual-provision environment we analyze in the present paper), provides an interesting point of comparison.

higher, than their respective counterparts in the one-shot game ($\hat{F}^1(\alpha_L, \tilde{F}) < \hat{F}(\alpha_L, \tilde{F})$ *and* $\hat{F}^1(\alpha_H, \tilde{F}) > \hat{F}(\alpha_H, \tilde{F})$)*; and*

2. *The left boundary moves left farther than the right boundary moves right* ($\left|\hat{F}^1(\alpha_L, \tilde{F}) - \hat{F}^2(\alpha_L, \tilde{F})\right| \geq \left|\hat{F}^1(\alpha_H, \tilde{F}) - \hat{F}^2(\alpha_H, \tilde{F})\right|$, *with the inequality holding strictly if* $\alpha_L + A(\hat{F}^1(\alpha_L, \tilde{F})) - \alpha_H < \gamma\hat{F}^1(\alpha_L, \tilde{F})$.)

4.2 Externalities

In the next extension, we return to the one-shot environment, and vary the baseline model in a way that highlights the effects of cross-state spillovers on preferences for federal provision. In particular, suppose that state's i's utility incorporates an externality term, as follows:

$$\begin{aligned} u_i(F, S_i; \alpha_i, \beta_i, y, \gamma, \theta) &= y_i + \alpha_i(F + S_i) - \frac{\theta F^2}{2} - \frac{S_i^2}{2} - \gamma F S_i - K(\alpha; \theta, \gamma) \\ &\quad + \beta_i \int S(\alpha) dP(\alpha), \end{aligned} \tag{4}$$

where $\beta_i \in \mathbb{R}$ is a (state-specific) parameter scaling the magnitude of the externality. This parameterization permits us to focus on how cross-state externalities affect equilibrium policy and politics through their effects on preferences over federal provision. First, a state's own equilibrium level of provision S_i will not be *directly* affected by other states' public good production; instead, federal provision will respond to the externalities, which will in turn affect state provision as above. Second, note that we consider the externality from state provision in isolation, rather than the externality from other states' enjoyment of their own provision plus federal provision. Modeling the externality from other states' enjoyment of federal public goods provision would not change the intuition, but would complicate the derivation by adding a direct benefit or cost to federal provision beyond $\alpha_i F$.

As in the baseline case, a state i will be crowded out for all $F > \frac{\alpha_i}{\gamma}$, or rearranging terms, $\alpha_i < \gamma F$. Given the expectation that states not crowded out will implement $S^*(\alpha) = \alpha - \gamma F$ in equilibrium, the last term in equation (4) is equal to $\beta_i \int_{\gamma F}^{\overline{\alpha}} (\alpha - \gamma F) p(\alpha) d\alpha$ if $\gamma F < \overline{\alpha}$ and 0 otherwise.

In the results that follow in this section, we will assume for analytic tractability that $p(\alpha)$ is $U[0,1]$. First, we consider how the introduction of cross-*state* externalities affects induced preferences over *federal* provision.

Proposition 7 *Suppose all states have common externality parameter β, and $\alpha \sim U[0,1]$. Then all states have single-peaked preferences over national policy if and only if $\beta < \frac{\theta-\gamma^2}{\gamma^2}$. Given states' single-peaked preferences,*

1. *If $\beta > 0$, all states have a strictly positive level of state provision at their respective ideal national levels of provision. If $0 < \beta < \frac{1-\gamma}{\gamma}$, then a proper subset of states ($\alpha \in [0, \frac{\beta\gamma}{1-\gamma}]$) have ideal national provision of zero, and for the remaining states, ideal levels of federal provision are decreasing in β. If $\beta \geq \frac{1-\gamma}{\gamma}$, then all states have ideal national provision of zero.*

2. *If $\beta < 0$, then all states prefer strictly positive national provision, with a proper subset of states ($\alpha \in [0, \frac{\beta\gamma^2}{\beta\gamma^2-(\theta-\gamma)}]$) preferring zero state provision at their respective ideal national level of provision, and the remaining states' ideal levels of federal provision decreasing in β.*

3. *If a state with demand α' would be fully crowded out at its own ideal level of national provision, then there exists a neighborhood of states with demand strictly greater than α' that would also be fully crowded out at that level of national provision.*

Part 1 of the Proposition describes the effect of positive, symmetric externalities. For small levels of positive externalities, a set of states with low demand for public good provision will have that demand met by the provision of other states plus their own; consequently, they will be driven to prefer that all provision be local. For the states that prefer some positive level of federal provision, that level will be decreasing in the magnitude of the externality: intuitively, as the provision of other states substitutes for federal provision, it drives down demand for the latter. For sufficiently large values of positive externalities, all states will find their demand met by purely decentralized provision and zero federal provision will be unanimously preferred.

Part 2 describes what happens when the externalities are negative and symmetric. In that case, there will always be a set of states with low demand that prefer a level of federal provision sufficient to fully crowd themselves (and other states) out. As the magnitude of the negative externalities increases, the fraction of states in that set increases, but there will always be a subset of states that continues to prefer mixed provision. An increase in the magnitude of the negative externalities (i.e., a *decrease* in β) induces a state to prefer *more* crowding out of state-level provision by a larger federal presence.

Part 3 establishes out that any state that most prefers a level of federal provision sufficient to put itself out of the business of public goods provision (and, by extension, all states with lower demand) also wants to put higher-demander states out of business as well.

Next we turn to implicit policy conflict and its relationship to externalities.

Proposition 8 (Implicit Policy Conflict with Common Externalities) *Suppose all states have common externality parameter β and single-peaked preferences over federal policy. Then implicit policy conflict between two states is independent of β.*

This follows immediately from the fact that the externality term enters each state's utility function in the same way, such that for any federal policy, a comparison of utilities between two states differences out the term. The following corollary concerns the effects on implicit policy conflict of *asymmetric* externalities:

Corollary 2 *Suppose $\alpha_i < \alpha_j$, and F is such that $E[u_i(F|\cdot)] > (<) E[u_j(F|\cdot)]$. Then if and only if an increase in negative externalities leads to an increase in implicit policy conflict between the two states, then the magnitude of the externality grows faster for j (i) than for i (j).*

The corollary states that if the low-demander state enjoys the status quo federal policy more than the high-demander state (i.e., when F is relatively small), implicit policy conflict will increase if the change in the negative externality hits the latter harder than the former. By contrast, when the status quo level of F is more to the high-demander's liking, then implicit policy conflict will increase if the change in the negative externality hits the low-demander harder than the high-demander. The overall implication is that the effect of negative externalities on political polarization is contingent not only on their hitting states asymmetrically, but also the location of the status quo level of federal provision.

Next, we turn to polarization. The first result relating externalities and polarization concerns the presence of a common externality β:

Proposition 9 (Polarization with Common Externalities) *Suppose preferences over federal policy are single-peaked and externalities are common. Then polarization is:*

1. *increasing in the magnitude of a positive externality for any two states; and*
2. *decreasing in the magnitude of a negative externality for any two states unless one (and only one) of those states prefers exclusive federal provision*

The first part of the result emerges from the fact that when externalities are positive, the demand of states for public provision is partially satiated by the actions of other states. Owing to the concavity of the states' payoff functions, however, the corresponding reduction in the demand for federal provision is larger for low-demander states than high-demander ones – this produces an increase in the distance between their ideal points. To understand the second part of the result, note that when two states prefer some federal provision, but disagree about the level of that provision, than an increase in the magnitude of negative externalities produces an *endogenous consensus* in favor of federal action: in essence, the value to the states of using federal provision as a means to crowd out state provision (and mitigate the externality) pushes their preferences closer together. If, on the other hand, one of the states prefers exclusive federal provision, the change in the magnitude of the externality increases the demand of the one that prefers exclusive federal provision faster than the one that continues to prefer mixed provision.

Corollary 3 *Suppose $\alpha_i < \alpha_j$ and each state prefers mixed provision. If an increase in negative externalities leads to an increase in polarization between the two states, then the magnitude of the externality grows faster for j than for i.*

The corollary follows immediately from the preceding results. As noted above, a symmetric increase in negative externalities tends to reduce polarization between the two states by creating consensus for an increased federal presence. If, on the other hand, the high-demander state is "hit harder" by the externality, it's demand for federal provision will pull away from that of the low-demander state, increasing polarization.

4.3 Regulatory Federalism

While the division of public goods provision is a critical aspect of contemporary federalism, another is the division of regulatory responsibility. An important debate in the literature on regulatory federalism concerns partial preemption: the phenomenon wherein the national government sets regulatory "floors" that the states are permitted to exceed but not fall below. In this section, we present a simple version of our model in which the choices made concern the fraction of a harm the government chooses to remedy. Hewing closely to the notation above, let Let $F \in [0,1]$ represent a federal floor, and $S_i \in [F,1]$ denote the remedied fraction of a harm in state i. The magnitude of total harm in each state is normalized to one. States care about the harm within their own borders $(1 - S_i)$, as well as the harm coming from other states, denoted Z.[11] State i's utility is

$$u_i(S_i; \alpha_i, \beta) = -\alpha_i(\beta Z + (1 - S_i)) - \frac{S_i^2}{2}. \tag{5}$$

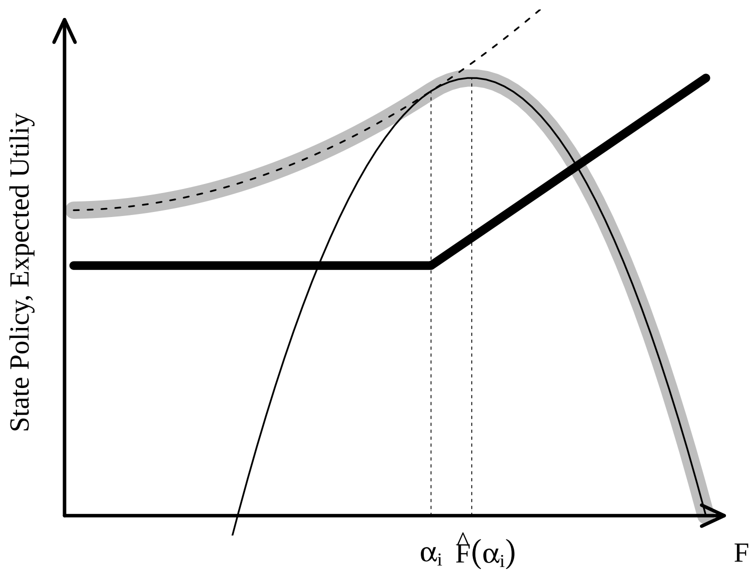
The quantity α_i is a taste parameter scaling the extent to which state i is adversely affected by the harm, and $\beta > 0$ is a parameter that captures the extent to which cross-border spillovers, as opposed to within-state harms, adversely affect state i. We will assume in this extension that the α_is are distributed $U[0,1]$. The sequence is identical to the one discussed above: the federal government sets a floor, and then the states set state-level policy, now subject to the constraint that $S_i \geq F$.

Here, we describe informally the induced preferences over federal provision and the unique equilibrium in this game (for a formal derivation, see the Appendix), and then establish the robustness of our main substantive results in the current environment.

In the absence of the federal floor, each state would choose $S_i^* = \alpha_i$. Adding the floor, states simply choose $S_i^* = \max\{F, \alpha_i\}$. If β is not too large (< 1), induced preferences over federal provision are single-peaked for all states. However, as in the model described in the previous sections, there is an asymmetry in induced preferences brought about by the constraint implicit in the federal floor: If $F < \alpha_i$, a marginal increase in F improves state i's welfare by reducing the harm to i from *other* states while not affecting the cost of implementation within state i. In this

[11] Adding heterogeneity in the magnitude of harm in each state is a straightforward extension that offers little additional insight.

Figure 3: The Effect of a Federal Regulatory Floor on State Policy and Induced Preferences over Federal Floors



State policy (the thick black line) is constrained by sufficiently high federal floors ($F > \alpha_i$). This constraint generates an asymmetry in the state's induced utility over federal policy (the shaded gray curve). For a full description, see text.

range, the state's payoff is increasing at an increasing rate. For $F \geq \alpha_i$, the cost of an incremental increase in F, now comes with costs as well as benefits: on this range, a state's induced utility is concave, reaching a maximum at

$$\hat{F}(\alpha_i) = \frac{\alpha_i}{1 - \alpha_i \beta}.$$

This quantity is greater than α_i (strictly greater unless $\alpha_i = 0$), i's state-level optimal policy, because in contemplating an optimal federal floor state i considers the benefit not only in terms of local harms but also national ones. Figure 3 depicts the state's induced utility over federal policy, as well as the state's optimal policy, graphically. Intuitively, a state's ideal federal floor is increasing in the state's taste for harm reduction α_i and the importance of cross-border spillovers β.

The next result affirms the robustness of our results on aggregate welfare in the public good version of the model in the regulatory setting:

Proposition 10 *Suppose all states have single-peaked preferences over the federal floor. Then (a) the federal floor that maximizes aggregate welfare is weakly less than the ideal federal floor of the* *median state; and (b) for any two states i and j whose preferences are distributed symmetrically around the median/mean state's ($\alpha_m = \frac{1}{2}$), the federal floor that maximizes their joint welfare is weakly decreasing in the distance between them, and strictly decreasing for sufficiently large distances.*

The logic underlying this result is substantially similar to the logic underlying Proposition 2 above: a marginal increase in the federal floor hurts low regulatory demanders more than it helps high demanders. The discrepancy between any two states increases the farther apart they are, lowering the federal floor that maximizes their joint welfare – an intuition that generalizes for the entire distribution of states.

The next result concerns the effect of an increase in the influence of regulatory externalities on polarization in the regulatory federalism environment:

Proposition 11 *Suppose states i and j have single-peaked preferences over the federal floor and $\alpha_i < \alpha_j$. Then polarization between states i and j is increasing in the importance of spillovers β if $\hat{F}(\alpha_j) < 1$; decreasing if $\hat{F}(\alpha_j) = 1$ and $\hat{F}(\alpha_i) < 1$, and unresponsive if $\hat{F}(\alpha_i) = \hat{F}(\alpha_j) = 1$.*

5 Discussion

Our analysis of the above model has a number of implications concerning how to think about the antecedents of political conflict in the United States. First, the political polarization of elites in the United States, particularly since 1980, is a widely-recognized empirical regularity. Accounts of the causes of polarization tend to focus on changes in the underlying demand for government action by public officials and interest groups. The account of political conflict and polarization offered above provides an institutional alternative that complements the preference-based account: we demonstrate that political conflict (measured as implicit policy conflict or polarization) can vary depending on the status quo level of federal provision, fiscal distortions, and government efficiency, *even holding the underlying demand constant.*

Second, our analysis uncovers a number of biases in the way that the federal system operates. One of these biases appears to favor states with a high demand for public policy: namely, the asymmetric effect of crowding out implies that states with low-demand for a particular policy are more constrained in their ability to compensate for undesirably high levels of federal provision than high-states are able to compensate for undesirably low levels. The flip side of this bias, however, is a corresponding conservatism in constitutional design. Our results indicate that if crowding out is a significant problem, pure majoritarianism at the national level can produce inefficient outcomes, and a more efficient level of federal provision will occur below the median state's ideal level. When the states are particularly heterogeneous in their tastes, the discrepancy between the median's preference and the social optimal can be quite substantial. If, at a constitution's inception, the size of federal provision is small, then antimajoritarian procedures can be structured in such a way as to achieve the social optimum even in the absence of cross-state transfers. Once the status quo level of provision is high, the social optimum will not generally be achievable without transfers. A second source of bias results from our analysis of dynamics: in particular, the fear of the status quo level of provision being gridlocked in the future at an undesirable level of federal provision will tend to make conservative states more conservative and liberal states more liberal: however, the fear of being crowded out in the future will tend to make conservatives *particularly* recalcitrant.

References

Alesina, A., Angeloni, I., Etro, F., 2005. "International Unions." *American Economic Review* 95 (2): 602–615.

Austen-Smith, David, and Jeffrey S. Banks. 1999. *Positive Political Theory I: Collective Preferences.* Ann Arbor: University of Michigan Press.

Banks, Jeffrey S., and John Duggan. "A General Bargaining Model of Legislative Policy-making." *Quarterly Journal of Political Science* 1(1): 49-85.

Baron, David P., and John A. Ferejohn. 1989. "Bargaining in Legislatures." *American Political Science Review* 83(4): 1181-1206.

Besley, Timothy, and Stephen Coate. 2003. "Centralized versus Decentralized Provision of Local Public Goods: A Political Economy Approach." *Journal of Public Economics* 87(12): 2611-2637.

Bolton, Patrick, and Gerard Roland. 1997. "The Break-Up of Nations: A Political Economy Analysis." *Quarterly Journal of Economics* 112(4): 1057-1090.

Bradford, David F., and Wallace E. Oates. 1971. "Toward a Predictive Theory of Intergovernmental Grants." *American Economic Review* 61(2): 440-448.

Corwin, Edward S. 1950. "The Passing of Dual Federalism." *Virginia Law Review* 36(1): 1-24.

Courant, Paul N., Edward M. Gramlich, and Daniel L. Rubinfeld. 1979. "The Stimulative Effects of Intergovernmental Grants: Or Why Money Sticks Where it Hits." In Mieszkowski, Peter, and William H. Oakland, eds., *Fiscal Federalism and Grants-in-Aid.* Washington, DC: Urban Institute.

Cox, Gary W. and Mathew D. McCubbins. 2005. *Setting the Agenda: Responsible Party Government in the U.S. House of Representatives.* New York: Cambridge University Press.

Crémer, J., Palfrey, T. R., 2000. "Federal Mandates by Popular Demand." *Journal of Political Economy* 108 (5): 905-927.

Crémer, J., Palfrey, T. R., 2006. "An Equilibrium Voting Model of Federal Standards with Externalities." *Journal of Public Economics* 90 (10-11): 2091–2106.

Dziuda, Wioletta and Antoine Loeper. 2014. "Dynamic Collective with Endogenous Status Quo." Working paper.

Fischer, David Hackett. 1989. *Albion's Seed.* Oxford: Oxford University Press.

Gordon, Sanford C., and Dimitri Landa. N.D. *Publius Unbound: Constitutional Design and the Faltering of American Federalism.* Book Manuscript, selections.

Grodzins, Morton. 1966. *The American System: A New View of Government in the United States.* Transaction Publishers. Hafer, Catherine, and Dimitri Landa, D. 2007. "Public Goods in Federal Systems." *Quarterly Journal of Political Science*, 2 (3), 253-275.

Ingelhart, Ronald, and Christian Welzel. 2005. *Modernization, Cultural Change, and Democracy.* Cambridge: Cambridge University Press.

Inman, Robert P., and Daniel L. Rubinfeld. 1997. "The Political Economy of Federalism." In Mueller, Dennis C., ed., *Perspectives on Public Choice.* New York: Cambridge University Press.

Knight, Brian. 2002. "Endogenous Federal Grants and Crowd-Out of State Government Spending: Theory and Evidence from the Federal Highway Aid Program." *American Economic Review* 92(1): 71-92.

Krehbiel, Keith. 1996. "Institutional and Partisan Sources of Gridlock: A Theory of Divided and Unified Government." *Journal of Theoretical Politics* 8(1): 7-40.

Krehbiel, Keith. 1998. *Pivotal Politics: A Theory of U.S. Lawmaking.* Chicago: University of Chicago Press.

Lacy, Dean P. 2009. "Why do Red States Vote Republican While Blue States Pay the Bills? Federal Spending and Electoral Votes, 1984-2008." Typescript, Dartmouth College.

Lockwood, Ben. 2002. "Distributive Politics and the Benefits of Decentralization." *Review of Economic Studies* 69: 313-337.

McCarty, Nolan, Keith T. Poole, and Howard Rosenthal. 2006. *Polarized America.* Cambridge, MA: MIT Press.

Oates, Wallace E. 1972. *Fiscal Federalism.* New York: Harcourt, Brace Jovanovich.

Poole, Keith T., and Howard Rosenthal. 1984. "The Polarization of American Politics." *Journal of Politics* 46(4): 1061-1079.

Rose-Ackerman, Susan. 1981. "Does Federalism Matter? Political Choice in a Federal Republic." *Journal of Political Economy* 89(1) 152-165.

Appendix

Proof of Lemma 1

Substituting the expression for S_i^* from equation (2) into equation (3) and simplifying yields

$$E[u_i(F|\alpha_i;\theta\gamma)] = \begin{cases} y_i - \frac{\theta-\gamma^2}{2}F^2 + (1-\gamma)\alpha_i F + \frac{\alpha^2}{2} & \text{if } F < \frac{\alpha_i}{\gamma} \\ y_i - \frac{\theta}{2}F^2 + \alpha_i F & \text{otherwise.} \end{cases} \quad (6)$$

This first line of (6) is globally concave if and only if $\theta > \gamma^2$, or $\gamma < \sqrt{\theta}$. Solving the state's first order condition under the supposition $F < \frac{\alpha_i}{\gamma}$ gives the expression for $\hat{F}(\alpha_i;\gamma,\theta)$ in part 1 of the lemma. Given $\theta > \gamma^2$, the expression for $\hat{F}$ is strictly positive if and only if $\gamma < 1$. To establish single-peakedness with strictly positive state provision at the federal ideal point, it is sufficient to demonstrate that (a) for all $F \geq \frac{\alpha}{\gamma}$, $\frac{\partial E[u_i(F|\cdot)]}{\partial F} < 0$; (b) $\hat{F}(\alpha_i;\gamma,\theta) < \frac{\alpha_i}{\gamma}$; and (c) no discontinuity exists at in $E[u_i(F|\cdot)$ at $F = \frac{\alpha_i}{\gamma}$. Differentiating the second line of (6) with respect to F yields $\alpha_i - F\theta$, which is strictly negative if and only if $F > \frac{\alpha}{\theta}$. $F \geq \frac{\alpha}{\gamma}$ implies $F > \frac{\alpha}{\theta}$ if and only if $\theta > \gamma$. Substituting the expression for the federal ideal point in part 1 of the lemma, $\hat{F}(\alpha_i;\gamma,\theta) < \frac{\alpha_i}{\gamma}$ if and only if $\theta > \gamma$. Finally, to show that there are no discontinuities in i's induced utility, set the first and second lines of (6) to equal each other. Simple algebra reveals a solution at $F = \frac{\alpha_i}{\gamma}$. Because $\theta < \sqrt{\theta}$ if and only if $\theta < 1$, the three conditions derived above ($\gamma < \sqrt{\theta}$, $\gamma < \theta$, and $\gamma < 1$) are jointly equivalent to $\gamma < \min\{1, \theta\}$. ■

Proof of Proposition 1

1. Comparing the first and second lines of (6) gives

$$y_i - \frac{\theta - \gamma^2}{2} F^2 + (1-\gamma)\alpha_i F + \frac{\alpha^2}{2} > y_i - \frac{\theta}{2} F^2 + \alpha_i F.$$

Simplifying and solving for F yields $F > \frac{\alpha_i}{\gamma}$. From Lemma 2, given $\gamma < \min\{1, \theta\}$ and $F > \frac{\alpha_i}{\gamma}$, both lines of (6) are decreasing in F; the second line is decreasing faster if and only if

$$-(\theta - \gamma)^2 F + (1-\gamma)\alpha > -\theta F + \alpha,$$

which is true if and only if $F > \frac{\alpha_i}{\gamma}$.

2. The shadow cost of the constraint is given by

$$\lambda = \frac{\gamma^2}{2} F^2 - \alpha\gamma F + \frac{\alpha^2}{2}.$$

Then if and only if $F > \frac{\alpha_i}{\gamma}$, $\frac{\partial \lambda}{\partial \gamma} = \gamma F^2 - \alpha F > 0$ and $\frac{\partial \lambda}{\partial \alpha} = \alpha_i - \gamma F < 0$. ■

Proof of Proposition 2

Let α_m be the demand of the median state. Given symmetric $p(\alpha)$, for any point $\alpha' < \alpha_m$ in the support of α there is an associated point $\alpha'' = 2\alpha_m - \alpha' > \alpha_m$ with $p(\alpha') = p(\alpha'')$. Let $v(\alpha'; \theta, \gamma) = E[u_i(F|\alpha = \alpha'; \theta, \gamma)] + E[u_i(F|\alpha = 2\alpha_m - \alpha'; \theta, \gamma)]$ for $\alpha' < \alpha_m$. Then the social welfare maximizing policy is

$$V(\theta, \gamma, p(\cdot)) \equiv \int_{\underline{\alpha}}^{\alpha_m} v(\alpha; \theta, \gamma) p(\alpha) d\alpha. \tag{7}$$

Let $F^* \in \arg\max_F V(\theta, \gamma, p(\cdot))$. There are four possible cases to consider:

1. All states fully crowded out at F^*. From single-peakedness, it must be the case that $F^* \in [\hat{F}(\underline{\alpha}), \hat{F}(\overline{\alpha})]$. But then by Lemma 1, at F^*, all states with $\hat{F}(\alpha) \geq F^*$ are not fully crowded out, a contradiction.

2. No states fully crowded out at F^*. Then aggregate welfare is

$$\begin{aligned} V(\theta, \gamma, p(\alpha) &= \int_{\underline{\alpha}}^{\alpha_m} \left(-(\theta - \gamma^2)F^2 + 2(1-\gamma)\alpha_m F + 2\alpha_m^2 + \alpha^2 - 2\alpha_m \alpha\right) p(\alpha) d\alpha \\ &= -(\theta - \gamma^2)F^2 + 2(1-\gamma)\alpha_m F + K(\alpha_m, p(\cdot)), \end{aligned} \tag{8}$$

where $K(\cdot)$ is a remainder term independent of F. This is maximized at $F^* = \frac{1-\gamma}{\theta-\gamma^2}\alpha_m = \hat{F}(\alpha_m)$. If no state is fully crowded out at $\hat{F}(\alpha_m)$, then no state is crowded out at any $F \leq \hat{F}(\alpha_m)$ and $\hat{F}(\alpha_m)$ welfare dominates. For any $F > \hat{F}(\alpha_m)$ that induces full crowding out for a subset of states, social welfare is strictly lower than it would be in the absence of full crowding out (via Lemma 1), so $\hat{F}(\alpha_m)$ welfare dominates.

3. Subset of states below with $\hat{F}(\alpha) < F^*$ fully crowded out at F^*. (a) There exist a set of policies $F \in (0, \frac{\underline{\alpha}}{\gamma})$ for which no state is crowded out. On this interval, social welfare is given by the second line of (8), and is strictly increasing in F. (b) For $F \in [\frac{\underline{\alpha}}{\gamma}, \hat{F}(\alpha_m))$, states with $\alpha \in (\underline{\alpha}, \gamma F)$ will be fully crowded out. In that range of F,

$$\begin{aligned} V(\theta, \gamma, p(\alpha) = & \int_{\underline{\alpha}}^{\gamma F} \left[-\frac{2\theta - \gamma^2}{2}F^2 + (2(1-\gamma)\alpha_m + \gamma\alpha)F\right] p(\alpha) d\alpha + \\ & \int_{\gamma F}^{\alpha_m} \left(-(\theta - \gamma^2)F^2 + 2(1-\gamma)\alpha_m F\right) p(\alpha) d\alpha + K(\alpha_m, p(\cdot)), \end{aligned} \tag{9}$$

where $K(\cdot)$ is a remainder term independent of F. Note that the term in square brackets is maximized at

$$F = \frac{2(1-\gamma)\alpha_m + \alpha\gamma}{2\theta - \gamma^2}. \tag{10}$$

Comparing this expression to $\hat{F}(\alpha_m)$, the former is smaller than the latter if and only if

$$\alpha < \gamma \frac{1-\gamma}{\theta - \gamma^2}\alpha_m \equiv \gamma \hat{F}(\alpha_m),$$

i.e., if the state with ideal point α is fully crowded out at $\hat{F}(\alpha_m)$, $v(\alpha)$ is maximized at a point strictly below $\hat{F}(\alpha_m)$. Then the expression in (9) is a weighted average of a function maximized at $\hat{F}(\alpha_m)$ and a function maximized strictly to the left of $\hat{F}(\alpha_m)$. Because $\gamma F > \underline{\alpha}$, some positive weight will be assigned to the latter, so $F^* < \hat{F}(\alpha_m)$.

4. All states with $\hat{F}(\alpha) < F^*$, and some with $\hat{F}(\alpha) \geq F^*$, fully crowded out at F^*. But by Lemma 1, all states with $\hat{F}(\alpha) \geq F^*$ are not fully crowded out, a contradiction. ■

Proof of Proposition 3

If no states are fully crowded out at $p'(\alpha)$, then no states will be crowded out at $p(\alpha)$; per Proposition 2, the social welfare maximizing policy in both cases will be $\hat{F}(\alpha_m)$. If no states are fully crowded out under $p(\alpha)$ but some are crowded out under $p'(\alpha)$, then per Proposition 2, the social welfare maximizing policy will be $\hat{F}(\alpha_m)$ in the first case and strictly less than $\hat{F}(\alpha_m)$ in the second.

Suppose some states are fully crowded out under both $p(\alpha)$ and $p'(\alpha)$. Then social welfare is given by (9). From above, the term in square brackets is maximized at the expression given in (10), which is increasing in α. Thus an increase in the distribution's scale has two re-enforcing effects: holding F^* constant, it assigns more weight to the first integral than the second, producing a decrease in F^*. Also, it implies that under $p'(\alpha)$, the expression in (9) is a weighted average of a function maximized at $\hat{F}(\alpha_m)$ and a function maximized at a point less than the policy at which it is maximized under $p(\alpha)$. As indicated by the bounds on the integrals in (9), the weights are themselves a function of F; however, per the envelope theorem, any indirect effect on the weights brought about by a change in F^* cannot offset the aforementioned direct effects. ■

Proof of Proposition 4

Implicit policy conflict is minimizing where state i's normalized induced utility over federal provision intersects state j's; given single-peakedness and concavity, the point of intersection is unique. Suppose neither state is fully crowded out at $\hat{F}(\frac{\alpha_i+\alpha_j}{2})$. Solving for F yields $F = \hat{F}(\frac{\alpha_i+\alpha_j}{2})$. Suppose both states are, or state j but not state i is, fully crowded out at $\hat{F}(\frac{\alpha_i+\alpha_j}{2})$; by Lemma 1, state j would not be fully crowded out, a contradiction. Finally, suppose state i is fully crowded out at $\hat{F}(\frac{\alpha_i+\alpha_j}{2})$ but state j is not. By Lemma 1 the point at which i and j's normalized induced utility over federal provision intersects must be at a value of F lower than if the zero-lower bound were not bounded. ■

Proof of Proposition 5

1. $\frac{\partial^2 \hat{F}(\alpha_i)}{\partial\alpha_i \partial\theta} = -\frac{1-\gamma}{(\theta-\gamma^2)^2} < 0$, which implies that the distance between any two ideal points is decreasing in θ (i.e., increasing in efficiency).

2. $\frac{\partial^2 \hat{F}(\alpha_i)}{\partial\alpha_i \partial\gamma} = \frac{-\theta+\gamma(2-\gamma)}{(\theta-\gamma^2)^2}$. This quantity is strictly negative if and only if $\theta > \gamma(2-\gamma)$. The right side of this inequality is strictly less than one for all $\gamma < \min\{1,\theta\}$, so the inequality holds for any $\theta > 1$. For $\theta \leq 1$, note that the right side of the inequality is strictly increasing in γ for $\gamma < 1$, globally concave, and maximized at $\gamma = 1$. Simple algebra reveals that the inequality is reversed at $\gamma = 1 - \sqrt{1-\theta}$, which is strictly less than θ for all $\theta < 1$, thus satisfying the condition $\gamma < \min\{1,\theta\}$.

3. Immediate. ■

Proof of Proposition 6

(1) Note first that state levels of provision $S^t(\alpha_i^t, F^t)$ are not sticky, and are chosen optimally given α_i^t and F^t. It is clear that $\hat{F}^2(\cdot,\cdot) = \hat{F}(\cdot,\cdot)$ from the one-period model. Because $\hat{F}^2(\cdot,\cdot)$ is monotone in α^2, its inverse is well-defined. Let $A(F)$ be inverse of $\hat{F}^2(\alpha_i^2,\cdot)$. Then the α_i^2 for whom $\hat{F}^2(\alpha_i^2, F) = F^1$ is $A(F^1)$. Thus, for F^1 to be in the gridlock interval in $t = 2$, it must be that the shock σ is such that

$A(F^1) \in [\alpha_L + \sigma, \alpha_H + \sigma]$, i.e., $\sigma \in [A(F^1) - \alpha_H,\, A(F^1) - \alpha_L]$.

The expected utility from choice F^1 is

$$u(F^1, \alpha_i, \cdot) + \lambda \int_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) u(F^1, \alpha_i + \sigma, \cdot) d\sigma$$
$$+\lambda \int_{-\infty}^{A(F^1)-\alpha_H} p(\sigma) u(\hat{F}^2(\alpha_H + \sigma), \alpha_i + \sigma, \cdot) d\sigma$$
$$+\lambda \int_{A(F^1)-\alpha_L}^{\infty} p(\sigma) u(\hat{F}^2(\alpha_L + \sigma), \alpha_i + \sigma, \cdot) d\sigma,$$

where $u(F^1, \alpha_i, \cdot)$ is the indirect utility given that $S_i^t = S(\alpha_i^t, F^t)$, the first integral is the expected utility when the shock lands the system in the gridlock interval, and the second and third integrals are when the shock moves the system to the right of the right bound and to the left of the left bound of the gridlock interval, respectively.

Taking the first-order condition, we get

$$\begin{aligned}
& \frac{\partial u(F^1, \alpha_i, \cdot)}{\partial F^1} \\
& +\lambda p(A(F^1) - \alpha_L) u(F^1, \alpha_i + A(F^1) - \alpha_L, \cdot) \frac{\partial A(F^1)}{\partial F^1} \\
& -\lambda p(A(F^1) - \alpha_H) u(F^1, \alpha_i + A(F^1) - \alpha_H, \cdot) \frac{\partial A(F^1)}{\partial F^1} \\
& + \int_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_i + \sigma)}{\partial F^1} d\sigma \\
& +\lambda p(A(F^1) - \alpha_H) u(F^2(\alpha_H + A(F^1) - \alpha_H), \alpha_i + A(F^1) - \alpha_H, \cdot) \frac{\partial A(F^1)}{\partial F^1} \\
& -\lambda p(A(F^1) - \alpha_L) u(F^2(\alpha_L + A(F^1) - \alpha_L), \alpha_i + A(F^1) - \alpha_L, \cdot) \frac{\partial A(F^1)}{\partial F^1} \\
= \; & 0
\end{aligned}$$

Noting that $F^2(A(F^1) = F^1$ and canceling terms, we obtain an equivalent condition

$$\frac{\partial u(F^1, \alpha_i, \cdot)}{\partial F^1} + \lambda \int_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_i + \sigma, \cdot)}{\partial F^1} d\sigma = 0 \tag{11}$$

If $\lambda \int_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_i+\sigma)}{\partial F^1} d\sigma$ less (greater) than 0 then F^1 is less (greater) than in the one-shot model.

$A(F^1)$ is the state for which $\frac{\partial u(F^1, A(F^1), \cdot)}{\partial F^1} = 0$. If $\alpha_i + \sigma < A(F^1)$, then the intergrand in the equation (11) is less than 0, and so for $\sigma < A(\hat{F}^1) - \alpha_i$, $\frac{\partial u(F^1, \alpha_i+\sigma, \cdot)}{\partial F^1} < 0$. So, for $A(\hat{F}^1) - \alpha_L \leq A(\hat{F}^1) - \alpha_i$, the integrand is less or equal to zero, and thus the value of the integral is less than 0, and thus $\hat{F}^1(\alpha_i) < \hat{F}(\alpha_i) = \hat{F}(\alpha_i)$.

If $\alpha_i + \sigma > A(F^1)$, then $\frac{\partial u(F^1, \alpha_i+\sigma, \cdot)}{\partial F^1} > 0$. Thus, if $\sigma > A(F^1) - \alpha_i$, $\frac{\partial u(F^1, \alpha_i+\sigma, \cdot)}{\partial F^1} > 0$. So, if $A(F^1) - \alpha_H \geq A(F^1) - \alpha_i$, then the value of the integral is greater than 0, and thus $\alpha_i \geq \alpha_H$ and so $\hat{F}^1(\alpha_i) > \hat{F}^2(\alpha_i) = \hat{F}(\alpha_i)$.

It follows that $\hat{F}^1(\alpha_L) < \hat{F}(\alpha_L)$ and $\hat{F}^1(\alpha_H) > \hat{F}(\alpha_H)$. Note next that the integral is monotonic (increasing) in α_i. Thus, there is a unique $\hat{\alpha}_i \in (\alpha_L, \alpha_H)$ such that the value of intergral is 0, and so $\hat{F}^1(\hat{\alpha}_i) = \hat{F}(\hat{\alpha}_i)$. Given monotonicity, then, part (1) of the result follows.

(2) Note that for $\alpha_i = \alpha_L$, the integrand evaluated at the upper bound $\sigma = A(F^1) - \alpha_L$ is $p(A(F^1) - \alpha_L)\frac{\partial u(F^1, A(F^1), \cdot)}{\partial F^1} = 0$, and $\forall \sigma < A(F^1) - \alpha_L$, the integrand is negative. For $\alpha_i = \alpha_H$, the integrand evaluated at the lower bound $\sigma = A(F^1) - \alpha_H$ is $p(A(F^1) - \alpha_H)\frac{\partial u(F^1, A(F^1), \cdot)}{\partial F^1} = 0$, and $\forall \sigma > A(F^1) - \alpha_H$, the integrand is positive. Given that the distribution of shocks is symmetric around 0 and the range of shocks is constant, and given that $\frac{\partial u(F^1, \alpha_i, \cdot)}{\partial F^1}$ is symmetric about its maximand $\hat{F}$ for $F \geq \frac{\alpha_i}{\gamma}$ (Lemma 2),

$$-\int_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma)\frac{\partial u(F^1, \alpha_L + \sigma, \cdot)}{\partial F^1}\partial\sigma = \int_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma)\frac{\partial u(F^1, \alpha_H + \sigma, \cdot)}{\partial F^1}\partial\sigma$$

if $\alpha_L + A(\hat{F}^1(\alpha_L, \tilde{F})) - \alpha_H \geq \gamma\hat{F}^1(\alpha_L, \tilde{F})$. In this case from (11), $\hat{F}(\alpha_L, \tilde{F}) - \hat{F}^1(\alpha_L, \tilde{F}) = \hat{F}^1(\alpha_H, \tilde{F}) - \hat{F}(\alpha_H, \tilde{F})$. From Lemma 2, if $\alpha_L + A(\hat{F}^1(\alpha_L, \tilde{F})) - \alpha_H < \gamma\hat{F}^1(\alpha_L, \tilde{F})$, then the LHS is strictly less than the RHS. In this case, from (11), $\hat{F}(\alpha_L, \tilde{F}) - \hat{F}^1(\alpha_L, \tilde{F}) > \hat{F}^1(\alpha_H, \tilde{F}) - \hat{F}(\alpha_H, \tilde{F})$.
■

Proof of Proposition 7

Given $\alpha \sim U[0, 1]$, the externality term in state i's utility is given by $\frac{\beta(1-\gamma F)^2}{2}$. Substituting into the state's induced utility over federal provision gives

$$E[u_i(F|\alpha_i; \beta, \theta, \gamma)] = \begin{cases} -\frac{\theta-\gamma^2-\beta\gamma^2}{2}F^2 + (\alpha_i(1-\gamma) - \beta\gamma)F + \frac{\alpha_i^2+\beta}{2} \text{ if } \alpha_i - \gamma F > 0 \\ -\frac{\theta-\beta\gamma^2}{2}F^2 + (\alpha_i - \beta\gamma) + \frac{\beta}{2} \text{ otherwise.} \end{cases} \quad (12)$$

The first line of (12) is globally concave if and only if $\theta - \gamma^2 - \beta\gamma^2 > 0$, or $\beta < \frac{\theta-\gamma^2}{\gamma^2}$. This condition implies global concavity of the second line, because $\frac{\theta-\gamma^2}{\gamma^2} < \frac{\theta}{\gamma^2}$. To establish single-peakedness it is sufficient to demonstrate that (a) there is no discontinuity at $F = \frac{\alpha_i}{\gamma}$ (the point at which a state is fully crowded out) and (b) the derivative of the first and second lines of (12) share the same sign at $F = \frac{\alpha_i}{\gamma}$. Substituting $F = \frac{\alpha_i}{\gamma}$ into both the first and second lines of (12) yields $\frac{\alpha_i^2\beta\gamma^2 - \alpha_i^2\theta + 2\alpha_i^2\gamma - 2\alpha_i\beta\gamma^2 + \beta\gamma^2}{2\gamma^2}$. Differentiating both lines of (12) with respect to F and evaluating at

$F = \frac{\alpha_i}{\gamma}$ yields $\frac{\alpha_i \beta\gamma^2 - \alpha_i\theta + \alpha_i\gamma - \beta\gamma^2}{\gamma}$.

1. $\beta > 0$. From the foregoing, state i's induced utility is maximized at $\hat{F}(\alpha_i) = \frac{\alpha_i(1-\gamma)-\beta\gamma}{\theta-(1-\beta)\gamma^2}$. From the condition given in the proposition, the denominator of this expression is strictly positive. The numerator is strictly positive if and only if $\alpha_i > \frac{\beta\gamma}{1-\gamma}$. For $\alpha_i \in [0, \frac{\beta\gamma}{1-\gamma}]$, the expression is weakly negative, and so the state's (constrained) ideal level of federal provision is zero. Given $\alpha_i \leq 1$ by assumption, if $\frac{\beta\gamma}{1-\gamma} > 1$, all states have an ideal federal provision of zero. If $\hat{F}(\alpha_i) = 0$, $S_i^* = \alpha_i > 0$. If $\hat{F}(\alpha_i) > 0$, then $S_i^* = \alpha_i - \gamma F = \frac{(1+\alpha_i)\beta\gamma^2 + \alpha_i(\theta-\gamma)}{\theta-(1-\beta)\gamma^2}$. From the condition given in the proposition, the denominator of this expression is strictly positive; the conjunction of that condition and $\beta > 0$ implies the numerator is positive as well. Therefore $S^* > 0$ for all β.

   Differentiating the expression for $\hat{F}(\alpha_i)$ with respect to β gives

   $$\frac{\partial \hat{F}}{\partial \beta} = -\frac{\gamma(\theta - \gamma^2 - \alpha\gamma + \alpha\gamma^2)}{(\beta\gamma^2 - (\theta - \gamma^2))^2},$$

   which is strictly negative if and only if

   $$\theta - \gamma^2 - \alpha\gamma(1-\gamma) > 0.$$

   Suppose $\gamma > 1$. Rearranging terms yields $\alpha > \frac{\theta-\gamma^2}{\gamma(1-\gamma)}$. Given $\beta > 0$, the condition $\beta < \frac{\theta-\gamma^2}{\gamma^2}$ implies $\gamma^2 < \theta$. Therefore, the numerator of this expression is always positive and the denominator always negative. Given $\alpha > 0$ by assumption, the condition is always met. Suppose $\gamma < 1$. Rearranging terms yields $\alpha < \frac{\theta-\gamma^2}{\gamma(1-\gamma)}$. From the above, $\hat{F}(\alpha_i) > 0$ if and only if $\alpha > \frac{\beta\gamma}{1-\gamma}$. Comparing the two conditions on α

   The right side of this inequality exceeds one for all $\gamma < \min\{1, \theta\}$. If the state is fully crowded out at its own ideal point, then $\frac{\partial \hat{F}}{\partial \beta} = \frac{-\gamma(\theta - \alpha_i\gamma)}{(\theta-\beta\gamma^2)^2}$. This quantity is negative if and only if $\alpha_i < \frac{\theta}{\gamma}$.

2. $\beta < 0$. From above, i's induced utility is maximized at $F = \frac{\alpha_i(1-\gamma)-\beta\gamma}{\theta-(1-\beta)\gamma^2}$ if it is not fully crowded out at its own ideal point, and $F = \frac{\alpha_i - \beta\gamma}{\theta-\beta\gamma^2}$ if it is. The first of these candidate ideal points is positive if and only if $\beta < \frac{1-\gamma}{\gamma}\alpha_i$. The right side of this condition is strictly positive

for any $\alpha_i > 0$, and thus holds for all $\beta < 0$. The second candidate ideal point is positive if and only if $\beta < \frac{\alpha_i}{\gamma}$, which holds for all $\beta < 0$. Noting that state i will be fully crowded out for all $F \geq \frac{\alpha_i}{\gamma}$, and substituting the expression for i's ideal federal provision and solving for α_i gives

$$\alpha_i < \frac{\beta\gamma^2}{\beta\gamma^2 - (\theta - \gamma)}. \tag{13}$$

This quantity is positive and bounded between zero and one.

3. The first state's ideal level of provision is given by $F^* = \frac{\alpha' - \beta\gamma}{\beta\gamma^2 - \theta}$. It is sufficient to demonstrate that $F^* > \frac{\alpha''}{\gamma}$ for some $\alpha'' > \alpha'$. Simplifying gives

$$\alpha'' < \frac{\alpha'\gamma - \beta\gamma^2}{\theta - \beta\gamma^2}.$$

The right side of this inequality is strictly larger than α' if and only if $\alpha' < \frac{\beta\gamma^2}{\beta\gamma^2 - (\theta - \gamma)}$, which is the condition delineating which states prefer themselves crowded out given in inequality (13).

■

Proof of Proposition 8

Immediate. ■

Proof of Proposition 9

The proof proceeds by taking derivatives of the polarization measure for the different cases. ■

Equilibrium Characterization for the Regulatory Federalism Game

Suppose there is no federal floor. Cursory examination of state i's utility in equation (5) reveals it to be globally concave with a unique maximum at $S_i^* = \alpha_i$. In the presence of a federal floor the utility maximizing state policy is $S_i = \max\{F, \alpha_i\}$. The expected harm from other states is then given by

$$\begin{aligned} E[Z] &= \int_0^F (1-F)d\alpha + \int_F^1 (1-\alpha)d\alpha \\ &= \frac{1-F^2}{2}. \end{aligned} \tag{14}$$

Substituting $S_i^* = \max\{F, \alpha_i\}$ and the second line of (14) into (5) gives the state's induced utility over the federal floor:

$$E[u_i(F|\alpha_i;\beta)] = \begin{cases} \frac{\alpha_i\beta}{2}F^2 + \frac{\alpha_i^2 - 2\alpha_i - \alpha_i\beta}{2} & \text{if } F \leq \alpha_i \\ -\frac{1-\alpha_i\beta}{2}F^2 + \alpha_i F - \frac{\alpha_i(2+\beta)}{2} & \text{otherwise.} \end{cases} \tag{15}$$

The term multiplying F^2 in the first line of (15) is strictly positive; moreover, state i's utility is strictly increasing for all $F \in [0, \alpha_i]$. The term multiplying F^2 in the second line is strictly negative if and only if $\beta < \frac{1}{\alpha_i}$, and strictly negative for all $\alpha_i \in [0,1]$ if and only if $\beta < 1$. If (and only if) this inequality holds, the second line of (15) is maximized at $F = \frac{\alpha_i}{1-\alpha_i\beta}$, which is strictly larger than α_i for $\beta \in (0,1)$. Next, note that the first and second lines of (15) intersect at $F = \alpha$. Taken together, the above conditions imply that induced utility over federal policy (a) everywhere continuous on $[0,1]$; increasing and convex for $[0, \alpha_i]$; and concave for $\alpha_i \in (\alpha_i, 1]$, reaching a global maximum at $\hat{F}(\alpha_i) = \min\{1, \frac{\alpha_i}{1-\alpha_i\beta}\}$. Thus, given federal bargaining protocol B, the national government chooses $F^* \in [\hat{F}(\alpha_L), \hat{F}(\alpha_H)]$ (where, as in the baseline model, α_L and α_H represent, respectively, pivotal states at the extreme low- and high-ends of the gridlock interval); and each state i chooses $S_i^* = \max\{F, \alpha_i\}$

Proofs of Proposition 10

(a)Aggregate welfare is given by

$$\begin{aligned} V(F;\beta) &= \int_0^1 E[u_i(F|\alpha,\beta)]d\alpha \\ &= -\frac{1}{6}F^3 + \frac{\beta}{4}F^2 - \frac{1}{3} - \frac{\beta}{4} \end{aligned}$$

This expression has two optima: $F = 0$ and $F = \beta$. Second-order conditions indicate that $F = 0$ is a local minimum and $F = \beta$ a local maximum. Therefore $F = \beta \equiv F^{sw}$ is a global maximum.

The ideal point of the median state is $\hat{F}(\frac{1}{2}) = \frac{1}{2-\beta}$. Thus $F^{sw} < \hat{F}(\alpha_m)$ if and only if $\beta < \frac{1}{2-\beta}$, or $0 < \beta < 1$, which is the condition for single-peakedness given in the proposition.

(b) Let $\alpha_i = \frac{1}{2} - \sigma$ and $\alpha_j = \frac{1}{2} + \sigma$; let F^{jw} denote the policy that maximizes the joint welfare of states i and j. By single-peakedness, the policy that maximizes the joint welfare of two states must lie between their respective ideal points. There are three possible cases to consider. (1) $F^{jw} \in [0, \alpha_i)$. But then $F^* < \hat{F}(\alpha_i)$, which lies outside of the interval between the two states' ideal points, a contradiction.

(2) $F^{jw} \in [\alpha_i, \alpha_j]$. Then the joint welfare of the two states is given by

$$V(\beta, \sigma) = -\frac{1-\beta}{2}F^2 + \frac{1-2\sigma}{2}F + \frac{4\sigma(\sigma+1) - 4\beta - 7}{8},$$

which is globally concave and maximized at

$$F^{jw} = \frac{1-2\sigma}{2(1-\beta)}.$$

Then $\frac{\partial F^{jw}}{\partial \sigma} = -\frac{1}{1-\beta} < 0$.

(3) $F^{jw} \in (\alpha_j, 1]$. Then

$$V(\beta, \sigma) = -\frac{2-\beta}{2}F^2 + F - \frac{2+\beta}{2},$$

which is globally concave and maximized at

$$F^{jw} = \frac{1}{2-\beta} \equiv \hat{F}(\alpha_m)$$

i.e., the ideal point of the state lying precisely between i and j. For this case to occur it must be the case that $\alpha_j = \frac{1}{2} + \sigma < \frac{1}{2-\beta}$ or $\sigma < \frac{\beta}{2(2-\beta)}$. ■

Proof of Proposition 11

From the expression for $\hat{F}(\alpha) < 1$, $\frac{\partial \hat{F}}{\partial \alpha} = \frac{1}{(1-\alpha\beta)^2} > 0$; $\frac{\partial \hat{F}}{\partial \beta} = \frac{\alpha^2}{(1-\alpha\beta)^2}$¿0; and $\frac{\partial^2 \hat{F}}{\partial \alpha \partial \beta} = \frac{2\alpha}{(1-\alpha\beta)^3} > 0$. Further, $\hat{F}(\alpha) = 1$ for all $\alpha > \frac{1}{1+\beta}$. From the expression for $\frac{\partial \hat{F}}{\partial \alpha}$, If $\hat{F}(\alpha_j < 1$, then $\hat{F}(\alpha_i) < 1$ for $\alpha_i < \alpha_j$. From the expression for $\frac{\partial \hat{F}}{\partial \beta}$, an increase in β increases both $\hat{F}(\alpha_i)$ and $\hat{F}(\alpha_j)$; however, from the expression for $\frac{\partial^2 \hat{F}}{\partial \alpha \partial \beta}$ $\hat{F}(\alpha_j)$ increases faster than $\hat{F}(\alpha_i)$, leading to an increase in polarization. If $\hat{F}(\alpha_j) = 1$ and $\hat{F}(\alpha_i) < 1$, then an increase in β increases $\hat{F}(\alpha_i)$ while leaving $\hat{F}(\alpha_j)$ unchanged, yielding a decrease in polarization. If $\hat{F}(\alpha_i) = \hat{F}(\alpha_j) = 1$, an increase in β yields no change in either quantity, yielding no change in polarization. ■