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

November 21, 2015

[1]Earlier versions of this paper was presented at the political economy workshop of the Stanford Graduate School of Business, the NYU-DC Conference on Federalism and Contemporary Political Problems, the Harris School of Public Policy at the University of Chicago, and the Political Economy workshop at the Institute for Advanced Studies at the Toulouse School of Economics, where the authors received valuable feedback. We are especially grateful to Scott Ashworth, Chris Berry, Ethan Bueno de Mesquita, Catherine Hafer, Michel Le Breton, Nolan McCarty, Ken Shotts, Matthew Stephenson, and David Wildasin for detailed comments and discussions.

Abstract

We explore the consequences of supermajoritarian national institutions in the federal decision making structure of the United States. States with high demand for public good provision are better positioned to adjust state-level policies to accommodate local demand in the presence of limited national government than corresponding states with low demand in the presence of a more extensive one. This asymmetry implies that the size of the federal government preferred by the median may be socially inefficient, and can exacerbate political conflict when gridlocked at a high level, particularly in a dynamic setting. The model's logic extends to a regulatory environment in which national standards partially preempt state ones and to an environment in which fiscal federalism operates through matching grants. We use the model to elucidate variation in the historical operation of U.S. federalism with reference to the Era of Internal Improvements (1817-37), the Progressive Era, and the present.

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 component 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 understanding of 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 lawmaking requirements. Our primary focus is the consequences of these features and their interactions for social welfare, political polarization, and conflict 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, 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 meet local demand in response to what they would perceive as overprovision at the federal level. Further increases in the level of national provision hurt these states more than they help states with high demand. The implicit asymmetry has a number of implications for political conflict at the national level, which we develop in detail. In particular, the optimal size of the national government may be lower than that which would be arrived at by majority rule. Depending on the status quo level of federal provision, this could justify supermajoritarian constitutional constraints on national lawmaking. 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 those same institutions prevent optimal adjustment. Anticipation of this phenomenon disproportionately increases the conservatism of low-demanders. And preference polarization can exacerbate political inefficiency by making federal policies that fail to fail safely more likely.

Having considered a setting in which the function of government is best construed as the direct provision of public goods, we then turn to alternative policy-making instruments in a federal system: regulation and matching grants. The regulatory setting, which we develop in greater detail, is particularly relevant for its examination of cross-state externalities, from which the baseline model abstracts away. We demonstrate that the core intuitions of the baseline model carry through to these alternative policy-making environments.

In the last substantive section of the paper, we use our formal analysis to shed light on two puzzles in the history of U.S. politics and policy. First, why, despite similar levels of partisan polarization in the Progressive Era and at present, did the former yield a legacy of substantial policy changes brought about with bipartisan support, while the latter is characterized by partisan obstruction and comparatively few legislative accomplishments? And second, why did gridlock at the national level over infrastructure investment correspond to a golden age of internal improvements in the early- to mid-19th century, but unmet local demand in the 21st? Our discussion of these historical episodes implicates key features of the fail-safe mechanism.

Background

The Object of Study

Although it may be applied to 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. Such heterogeneity is central to federalism, which is a key institutional tool that permits a polity to tailor government provision to variation in local demand, rather than destroying subordinate authority by subjecting subnational communities to the same national, uniform rule (Riker 1964; De Figueiredo and Weingast 2005).

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). 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, but are better described as a "marble cake" (Grodzins 1966; see also Riker 1975); and when they do exist, they 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,[1] 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, notes that, in contrast to the relative ease of distinguishing executive, judicial, and legislative power, distinctions between national and state governments are more difficult: "the powers being of a more kindred nature, their boundaries are more obscure and run more into each other." The permeability of boundaries between national and state governance raise the possibility that the former may crowd out the latter (Bradford and Oates 1971; Volden 2005; Hafer and Landa 2007). We explore the implications of different forms of crowding out – fiscal and legal – in the models that follow.

[1] 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 (2000).

In focusing on these three features of federalism, we necessarily abstract away from several others. To focus on *across*-state preference heterogeneity, we abstract away from *within*-state heterogeneity, and, because of that, also do not consider 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. Further, we adopt the approach, common in the literature, in which the national government imposes a uniform (floor) 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 1997 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.

Related Research

Our 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). Finally, Volden (2005) describes a model in which both national and subnational governments can provide public goods and services, but in which the desire of politicians to claim credit leads to inefficient overprovision by the less efficient level of government.

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. Rodden (2006) considers the relationship between fiscal externalities between the states, commitment problems at the national level, and the ability of federal systems to maintain fiscal discipline. Closer to the present model, Alesina et al. (2005) and Hafer and Landa (2007) 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 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 determinants of the composition of political unions, our model takes the union as a given and is chiefly concerned with the welfare consequences of the interaction of the supermajoritarian procedures of the central government with the federal fiscal and legal structure.

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

The Baseline Model

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.[2] 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 $p(\alpha)$. Higher values of α correspond to higher valuations of the public good.[3] Each state pays corresponding quadratic costs for a given level of state government activity, $S_i \in \mathbb{R}_+$, and of federal activity, $F \in \mathbb{R}_+$.

We model the distortionary effect of federal taxation (the size of the federal government) on state revenue collection by a product $\gamma F \cdot S_i$, with $\gamma \in \mathbb{R}_{++}$ scaling the magnitude of the distortion. The fiscal distortion may manifest itself via two complementary mechanisms that our model captures in reduced form. Both mechanisms depend on the fact that a higher level of federal taxation reduces disposable income. According to the first mechanism, lower disposable income will tend, holding fixed redistributive considerations, to reduce demand for state-level public good provision. Second, because lower disposable income tends to result in lower consumption, a higher level of federal taxation can reduce state revenue from consumption taxes.[4]

[2] The assumption of the continuum is a mathematical convenience and has no bearing on the substantive results that follow.

[3] To focus on interstate preference heterogeneity, we abstract away from intrastate heterogeneity; see Beramendi and Jensen (2015) for a discussion of malapportionment and diverse preferences within states.

[4] Our formalization of this distortion echoes one of the core arguments for allowing citizens to deduct state and local income tax from federally taxable income, aired most recently in

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

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

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 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 2007]) and socio-cultural factors (e.g., prior immigrant group experiences with oppressive governments [Fischer 1989], or modernization-induced liberalism [Ingelhart and Welzel 2005];

the debate over the Alternative Minimum Tax. See Mason 2011; Galle 2008; and Kaplow 1996. It bears noting that while early work on the economics of federalism hypothesized crowding out to be a straightforward consequence of exogenous nonmatching federal grants to states and localities (Bradford and Oates 1971). Subsequent empirical research (e.g., 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). Critically, though, whereas empirical documentation of this effect focuses on discrete programs, the crowding out we consider in our baseline model below is more akin to an economic distortion induced by the overall size of the national government (cf., Bolton and Roland [1997]), and as such, is consistent with the possibility of a program-specific flypaper effect – see our discussion of matching grants below.

[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.

see also Elazar 1966). The relationship between a state's preference parameter α_i and, e.g., 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.[6] Recognizing these possibilities, we do not commit ourselves to a particular unmodeled mechanism generating demand for public good provision.[7]

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. 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. Relatedly, while in the current model the distortionary effect of federal on state provision enters linearly into the state's utility function, an alternative approach might have it enter non-linearly. In the appendix, we show that such a model generates qualitatively identical results. Because it is much less tractable mathematically, we do not pursue that specification here.

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 isolate the institutional sources of these asymmetries.

Returning now to the formal description of the environment, let B represent the federal bargaining protocol, which maps the states' preference profile and the (exogenously given) status quo federal level of provision into a level of federal provision F.[8] Rather than commit

[6]In fact, as can be seen in (1), the state's utility does not include a term for state income. As long as the federal government does not completely expropriate state income, this exclusion is immaterial for our results.

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

[8]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 $B := \boldsymbol{\mathcal{U}} \times \mathbb{R}_+ \to \mathbb{R}_+$.

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 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.

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.*

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

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

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 Appendix A. ■

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 henceforth maintain the assumption that the restriction on parameters given in the Lemma is met, and so, that states' preferences are single-peaked.

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 preference 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 preference parameter of the actor at the extreme right, and $\hat{F}(\alpha_H)$ its associated ideal point.[9] In the context of Krehbiel's pivotal politics model, these actors might represent the filibuster

[9] To economize on notation, we will suppress the dependence of ideal points on θ and γ.

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, then, 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 crowding out* on state provision.[10]

It is essential that readers not interpret "fully crowded out" literally – indeed, in the alternative, non-linear specification described in Appendix B (which, as noted above, preserves all of our central results), crowding out occurs, but full crowding out does not. The more general substantive point is that the pressure on state revenue collection brought about by a larger federal presence impedes the ability of a state to meet a given level of local demand.

A natural way to interpret the shadow cost is with reference to the possibility of debt-financed tax credits: states can conceivably borrow money to offset the high (from their

[10]The *shadow* cost of crowding out should not be confused with the full cost of crowding out, which does, of course, exist for all $F > 0$.

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. The possibility of full crowding out simply captures this effect in reduced form.

The shadow cost of crowding out creates a "jerk"[11] in a state's utility function strictly to the right of the state's ideal point. At the jerk, the rate of decline in the state's welfare associated with additional increases in federal provision accelerates. 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.

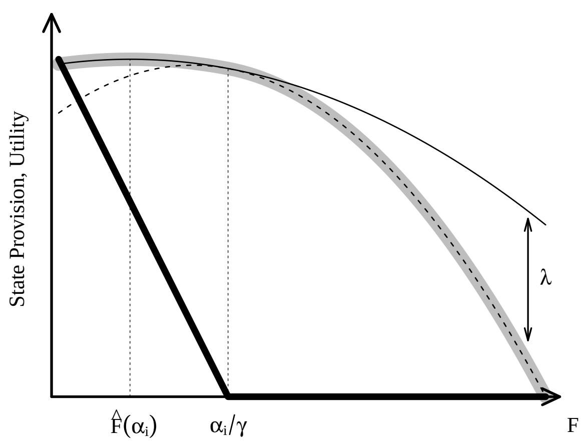
Figure 1 displays the above intuition graphically. The horizontal axis depicts the level of federal provision F. The thick black curve represents a state's equilibrium level of state provision, which is decreasing in F until it reaches zero at $F = \frac{\alpha_i}{\gamma}$. The thin, solid black curve represents the state's induced utility over federal provision in a counterfactual world where states could tax negatively. The dashed curve represents the state's induced utility *if state provision is constrained to zero.* Overall, the state's induced utility over provision – shaded gray – is defined by the solid curve below $\frac{\alpha_i}{\gamma}$, and the dashed curve above that value. Finally, the gap between the dashed and solid curves to the right of $\frac{\alpha_i}{\gamma}$, labeled λ, represents the shadow cost of crowding out. As is evident from the figure, it is increasing in the level of federal provision.

Polarization and Welfare

Having characterized the equilibrium of the baseline model, we now move to our analysis of three important measures of social outcomes. The first is *polarization*, defined conventionally in terms of the distance between ideal points (e.g., Poole and Rosenthal 1984; McCarty, Poole, and Rosenthal 2006). The second, *aggregate welfare*, is a standard utilitarian metric.

[11]The term, borrowed from physics, refers to the third derivative, i.e., change in acceleration.

Figure 1: State Provision and 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.

A third, related measure, *political inefficiency* (PI), captures the distributive implications of political failures to achieve socially efficient policies.

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

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

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 1 (Ideal Point Polarization in the Baseline Model) *Polarization between any two states is*

1. *strictly increasing with the efficiency of federal provision (i.e., strictly decreasing in θ); and*

2. *strictly decreasing in the magnitude of the fiscal distortion, γ, if and only if federal provision is weakly less efficient than state provision ($\theta \geq 1$); and otherwise first decreasing, and then increasing in the magnitude of the fiscal distortion.*

The first part of the proposition may, at first, appear puzzling. Indeed, as a price effect, greater federal efficiency increases demand for federal provision across the board. However, 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 the 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, which, in equilibrium, will result in policy change. If gridlock, conventionally defined, means the difficulty of policy change, the result implies that 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. As we will see below, this relatively straightforward conclusion can help shed light on an important puzzle in the history of the relationship between polarization and policy-making in the United States.

Although the location of status quo federal provision does not affect the extent of ideal point polarization, it can moderate the *consequences* of polarization that emerge from an increase in federal efficiency. When such an increase yields an increase in federal provision via the mechanism described in the previous paragraph, it will in turn *decrease* what might be called "experience polarization" – the difference among states in the lived experience of public good provision. The higher federal provision, the more homogeneous that experience. Moreover, if the increase in federal provision is sufficient to fully crowd out some states, which might be anticipated under higher levels of initial ideal point polarization, the compression will be magnified. If a long term effect of the experience of public good provision is to increase demand for the public good itself – as modernization theory (e.g., Lipset 1960; Ingelhart 1997) anticipates – then an efficiency shock that increases polarization in the short run can actually decrease ideological polarization in the long run.

To understand the intuition behind the second part of the proposition, note, first, 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: states' tolerance of being more crowded out to take advantage of the more efficient federal provision. Because states differ in the rates at which they prefer to substitute from state to federal provision, this will tend to increase polarization. For low levels of γ, the first effect dominates, whereas for high levels, the latter does.

Aggregate Welfare. Next, we turn to the aggregate welfare of all states in the polity.

We will assume in 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.

The results in this section turn on the extent of polarization in the federation. We will say that two states, i and j, with $\alpha_i < \alpha_j$, are *significantly polarized* when state i would be fully crowded out at the midpoint between its ideal point and that of j.[12] A federation is significantly polarized when any pair of states i and j such that $\alpha_i = \underline{\alpha}$ and $\alpha_j = \overline{\alpha}$ are significantly polarized.

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's ideal policy if and only the federation is significantly polarized. Otherwise, the socially optimal level of provision is the median's ideal policy.*

To understand the intuition behind this result, let m index the median state, and imagine two states: a "low-demander" state whose preference parameter α_i is less than that of the median state, α_m, and a corresponding "high-demander" state whose value of public good consumption α_j is higher than, but equidistant to, α_m (i.e., $\alpha_j = 2\alpha_m - \alpha_i$). If the two states are not significantly polarized, the aggregate welfare of those two states will be maximized at m's ideal point, $\hat{F}(\alpha_m)$, because the marginal cost to i of an increase in F away from that point will exactly equal the marginal benefit to j. If the two states are significantly polarized, however, the shadow cost of crowding out implies that the marginal cost to i of an increase in F exceeds the marginal benefit to j at that point. This, in turn, implies that level of federal provision that maximizes their joint welfare must lie to the left of $\hat{F}(\alpha_m)$. The proposition extends this two-state intuition to the continuum of states, exploiting the symmetry of the distribution.

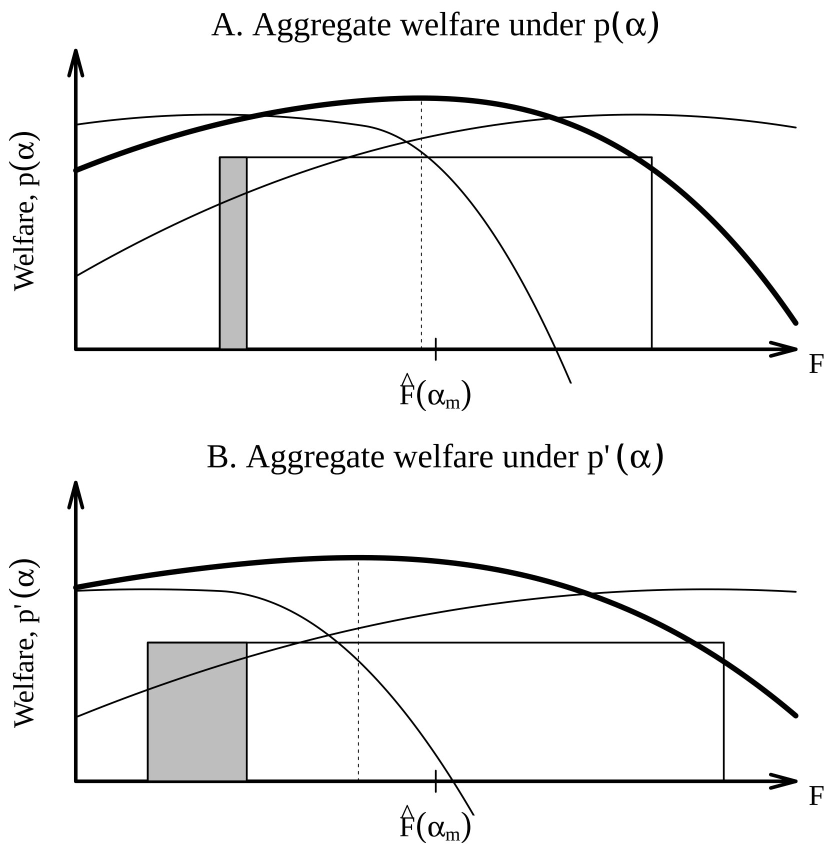
[12]Formally, $\frac{\alpha_i}{\gamma} < \frac{\hat{F}(\alpha_i)+\hat{F}(\alpha_j)}{2}$.

Panel A of Figure 2 displays this intuition behind the result graphically for a uniform $p(\alpha)$. The rectangle depicts the distribution of α, while the gray region shows states fully crowded out at the median's ideal point. Also depicted in the figure (in thin black lines) are the payoff functions for a state with lowest demand $\underline{\alpha}$ and the payoff for a state with highest demand $\overline{\alpha}$. (Note the jerk in the low-demander state's utility function.) 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.

Figure 2 About Here

A corollary to this proposition concerns institutional design, and in particular the extent to which democratic 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 actor 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 federal 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 coincide, 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 state's preferred policy is not necessarily the social welfare-maximizing (and so the institutional configuration that results in that policy's selection 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 to the left of of that point. This effect is compounded when preferences are more heterogeneous, as depicted in Panel B.

Corollary 1 *Pure majority rule with an open agenda yields a socially suboptimal level of provision if and only if the federation is significantly polarized.*

Our next result relates aggregate welfare to the degree of preference heterogeneity across the states. Whereas Proposition 2 suggests that the welfare maximizing policy is strictly less than the median state's ideal point, the next result documents a relationship between that optimal policy and the extent of heterogeneity in the demand for federal provision. To focus attention, we consider a very simple form of increasing heterogeneity that leaves unchanged the mean and median of the distribution. Formally, 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 distribution 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 under $p(\alpha)$, and strictly lower if and only if the federation is significantly polarized 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 shadow cost of crowding out 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.

The existence, owing to gridlock, of a possible gap between the aggregate-welfare maximizing federal policy and the equilibrium federal policy suggests the presence of unrealized gains from trade among states. Accordingly, one may wonder how the possibility of inter-state transfers would affect the efficiency of federal policy-making and the asymmetric distributional effects described in our results. Such transfers can be thought to represent compromises that states may be willing to make on other policy dimensions to help break the gridlock on federal policy. It is straightforward to show that, in a Nash Bargaining framework with transfers, the states will be able to reach a socially efficient bargaining agreement that realizes the social welfare maximum.

However, we are deeply skeptical about the political enforceability of such transfers. The agreements they imply are radical idealizations that in the messy politics outside our model run into severe political transaction costs. In order to focus on the particular sources of distributional asymmetries between states, we do not model the sources of such transaction costs explicitly, but Acemoglu (2003) and Bednar (2009) point to two closely related sources that are particularly relevant to our substantive setting: the commitment problems due to the incentive to renege on the part of the interests that control the government at a given time, and opportunistic burden-shifting and shirking by some states at the expense of others. The punchline of their arguments is that a "political Coase theorem" is implausible, and we share that view. A somewhat distinct consideration that is particularly relevant to us concerns the dimensionality of the underlying issue space. In our model, the space is unidimensional, but the natural interpretation of transfers that states could make to each other is as policy concessions on other (unmodeled) policy dimensions. Such transfers are feasible when losses on some issue dimensions can be traded profitably for gains on other dimensions. This would, of course, entail that the policy space is non-trivially multidimensional. But, with limited exceptions (most notably, the race dimension in mid-20th century), policy conflict at the national level in the U.S. has been largely unidimensional, and increasingly so since the early 1980s (Poole and Rosenthal 2000), reinforcing our skepticism of policy transfers as a solution to the challenges to federalism we focus on in this paper.

In light of this, we consider a *political inefficiency index* (PI) reflecting the unrealized gains from trade between two states. Naturally, the unrealized gains from trade increase in the distance between the equilibrium level of federal provision and the optimal level. Now consider a policy gridlocked between the ideal points of the two states, i and j, with $\alpha_i < \alpha_j$.

A marginal rightward shift in the policy will benefit j while harming i, and vice versa given a leftward shift. By definition, when the ratio of these marginal effects is one, the joint welfare of the two states is maximized and there is no room for mutually beneficial trades. To the right of this point, the marginal benefit to i of a leftward shift outweighs the marginal cost to j, and PI exceeds one. Contrariwise, to the left of this point, the marginal benefit to j of a rightward shift outweighs the marginal cost to i, and again, PI exceeds one. Our next result points to a critical asymmetry in political inefficiency between two states associated with a federal policy gridlocked between them.

Proposition 4 (Political inefficiency for a gridlocked status quo) *Consider any two states i and j, with $\alpha_i < \alpha_j$. Political inefficiency is strictly higher at any $\overline{F} \in (\hat{F}(\frac{\alpha_i+\alpha_j}{2}), \hat{F}(\alpha_j))$ than at its reflection about $\hat{F}(\frac{\alpha_i+\alpha_j}{2})$, $\underline{F}$, if and only if state i is fully crowded out at $\overline{F}$, and otherwise equal at those two policies.*

Whereas Proposition 2 describes conditions under which the aggregate welfare maximizing federal policy deviates from a putatively neutral policy (the median/mean), Proposition 4 goes further, documenting how the extent of inefficiency associated with particular equilibrium policies varies asymmetrically on either side of an analogous point (the midpoint between two states' ideal points). What the result implies is that constraints on transfers or multidimensional logrolls may be particularly irksome for low-demanders endeavoring to reduce the scope of federal provision, relative to high-demanders trying to raise it.

Extensions and Alternative Specifications

Dynamics

In this subsection, 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 threefold. First, and most obviously, if a state anticipates that future shocks may make a candidate policy less attractive to it, then it is less likely to accede to that policy in the current period. Second, anticipating the possibility of future opposition from other states to a policy it may turn out to favor even more than at present, a state should be more willing to incur a current-period hit to give itself a greater opportunity to implement that policy in the future. For states with low demand for public good provision, this means preferring an even lower federal policy than they would prefer in the one-shot environment, because in the future, they may be pivotal in adjusting it upward if necessary. For high-demand states, it means preferring a still higher federal policy because they are pivotal in adjusting it downward, if necessary.[13] The third part of the intuition relates 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 states' α parameters are shocked by some value σ symmetrically distributed around 0, with pdf $p(\sigma)$. Thus, state i's second-period demand, α_i^2, is equal to $\alpha_i + \sigma$. We will show that, in expectation of these shocks and in anticipation 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.*

First, note that in each period, each state i will choose its own state level of provision optimally, dependent only on the current period's values of α_i^t and F^t. Let $\hat{F}^2(\alpha_i^2)$ be i's optimal federal policy in $t = 2$ anticipating optimal second-period state-level provision

[13] These two parts of the intuition are analogous to that underlying key results in a recent paper by Dziuda and Loeper (forthcoming), of which we became aware after independently deriving our result. Dziuda and Loeper show that the logic underlying these intuitions persists in a number of different environments, underscoring their broader applicability.

$S^2(\alpha_i + \sigma, F^2)$; and let $\hat{F}^1(\alpha_i)$ be i's optimal federal policy in $t = 1$, anticipating optimal subsequent play. Recall that α_L and α_H are types whose optimal federal policies define the lower and upper bounds of the gridlock interval, respectively. For mathematical convenience, we will assume that if the inherited 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 the second period's inherited status quo F^1 is in the second period's gridlock interval, then it will persist as the federal policy in that period. We will employ the notation $\hat{F}(\alpha_i)$ (without superscript) to refer to the i's ideal level of federal provision in the one-shot environment. Our result in this section is the following proposition:

Proposition 5 *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 higher, than their respective counterparts in the one-shot game* ($\hat{F}^1(\alpha_L) < \hat{F}(\alpha_L)$ *and* $\hat{F}^1(\alpha_H) > \hat{F}(\alpha_H)$)*; and*

2. *The left boundary moves left farther than the right boundary moves right* ($\left|\hat{F}^1(\alpha_L) - \hat{F}(\alpha_L)\right| \geq \left|\hat{F}^1(\alpha_H) - \hat{F}(\alpha_H)\right|$, *with the inequality holding strictly if the marginal effect of distortion from federal taxation,* γ, *is sufficiently great.*

Alternative Specifications

Regulatory Federalism. While the division of public goods provision is one 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 practice in which the national government sets regulatory "floors" that the states are permitted to exceed but not fall below (O'Reilly 2006; Scicchitano and Hedge 1993). In this section, we present a simple version of our model in which the choices made at the national and state level concern the fraction of a harm a particular government chooses to remedy. Hewing closely to the notation above, 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.[14] State i's utility is

$$u_i(S_i; \alpha_i, \beta) = -\alpha_i(\beta Z + (1 - S_i)) - \frac{S_i^2}{2}. \tag{4}$$

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 uniformly distributed on $[\alpha_m - R, \alpha_m + R]$, with α_m, the taste parameter of the median state, strictly greater than R, the dispersion parameter of the preference distribution. The sequence, echoing the baseline model above, is as follows: the federal government sets a floor, and then the states set state-level policy, now subject to the constraint that $S_i \geq F$.

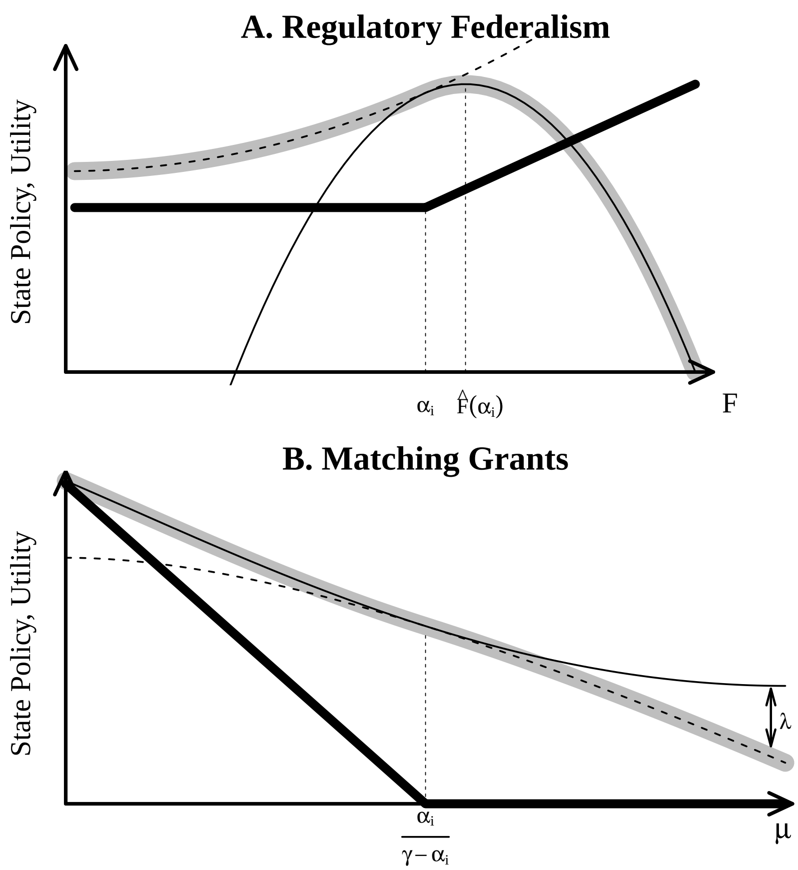
Here, we describe informally the induced preferences over federal provision and the unique equilibrium in this game (for a formal derivation, see Appendix A), and then establish the robustness of our main substantive results in the current environment. Panel A of Figure 3 conveys the intuition graphically.

Figure 3 About Here

In the absence of a federal government, each state would choose $S_i^* = \alpha_i$. Adding the floor, states simply choose $S_i^* = \max\{F, \alpha_i\}$, depicted as the thick black curve in Figure **??**. If β is not too large ($< \frac{2R}{\alpha_m + R}$), induced preferences over the federal floor are single-peaked

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

Figure 3: State Policy and Induced Preferences in the Regulatory and Matching Grant Models



A. In the regulatory model, 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). B. In the matching grant model, public good provision by a low-demander state (the thick black line) is decreasing in the generosity of the federal match, μ. The induced utility over federal policy (the shaded gray curve) is strictly decreasing in the size of the match, with full crowding out exacerbating the marginal disutility.

for all states. However, as in the public goods provision model described in the previous sections, there is an asymmetry in induced preferences. In this model, it is brought about not by the shadow cost of crowding out, but 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 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

$$\hat{F}(\alpha_i) = \frac{(2R - \beta(\alpha_m - R))\alpha_i}{2R - \beta\alpha_i}. \tag{5}$$

This quantity, which is (unsurprisingly) increasing in α_i, is greater than the optimal policy a state would set for itself in the absence of a federal government, α_i. This is because in contemplating an optimal federal floor, state i considers the benefit not only in terms of remediating local harms but also national ones. The state's ideal level of federal regulation is also increasing in the magnitude of the externalities, β – in other words, greater cross-border spillovers increase demand for national solutions. The thick gray curve in Figure **??** denotes the state's induced utility over federal policy.

The next result affirms, in the regulatory setting, the robustness of our previous results on aggregate welfare:

Proposition 6 *Suppose all states have single-peaked preferences over the federal floor. Then the federal floor that maximizes aggregate welfare is (a) weakly less than the ideal federal floor of the median state, $\hat{F}(\alpha_m)$; and (b) strictly decreasing in the dispersion of the preference distribution, R.*

The logic underlying this result is substantially similar to the logic underlying Propositions 2 and 3 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. Unlike in the baseline model, though, these results are not contingent on the degree of polarization in the polity being sufficiently high: here, they hold for any any level of polarization, because unlike in that environment, a federal floor prevents low-demander states from taking compensating policy action even when that floor is low.

Matching Grants. We also considered a variant of the baseline model in which the federal government acts by providing matching funds to the states to engage in public goods provision. Let state i's utility be given by

$$u_i = \alpha_i(1+\mu)S_i - \frac{S_i^2}{2} - \int \frac{\mu^2 S(\alpha)^2}{2} dP(\alpha) - \gamma\mu S, \tag{6}$$

where μ denotes a federal subsidy for every dollar spent by a state, and all other parameters are defined as above. In the interest of brevity, we describe how this variant of the model works informally; for the formalization, see Appendix A. First, the size of the federal subsidy has both a direct and indirect effect on state-level public good provision. The direct effect is the familiar price effect from the subsidy common to theoretical models of fiscal federalism: by offsetting costs, the federal subsidy encourages greater levels of public good provision. The indirect effect is the fiscal distortion akin to that in the baseline model: a larger federal government crowds out state-level spending. The relative sizes of these two effects give rise to what we may call a *conditional flypaper effect* (cf., Volden 2007). For states with sufficiently high demand for public good provision, the direct effect dominates: their spending is increasing in the size of the federal subsidy μ, and they are never fully crowded out. For states with sufficiently low demand for public good provision, the indirect effect dominates: their spending decreases in μ, and they will be fully crowded out for sufficiently large μ. (The disutility of subsidizing high-demand states will induce them to strictly prefer no federal program at all.) The effect of full crowding out is to impose a shadow cost in precisely the same way that full crowding out does in the baseline model. Panel B of Figure 3 displays this graphically.

Because in this environment, the underlying utility functions are not symmetric even in the absence of the distortion, the median state's preferences are no longer the appropriate benchmark as they were in the baseline model.[15] However, a key implication of both models – in which crowding out pushes the socially optimal federal presence downward – is the same, as the next result (employing a $U(0,1)$ distribution of types for ease of exposition) indicates:

Proposition 7 *Suppose $\alpha \sim U(0,1)$ and preferences are single-peaked. If the socially optimal matching level μ^* is greater than zero, then it is strictly lower than it would be in the absence of full crowding out.*

Historical Applications

In this section, we draw on the experience of U.S. political history to illustrate some of the empirical implications of the theoretical model. While, as with any theoretical account, our model cannot grant us a claim on causal exclusivity, it furnishes an attractive, unified explanation for several intriguing puzzles from the historical record.

Polarization and Legislative Innovation

Work by McCarty, Poole, and Rosenthal (2006) has demonstrated that partisan polarization in Congress, defined as the ideological distance between the Republican and Democratic party caucuses, is at historically high levels unseen since the Progressive Era a century ago. And yet no observer would confuse our current politics with those of that bygone age. The Progressive Era (1900-1916) is remembered for enormous legislative productivity and ferment, with landmark legislation, which laid the groundwork for the 20th century national administrative state, passing with bipartisan majorities. By contrast, in the past two decades, major legislative accomplishments have been few and far between, and those

[15]Indeed, the socially efficient policy is generically higher than the ideal point of the median state.

that have passed (e.g., the Affordable Care Act, the Dodd-Frank Financial Reform Act, and the Stimulus Package) did so over the strenuous objections of a unified minority party.

Why is partisan polarization coincident with an expansion of national governance in one period and stalemate in another? Nominally, congressional institutions made obstructionist tactics easier then than today: before the adoption of Senate Rule 22 in 1917, debate in the senate could conclude only by unanimous consent. However, filibusters are far more common today (Wawro and Schickler 2006; Binder and Smith 1996).

Our model suggests two complementary accounts. First, recall that a state's ideal level of federal provision is increasing in the relative efficiency of that provision, but increasing faster for states with higher underlying demand for the public good. This yields the positive relationship between relative efficiency and ideal point polarization. The advent of the national market following industrialization in the late 19th Century (Bensel 2000) enhanced the relative efficiency of national-level governance over a patchwork of state-level administrations (Skowronek 1982). Contemporary political science scholarship gives us the other half of the relationship: a high degree of partisan polarization in Congress at the turn of the 20th century. In contrast with today, however, at the start of the Progressive Era the level of federal provision was low. Viewed through the prism of our model, the increase in the relative efficiency of the national government pushed the low end of the gridlock interval upward, to the point where the previously gridlocked low level of status quo national provision was now outside of the gridlock interval, enabling relatively consensual (in most cases) legislative changes to higher levels of provision. The result was the policy innovation observed during the period. By contrast, in the contemporary period the status quo level of provision is relatively high, and increases in contemporary polarization correspond to conservative shifts among Republicans (McCarty et. al. 2012), leaving the status quo firmly gridlocked.

The second account of the comparison consistent with our theoretical model relies on our understanding of how structural features of federalism create asymmetries in the inefficiencies associated with unrealized gains from trade in the political arena. As in the first account, much hinges on the location of the status quo level of federal provision: when it is low, as it was when the Progressive Era began, those unrealized gains from trade are themselves relatively low, because high-demanders may compensate for perceived inadequacies of federal provision via state action. However, when the federal presence is large relative to that of the states, as it is today, low-demanders cannot similarly compensate, and the resulting inefficiencies are only exacerbated by the low dimensionality of contemporary U.S. politics, which frustrates logrolls across issues.

Gridlock, Federalism, and Infrastructure Investment

What explains the dearth of high-speed, intercity rail travel in the United States? Commentators (e.g., Gopnik 2015) argue that the combination of conservative ideological opposition to these expenditures and large regional disparities in the demand for train travel (owing, in part, to variation in population density) make significant national investment in rail impossible: for example, the American Recovery and Reinvestment Act of 2009 allocated just \$8 billion of \$787 billion (about one percent) to intercity rail projects over three years; and earlier in 2015, the House voted to fund Amtrak at the meager (by international standards) level of \$1.4 billion per year for the next three years. Contrast this to the recent transportation bill passed by the House, which allocates \$261 billion to highways and \$55 billion to transit over the next six years (subject to revenue constraints).

Ideological opposition to, and regional heterogeneity in demand for, a national program of infrastructure investment is decidedly not without precedent. In 1808, Thomas Jefferson's Secretary of State, Albert Gallatin, presented an ambitious plan for a \$20 million federal program of road and canal construction to bridge the Appalachians and improve navigation along the East Coast. The legislation went nowhere in the following Congress, and was a non-starter for the duration of the War of 1812. In 1817, Congress passed the "Bonus Bill," which would dedicate a portion of the revenues from the newly authorized Second Bank of the United States to a fund for internal improvements. Despite the painful compromises accepted by the Bill's chief backers, then-President James Madison vetoed the legislation on his last day in office. Madison's veto ushered in a period largely characterized by federal *in*action on the issue of "internal improvements," as they were then called. Nearly half of the presidential vetoes before the Civil War were of infrastructure bills (generally disparaged as wasteful pork-barrel spending). And disagreement and deadlock in Congress over federal internal improvements spending was a defining feature of the second party system.

Notably, however, and in distinct contrast to the contemporary era, the period following Madison's Bonus Bill veto is remembered as a period of massive infrastructure investment. Just six weeks after the veto, the New York State legislature appropriated $7 million for the construction of the Erie Canal. Road and canal expenditures by the states, often working in partnership with private companies, amounted to $300 million before the Civil War, with localities adding another $125 million. These expenditures, compared with $7 million in direct financial expenditures by the national government on internal improvements, resulted in the near-total completion of Gallatin's plan over the course of the 19th century (Goodrich 1960, 35 and 268). If anything, *over*-investment was the order of the day: the Main Line could not service its own debt, much less enrich Pennsylvania, and Indiana's Mammoth Internal Improvement program nearly bankrupted the state (Larson 2001).

What we have, thus, is two periods of U.S. history characterized by national gridlock in a particular policy area, with dramatically different results. Our model provides an account of why. In the earlier period, the status quo level of federal provision in this policy area was low. Because of the national government's small size, state investment in public goods in the pre-bellum era could in no sense be said to have been crowded out by the central government. Moreover, as has been meticulously documented by economic historians, the period ushered in by the authorization of the Erie Canal and brought to a close by the Panic of 1837 was one in which states enjoyed unusually high fiscal capacity: the states maintained monopolies in granting corporate and bank charters to generate asset income that could ultimately be applied to the provision of governmental services, and could direct chartered banks to invest in public goods provision (Sylla, Legler, and Wallis 1987). Further, states also enjoyed unprecedented access to domestic and international credit markets (Kim and Wallis 2005; Sylla and Wallis 1998), backed by their revenue-raising capacity, which enhanced the operation of the fail-safe mechanism.

By contrast, in the contemporary period, while the federal government's footprint in intercity *rail* is small, its overall presence in surface transportation is not: from 2007 to 2011, for example, the total federal contribution to highways and transit averaged $51 billion per year, or about 25% of total transportation expenditures by all levels of government (Pew 2014). Federal Aid Highway Program expenditures are generally structured as 4:1 matching grants to state and local governments, lowering the marginal cost of highway construction and maintenance to the states. This, combined with the absence of similarly generous funds for intercity rail, induces a substitution effect, crowding out state investment in rail travel.[16] The net result has been the inability of the states to pick up the slack: that the governors of Wisconsin, Ohio, and Florida rejected federal stimulus funds for proposed high-speed rail lines in their states should be unsurprising given the comparatively tiny size of the subsidy. And California High-Speed Rail, which commenced in 2015 after decades of delay, may become the exception that proves the rule: its scheduled completion date is 2029, and likely cost-overruns could undermine the project long before then.

Conclusion

A canonical account of federalism suggests that decentralization of policy-making responsibilities to subnational governments is particularly valuable in politically polarized societies (cf., Oates' [1972] well-known "decentralization theorem"). Our paper makes a different point: the nature of the federal system is one in which states are in a position to meet local demand through compensating actions to account for perceived deficiencies in what is being done at the national level. However, due to the structure of federalism, and in particular

[16] This phenomenon can be likened to the conditional flypaper effect described in our discussion of matching grants above; space constraints prevent us from developing this point further.

the fiscal or legal distortions brought about by national provision or regulation, there is a fundamental asymmetry in the ability of different states with different levels of demand for the policy to engage in some kind of "self-help" to mitigate what they perceive is the adverse consequences of a national policy. These fiscal and legal distortions create asymmetries in aggregate welfare that are contingent on the location of the status quo national policy. One way to think about our paper, therefore, is in comparison with Oates' argument. While the decentralization theorem concerns efficiency, it is silent on distribution. It is an economic account, whereas ours is a political-economic one.

Our analysis 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. Our account 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 critical biases in the operation of the federal system. 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-demand states are able to compensate for undesirably low levels. Another emerges in a dynamic setting: 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. Finally, our account of fail-safe federalism sheds light on important moments in the political development of the

United States, by pointing to instances in which the magnitude of these biases vary, with significant implications for the creation of public policy.

References

Acemoglu, Daron, 2003. "Why Not a Political Coase Theorem? Social conflict, Commitment, and Politics." *Journal of Comparative Economics* 31: 620-652.

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.

Bednar, Jenna. 2009. *Robust Federation: Principles of Design.* New York: Cambridge University Press.

Bensel, Richard F. 2000. *The Political Economy of American Industrialization, 1877-1900.* Cambridge: Cambridge University Press.

Beramendi, Pablo, and Jeffrey Jensen. 2015. "The Long Shadow of Economic Geography: Political Inequality and Public Goods Provision in the Original 13 US States." Typescript, Duke University.

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.

Binder, Sarah A., and Steven S. Smith. 1996. *Politics or Principle? Filibustering in the United States Senate.* Washington, DC: Brookings Institution.

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.

De Figueiredo, Rui, and Barry R. Weingast. 2005. "Self-Enforcing Federalism." *Journal of Law, Economics, and Organization* 21(1): 103-135.

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

Elazar, Daniel J. 1966. *American Federalism: A View from the States.* New York: Thomas Y. Crowell Company.

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

Galle, Brian. 2008. "Federal Fairness to State Taxpayers: Irrationality, Unfunded Mandates and the 'Salt' Deduction." *University of Michigan Law Review* 106(March): 805-852

Goodrich, Carter. 1960. *Government Promotion of American Canals and Railroads, 1800-1890.* New York: Columbia University Press.

Gopnik, Adam. 2015. "The Plot Against Trains." *The New Yorker*, May 15.

Gordon, Roger. 1983. "An Optimal Taxation Approach to Fiscal Federalism." *Quarterly Journal of Economics* 98(4): 567-86.

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

Gordon, Sanford C., and Hannah K. Simpson. 2015. "The Birth of Pork." Typescript, New York University.

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. 1997. *Modernization and Postmodernization: Cultural, Economic, and Political Change in 43 Societies.* Cambridge: Cambridge University Press.

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.

Kaplow, Louis. "Fiscal Federalism and the Deductibility of State and Local Taxes under the Federal Income Tax." *University of Virginia Law Review* 82(3): 413-492.

Kim, Namsuk, and John J. Wallis. 2005. "The Market for American State Government Bonds in Britain and the United States, 1830-1843." *Economic History Review* 58(4): 736-764.

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.

Krelove, Russell. 1992. "Competitive Tax Theory in Open Economies: Constrained

Inefficiency and a Pigovian Remedy." *Journal of Public Economics* 48(3): 361-375.

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.

Larson, John Lauritz. 2001. *Internal Improvement: National Public Works and the Promise of Popular Government in the Early United States.* Chapel Hill, NC: University of North Carolina Press.

Lipset, Seymour Martin. 1960. *Political Man: The Social Bases of Politics.* Garden City: Doubleday.

Mason, Ruth. 2011. "Federalism and the Taxing Power." *California Law Review* 99, 975-1036.

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

McCarty, Nolan, Keith Poole, Howard Rosenthal, and Chris Hare. "Polarization is Real (and Asymmetric)." Blog post on *themonkeycage.org,* May 15, 2012.

Minicucci, Stephen. 2004. "Internal Improvements and the Union, 1790-1860." *Studies in American Political Development* 18(2): 160-185.

Myers, Gordon M. 1990. "Optimality, Free Mobility, and the Regional Authority in a Federation." *Journal of Public Economics* 43(1): 107-121.

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

Oates, Wallace E. 1999. *An Essay on Fiscal Federalism. Journal of Economic Literature* 37(3): 1120-1149.

O'Reilly, James T. 2006. *Federal Preemption of State and Local Law: Legislation, Regulation, and Litigation.* Chicago, IL: ABA Publishing.

Pew Charitable Trusts. 2014. *Intergovernmental Challenges in Surface Transportation Funding.* Report: Fiscal Federalism in Action Series.

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

Poole, Keith T. and Howard Rosenthal. 2000. *Congress: a Political-Economic History of Roll Call Voting.* Oxford: Oxford University Press.

Riker, William H. 1964. *Federalism: Origin, Operation, and Significance.* Boston: Little, Brown.

Riker, William H. 1975. "Federalism." In Greenstein, Fred., and Nelson Polsby, eds., *Handbook of Political Science*, Vol. 5. Reading, Mass: Addison-Wesley, 93-172.

Rodden, Jonathan A. 2006. *Hamilton's Paradox: The Promise and Peril of Fiscal Federalism. New York: Cambridge University Press.*

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

Scicchitano, Michael J., and David M. Hedge. 1993. "From Coercion to Partnership in Federal Partial Preemption: SMCRA, RCRA, and OSH Act." *Publius* 23(4): 107-121.

Skowronek, Stephen. 1982. *Building a New American State.* Cambridge: Cambridge University Press.

Sylla, Richard, John B. Legler, and John J. Wallis. 1987. "Banks and State Public Finance in the New Republic: The United States, 1790-1860." *Journal of Economic Perspectives* 47(2): 391-403.

Sylla, Richard, and John J. Wallis 1998. "The Anatomy of Sovereign Debt Crises: Lessons from the American State Defaults of the 1840s." *Japan and the World Economy* 10(3): 267-293.

Volden, Craig. 2005. "Intergovernmental Political Competition in American Federalism." *American Journal of Political Science* 49(2): 327-342.

Volden, Craig. 2007. "Intergovernmental Grants: A Formal Model of Interrelated National and Subnational Political Decisions." *Publius* 37(2): 209-243.

Wawro, Gregory J., and Eric Schickler. 2006. *Filibuster: Obstruction and Lawmaking in the U.S. Senate.* Princeton, NJ: Princeton University Press.

Appendix A. Proofs of Results

Proof of Lemma 1

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

$$u_i(F|\alpha_i;\theta\gamma) = \begin{cases} -\frac{\theta-\gamma^2}{2}F^2 + (1-\gamma)\alpha_i F + \frac{\alpha_i^2}{2} & \text{if } F < \frac{\alpha_i}{\gamma} \\ -\frac{\theta}{2}F^2 + \alpha_i F & \text{otherwise.} \end{cases} \tag{7}$$

This first line of (7) 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 $F \geq \frac{\alpha_i}{\gamma}$, $\frac{\partial u_i(F|\cdot)}{\partial F} < 0$; (b) $\hat{F}(\alpha_i;\gamma,\theta) < \frac{\alpha_i}{\gamma}$; and (c) no discontinuity exists at $u_i(F|\cdot)$ at $F = \frac{\alpha_i}{\gamma}$. Differentiating the second line of (7) with respect to F yields $\alpha_i - F\theta$, which is strictly negative if and only if $F > \frac{\alpha_i}{\theta}$. $F \geq \frac{\alpha}{\gamma}$ 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 (7) 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

Let $\alpha_i < \alpha_j$. Then ideal point polarization between i and j is $\Pi_{ij} = \frac{1-\gamma}{\theta-\gamma^2}(\alpha_j - \alpha_i)$.

1. $\frac{\partial \Pi_{ij}}{\partial \theta} < 0$ (by inspection).

2. $\frac{\partial \Pi_{ij}}{\partial \gamma} = \frac{2\gamma-\gamma^2-\theta}{(\theta-\gamma^2)^2}(\alpha_j - \alpha_i)$. $(\alpha_j - \alpha_i)$ and the denominator of the fraction are strictly positive. The numerator of the fraction is strictly negative if and only if $\gamma^2 - 2\gamma + \theta > 0$. This inequality has two roots, given by $1 \pm \sqrt{1-\theta}$. If $\theta \leq 1$, both roots are real

and strictly positive, and the inequality is satisfied if and only if $\gamma < 1 - \sqrt{1-\theta}$ or $\gamma > 1 + \sqrt{1-\theta}$. By assumption, $\gamma < 1$, implying that for $\gamma \in [0, 1-\sqrt{1-\theta}]$, Π_{ij} is decreasing in γ, and for $\gamma \in (1-\sqrt{1-\theta}, 1)$, increasing in γ. If $\theta > 1$, both roots are imaginary, implying that the inequality is always satisfied, and so Π_{ij} is everywhere decreasing in γ for $\gamma \in [0, 1)$. ■

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 $v(F, \alpha'; \theta, \gamma) = u_i(F|\alpha = \alpha'; \theta, \gamma) + u_i(F|\alpha = 2\alpha_m - \alpha'; \theta, \gamma)$ for $\alpha' < \alpha_m$. Then aggregate welfare is

$$V(F; \theta, \gamma, p(\cdot)) \equiv \int_{\underline{\alpha}}^{\alpha_m} v(F, \alpha; \theta, \gamma) p(\alpha) d\alpha. \tag{8}$$

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

1. All states fully crowded out at F^* ($F^* \geq \overline{\alpha}/\gamma$). 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^* ($F^* < \underline{\alpha}/\gamma$). Then aggregate welfare is

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

   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, aggregate welfare is strictly lower than it would be in the absence of full crowding out (owing to the shadow cost of crowding out), 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 (9), 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,

$$\begin{aligned} V(\theta, \gamma, p(\alpha)) &= \int_{\underline{\alpha}}^{\gamma F} \left[-\frac{2\theta - \gamma^2}{2} F^2 + (2(1-\gamma)\alpha_m + \gamma\alpha)F \right] p(\alpha) d\alpha + \\ & \int_{\gamma F}^{\alpha_m} \left(-(\theta - \gamma^2)F^2 + 2(1-\gamma)\alpha_m F \right) p(\alpha) d\alpha + K(\alpha_m, p(\cdot)), \quad (10) \end{aligned}$$

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

$$F = \frac{2(1-\gamma)\alpha_m + \alpha\gamma}{2\theta - \gamma^2}. \quad (11)$$

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 (10) 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 (10). From above, the term in square brackets is maximized at the expression given in (11), 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 (10) 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 (10), 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

Define $PI_R \equiv -\frac{u_j'(F)}{u_i'(F)}$ as political inefficiency associated with a rightward shift, $PI_L \equiv -\frac{u_i'(F)}{u_j'(F)}$ as political inefficiency associated with a leftward shift, and $PI \equiv \max\{PI_L, PI_R\}$. Given single-peakedness, on the interval $\left(\hat{F}(\alpha_i), \hat{F}(\alpha_j)\right)$, j is never fully crowded out (by Lemma 1), but i may be. Let $\alpha_m \equiv \frac{\alpha_i+\alpha_j}{2}$ and $\hat{F}(\alpha_m)$ the associated ideal point. Let $\Delta \in \left(0, \frac{1-\gamma}{\theta-\gamma^2}\left(\frac{\alpha_j-\alpha_i}{2}\right)\right)$. Then $\overline{F} = \hat{F}(\alpha_m) + \Delta$ and $\underline{F} = \hat{F}(\alpha_m) - \Delta$. There are four cases to consider.

1. i not fully crowded out at $F = \hat{F}(\alpha_m) - \Delta$ or $F = \hat{F}(\alpha_m) + \Delta$. Then i is not fully crowded out at $\hat{F}(\alpha_m)$, and from the proof of Proposition 2, the policy that maximizes the joint welfare of i and j, is $F^* = \hat{F}(\alpha_m)$. By construction, $PI_R(F^*) = PI_L(F^*) = 1$; and by concavity, $PI(\hat{F}(\alpha_m) - \Delta) = PI_R(\hat{F}(\alpha_m) - \Delta)$ and $PI(\hat{F}(\alpha_m) + \Delta) = PI_L(\hat{F}(\alpha_m) + \Delta)$. Substituting $\hat{F}(\alpha_m) = \frac{1-\gamma}{\theta-\gamma^2}\left(\frac{\alpha_i+\alpha_j}{2}\right)$, and deriving $u_i'(F)$ and $u_j'(F)$

from the first line of (7), simple algebra reveals that

$$PI_R(\hat{F}(\alpha_m) - \Delta) = PI_L(\hat{F}(\alpha_m) + \Delta) = \frac{(1-\gamma)(\alpha_j - \alpha_i) + 2(\theta - \gamma^2)\Delta}{(1-\gamma)(\alpha_j - \alpha_i) - 2(\theta - \gamma^2)\Delta}, \tag{12}$$

implying that $PI(F)$ is symmetric about $\hat{F}(\alpha_m)$.

2. i fully crowded out at $\hat{F}(\alpha_m) + \Delta$ but not at $\hat{F}_m$ or $\hat{F}(\alpha_m) - \Delta$. Then by the logic of Part 1, $F^* = \hat{F}(\alpha_m)$, $PI_R(F^*) = PI_L(F^*) = 1$, $PI(\hat{F}(\alpha_m) - \Delta) = PI_R(\hat{F}(\alpha_m) - \Delta)$, and $PI(\hat{F}(\alpha_m) + \Delta) = PI_L(\hat{F}(\alpha_m) + \Delta)$. It is then sufficient to demonstrate that

$$PI_R(\hat{F}(\alpha_m) - \Delta) < PI_L(\hat{F}(\alpha_m) + \Delta),$$

or, rearranging,

$$u_j'(\hat{F}(\alpha_m) - \Delta)u_j'(\hat{F}(\alpha_m) + \Delta) < u_i'(\hat{F}(\alpha_m) - \Delta)u_i'(\hat{F}(\alpha_m) + \Delta). \tag{13}$$

Recall the supposition that i is not fully crowded out at $\hat{F}(\alpha_m) - \Delta$ and that, further, j is never fully crowded out for any $\hat{F}(\alpha_m) + \Delta < \hat{F}(\alpha_j)$. Substituting for $\hat{F}(\alpha_m)$ and rearranging, simple algebra reveals that $u_j'(\hat{F}(\alpha_m) + \Delta) = -u_i'(\hat{F}(\alpha_m) - \Delta)$. Recalling that i is fully crowded out by supposition at $F = \hat{F}(\alpha_m) + \Delta$, and deriving $u_i'(F)$ from the second line of (7), under that circumstance from the second line of inequality (13) reduces to

$$-(\theta - \gamma^2)(\hat{F}(\alpha_m) - \Delta) + (1-\gamma)\alpha_j < \theta(\hat{F}(\alpha_m) + \Delta) - \alpha_i.$$

Substituting for $\hat{F}(\alpha_m)$ and rearranging, this condition is met if and only if $\hat{F}(\alpha_m) + \Delta > \frac{\alpha_i}{\gamma}$. This is the condition for i being fully crowded out at $F = \hat{F}(\alpha_m) + \Delta$, which is true by supposition.

3. i fully crowded out at $\hat{F}(\alpha_m) + \Delta$ and $\hat{F}(\alpha_m)$, but not at $\hat{F}(\alpha_m) - \Delta$. The proof is

identical to that in Part 2.

4. i fully crowded out at $\hat{F}(\alpha_m)+\Delta$, $\hat{F}(\alpha_m)$, and $\hat{F}(\alpha_m)-\Delta$. First, note that if i is fully crowded out at $\hat{F}(\alpha_m)$, it is also fully crowded out at the policy that maximizes the joint welfare of i and j, $F^* < \hat{F}(\alpha_m)$. To see why, suppose otherwise. From the first order condition for a joint welfare maximizer, $-u_i'(F^*) = u_j'(F^*)$. If i is not fully crowded out at F^*, then neither is j. Then from the proof of Proposition 2, $F^* = \hat{F}(\alpha_m)$. But by supposition, i is fully crowded out at $\hat{F}(\alpha_m)$, a contradiction.

   This leads to two subcases: (a) $\hat{F}(\alpha_m)-\Delta \in [F^*, \hat{F}(\alpha_m)]$. In this interval, $PI_L(F) > PI_R(F)$, so $PI(\hat{F}(\alpha_m)-\Delta) = PI_L(\hat{F}(\alpha_m)-\Delta)$ and $PI(\hat{F}(\alpha_m)+\Delta) = PI_L(\hat{F}(\alpha_m)+\Delta)$. Then $PI(\hat{F}(\alpha_m)+\Delta) > PI(\hat{F}(\alpha_m)-\Delta)$ if and only if $-\frac{u_i'(\hat{F}(\alpha_m)-\Delta)}{u_j'(\hat{F}(\alpha_m)-\Delta)} < -\frac{u_i'(\hat{F}(\alpha_m)+\Delta)}{u_j'(\hat{F}(\alpha_m)+\Delta)}$, which holds trivially from concavity of $u_i(\cdot)$ and $u_j(\cdot)$. (b) $\hat{F}(\alpha_m)-\Delta \in [\frac{\alpha_i}{\gamma}, F^*]$. Then $PI(\hat{F}(\alpha_m)-\Delta) = PI_R(\hat{F}(\alpha_m)-\Delta)$ and $PI(\hat{F}(\alpha_m)+\Delta) = PI_L(\hat{F}(\alpha_m)+\Delta)$, and it is sufficient to demonstrate that (13) is satisfied for this case. Part 2 above demonstrates that for that case, the condition holds. Therefore if $u_i'(\hat{F}(\alpha_m)-\Delta)$ is larger (in absolute magnitude) in the current case, the condition will be met in this case as well. Differentiating the first and second lines of (7), this is the case if and only if $(\theta-\gamma^2)(\hat{F}(\alpha_m)-\Delta)-(1-\gamma)\alpha_i < \theta(\hat{F}(\alpha_m)-\Delta)-\alpha_i$, or $\hat{F}(\alpha_m)-\Delta > \frac{\alpha_i}{\gamma}$. This is the condition for i being fully crowded out at $\hat{F}(\alpha_m)-\Delta$, which is true by supposition.

   ■

Proof of Proposition 5

(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 the inverse of $\hat{F}^2(\alpha_i^2;\cdot)$, that is, the α_i^2 for whom $\hat{F}^2(\alpha_i^2;\cdot) = F$ is $A(F)$. 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 ex ante expected utility from choice F^1, given subsequent equilibrium behavior, is

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

where $u(F^1,\alpha_i,\cdot)$ is the indirect single-period payoff for the first period given that $S_i^t = S(\alpha_i^t, F^t)$, the first integral is the expected second-period payoff when the shock lands the system in the gridlock interval, and the second and third integrals are the second-period payoffs 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. Note that in the integrand of the first integral, the payoff is evaluated at F^1, because the gridlock in the second period implies that $F^2 = F^1$.

The first-order condition that defines the optimal value F^1 for α_1 is

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

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

$$\frac{\partial u(F^1, \alpha_i, \cdot)}{\partial F} + \lambda \int\limits_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_i + \sigma, \cdot)}{\partial F} d\sigma = 0 \tag{14}$$

If $\lambda \int\limits_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_i + \sigma)}{\partial F^1} d\sigma$ is less (greater) than 0, then $\frac{\partial u(F^1, \alpha_i, \cdot)}{\partial F}$ must be less (greater) than 0 to compensate. It follows that the value of F^1 that solves (14) is less (greater) than the value $\hat{F}(\alpha_i, \cdot)$ from the one-shot model, for which $\frac{\partial u(\hat{F}(\alpha_i; \cdot), \alpha_i, \cdot)}{\partial F} = 0$.

$A(F^1)$ is the state for which $\frac{\partial u(F^1, A(F^1), \cdot)}{\partial F} = 0$. If $\alpha_i + \sigma < A(F^1)$, then the intergrand in equation (14) 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. Thus, if $\alpha_i < \alpha_L$, then $\hat{F}^1(\alpha_i) < \hat{F}(\alpha_i) = \hat{F}^2(\alpha_i)$.

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

It follows that $\hat{F}^1(\alpha_L) < \hat{F}(\alpha_L)$ and $\hat{F}^1(\alpha_H) > \hat{F}(\alpha_H)$.

(2) First, note that for $\alpha_i = \alpha_L$, the integrand from (14) evaluated at the upper bound $\sigma = A(F^1) - \alpha_L$ is $p(A(F^1) - \alpha_L) \frac{\partial u(F^1, A(F^1), \cdot)}{\partial F}$. From the definition of $A(F^1)$, $\frac{\partial u(F^1, A(F^1), \cdot)}{\partial F} = 0$, and thus $\forall \sigma < A(F^1) - \alpha_L$, the integrand is negative. Similarly, for $\alpha_i = \alpha_H$, the integrand evaluated at the lower bound $\sigma = A(F^1) - \alpha_H$ is $p(A(F^1) - \alpha_H) \frac{\partial u(F^1, A(F^1), \cdot)}{\partial F} = 0$, and $\forall \sigma > A(F^1) - \alpha_H$, the integrand is positive.

Consider first the case $\alpha_L + A(\hat{F}^1(\alpha_L)) - \alpha_H \geq \gamma \hat{F}^1(\alpha_L)$. In this case, even α_L with the smallest shock engages in provision at the state level. Given that the distribution of shocks is symmetric around 0, and given that $\frac{\partial u(F^1, \alpha_i, \cdot)}{\partial F}$ is symmetric about its maximand $\hat{F}$ in this case,

$$-\int\limits_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_L + \sigma, \cdot)}{\partial F} \partial\sigma = \int\limits_{A(F^1)-\alpha_H}^{A(F^1)-\alpha_L} p(\sigma) \frac{\partial u(F^1, \alpha_H + \sigma, \cdot)}{\partial F} \partial\sigma \tag{15}$$

From (14), then, $\hat{F}(\alpha_L) - \hat{F}^1(\alpha_L) = \hat{F}^1(\alpha_H) - \hat{F}(\alpha_H)$.

Suppose, instead, $\alpha_L + A(\hat{F}^1(\alpha_L)) - \alpha_H < \gamma \hat{F}^1(\alpha_L)$. In this case, α_L with a sufficiently small shock chooses 0 provision at the state level. From (7) and Lemma 1, the LHS of (15) is strictly greater than the RHS. From (14), $\hat{F}(\alpha_L) - \hat{F}^1(\alpha_L) > \hat{F}^1(\alpha_H) - \hat{F}(\alpha_H)$. ■

Regulatory Federalism: Preliminary Analysis

Suppose there is no federal floor. Cursory examination of state i's utility in equation (4) reveals it to be globally concave in S_i 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

$$\begin{aligned} Z &= \frac{1}{2R}\int_{\alpha_m - R}^{F}(1-F)d\alpha + \int_{F}^{\alpha_m + R}(1-\alpha)d\alpha \\ &= \frac{(4 - 2F - 2\alpha_m - R)R - (F-\alpha_m)^2}{4R}. \end{aligned} \tag{16}$$

Substituting $S_i^* = \max\{F, \alpha_i\}$ and the second line of (16) into (4) gives the state's induced utility over the federal floor:

$$E[u_i(F|\alpha_i;\beta)] = \begin{cases} \frac{\alpha_i\beta}{4R}F^2 - \frac{\alpha_i\beta(\alpha_m - R)}{2R}F + \frac{(\beta(\alpha_m+R)^2 - 2R(2\beta - \alpha_i + 2))\alpha_i}{4R} & \text{if } F \leq \alpha_i \\ -\frac{2R-\alpha_i\beta}{4R}F^2 + \frac{(2R - \beta(\alpha_m - R))\alpha_i}{2R}F - \frac{(\beta(\alpha_m+R)^2 - 2R(2\beta+2))\alpha_i}{4R} & \text{otherwise.} \end{cases} \tag{17}$$

The term multiplying F^2 in the first line of (17) is strictly positive; moreover, state i's utility is strictly increasing for all $F \in [\alpha_m - R, \alpha_i]$. The term multiplying F^2 in the second line is strictly negative if and only if $\beta < \frac{2R}{\alpha}$, and strictly negative for all $\alpha_i \in [\alpha_m - R, \alpha_m + R]$ if and only if $\beta < \frac{2R}{\alpha_m + R}$. If (and only if) this inequality holds, the second line of (17) is maximized at the value given in equation (5), which is is strictly larger than α_i. Next, note that the first and second lines of (17) 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 $[\alpha_m - R, \alpha_i]$; and concave for $\alpha_i \in (\alpha_i, \infty)$, reaching a global maximum above α_i. 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 6

(a)Aggregate welfare as a function of F is given by

$$\begin{aligned} V(F;\beta) &= \frac{1}{2R}\int_{\alpha_m-R}^{\alpha_m+R} E[u_i(F|\alpha,\beta)]d\alpha \\ &= -\frac{F^3}{6} + \left(\frac{\alpha_m - R + \beta\alpha_m}{2}\right)F^2 - \left(\frac{(\alpha_m+R)^2 + 2\beta\alpha_m(\alpha_m - R))}{2}\right)F + K, \end{aligned}$$

where K is a trailing constant. This expression has two optima: $F = \alpha_m - R$ and $F = \alpha_m - R + 2\beta\alpha_m$. Second-order conditions indicate that the first of these is a local minimum and the second a local maximum. By the conditions for single-peakedness, any $F \leq \alpha_m - R$ is Pareto-dominated by some $F > \alpha_m - R$. Therefore the second root is a global maximum. The ideal point of the median state is the expression in (5) evaluated at $\alpha_i = \alpha_m$. Comparing $\alpha_m - R + 2\beta\alpha_m$ with this quantity, the latter exceeds the former if and only if $(\beta\alpha_m - R)^2 > 0$, which must be true given the assumption that $\beta < \frac{2R}{\alpha}$ for all α.

(b) From (a), the aggregate welfare-maximizing policy is $\alpha_m - R + 2\beta\alpha_m$, which is strictly decreasing in R. ■

Matching Grants: Preliminary Analysis

Starting at the end of the game, the optimal level of provision in state i given taste parameter α_i and matching level μ is

$$S_i^* = \max\{0, \alpha_i(1+\mu) - \mu\gamma\}.$$

For our next two results, we will assume for simplicity that the αs are distributed $U(0,1)$. The first, preliminary result gives condition for an interior optimal matching level μ^*.

Lemma 2 *Suppose $\alpha \sim U(0,1)$. Then the welfare-optimizing matching level is given by $\mu^* = \max\{0, \frac{2-3\gamma}{4(1-\gamma)}\}$. If $\gamma < \frac{2}{3}$, this value is interior.*

Proof. From the expression for S^*, note first that for all states with $\alpha_i < \frac{\gamma\mu}{1+\mu}$, $S^* = 0$. Therefore, the bounds of integration on the integral in equation (6) are $\frac{\gamma\mu}{1+\mu}$ and 1. Given the uniform distribution and the expression for S^*, this integral evaluates to $\frac{\mu^2(1+(1-\gamma)\mu)}{6(1+\mu)}$. Substituting this and the expression for S^* into equation (6) and integrating over the distribution of α yields

$$V(\mu) = \frac{1}{6}(1-\mu)(1+(1-\gamma)\mu).$$

This expression has three critical points: the first two are strictly negative; the third, $\frac{2-3\gamma}{4(1-\gamma)}$, is strictly positive if and only if $\gamma < \frac{2}{3}$. The second order condition evaluated at the third critical point reveals it to be a maximum. ■

Proof of Proposition 7

Let $\hat{u}_i(\alpha_i, \mu)$ be state i's induced utility over μ when the state is not fully crowded out, and $\hat{u}_i^\circ(\alpha_i, \mu)$ be i's induced utility when it is fully crowded out. Let $\lambda(\alpha_i, \mu) \equiv \hat{u}_i(\alpha_i, \mu) - \hat{u}_i^\circ(\alpha_i, \mu)$ be the shadow cost of crowding out. For the proof of Lemma 2, states with $\alpha_i \in (0, \frac{\gamma\mu}{1+\mu})$ are fully crowded out. Given the uniform distribution of α, social welfare is given by

$$\begin{aligned} V(\mu) &= \int_0^1 \hat{u}_i(\alpha_i, \mu) d\alpha - \int_0^{\frac{\gamma\mu}{1+\mu}} \lambda(\alpha_i, \mu) d\alpha \\ &= V'(\mu) - \Lambda(\mu), \end{aligned}$$

where $V'(\mu)$ is the social welfare function in the absence of a zero lower bound constraint, and $\Lambda(\mu) = \frac{\gamma^3\mu^3}{6(1+\mu)}$ is the shadow cost integrated over the domain for which it applies. Second order conditions reveal that in $\mu \in \mathbb{R}^+$, $-\Lambda(\mu)$ is strictly concave and decreasing in μ. Recall from Lemma 2 that for $\gamma < \frac{2}{3}$, μ^*, the value of μ that maximizes $V(\mu)$, is interior. Let μ' be the value μ that maximizes $V'(\mu)$ if it exists. Then, if $V'(\mu)$ is concave, $V'(\mu) - \Lambda(\mu)$ is also concave, implying $\mu^* \in (0, \mu')$. Substituting specific functional forms for $V'(\mu)$ and twice differentiating yields

$$\frac{\partial^2 V'}{\partial \mu^2} = \frac{-6(1-\gamma^3)\mu^5 - 3(8-5\gamma)(1-\gamma^2)\mu^4 - (3-2\gamma)(5\gamma^2 - 18\gamma + 12)\mu^3}{3(1+\mu)^3} - \frac{(3\gamma^2 - 12\gamma + 8)\mu^2 + (2-3\gamma^2)\mu + \gamma(1-\gamma)}{(1+\mu)^3},$$

which is strictly negative $\forall \gamma \in (0, \frac{2}{3})$.■

Appendix B. Non-linear Specification of the Baseline Model

The purpose of this Appendix is to derive an alternative parameterization of the baseline model. We show via simulation that the intuitions from the baseline model are substantively identical to those in this alternative. Using the notation from the paper, state i's utility is expressed as

$$\alpha_i(F + S_i) - \frac{\theta F^2}{2} - \frac{(1 + \gamma F)S^2}{2}. \tag{18}$$

Note that the distortion brought about by federal provision, γF, now multiplies the quadratic cost term $-S^2/2$ instead of $-S$ (as in the baseline model). The solution concept is subgame perfect Nash. In the state policy-making stage, each state i chooses

$$S_i^*(F) \equiv \frac{\alpha_i}{1 + \gamma F}. \tag{19}$$

Two things are immediately clear. First, Remark 1 holds (strictly instead of weakly): there is crowding out, asS_i^* is strictly decreasing in F. Second, unlike in the baseline model, S_i^* approaches zero asymptotically rather than hitting the zero lower bound.[17]

Substituting the right hand side of (19) into (18), and simplifying yields the state's induced utility over federal policy:

$$-\frac{\theta}{2}F^2 + \alpha_i F + \frac{\alpha_i^2}{2(1 + \gamma F)} \tag{20}$$

Note that this is the sum of a quadratic (maximized at $\frac{\alpha_i}{\theta}$) and a function that for $F \in \mathbb{R}_+$ is a strictly decreasing, convex function. As $F \to \infty$, the convex component approaches zero and the induced utility approaches the quadratic component. A sufficient condition for single-peakedness for $F \in \mathbb{R}_+$ is that the convex component not exert too large of an effect (namely, creating a second local maximum in the nonnegative domain at $F = 0$). For

[17] Once having demonstrated the robustness of the paper's main results in this environment, this feature should reassure readers concerned about the artificiality of the zero lower bound in the baseline model.

$\alpha_i > 0$, a necessary and sufficient condition for single-peakedness is that the derivative of the induced utility evaluated at $F = 0$ be greater than or equal to zero, or

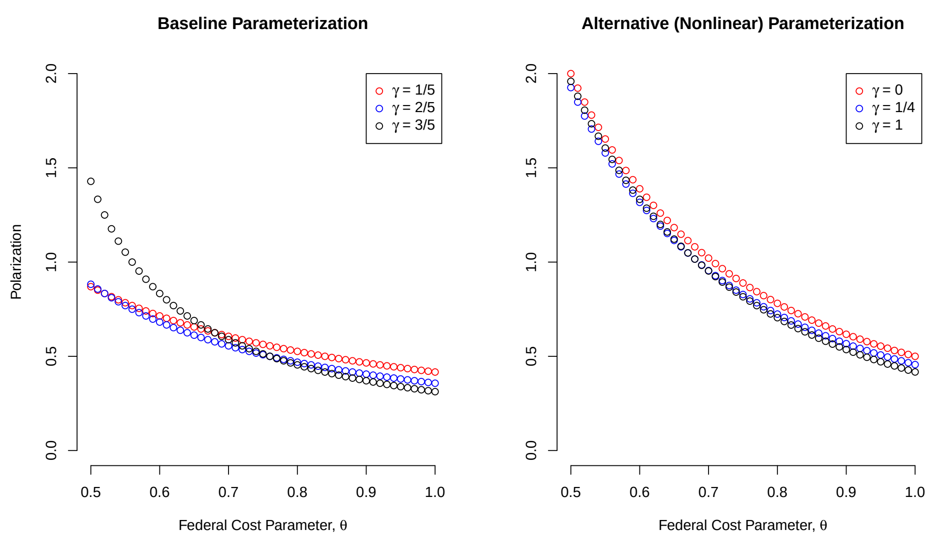
$$\gamma \leq \frac{2}{\alpha_i},$$

and a necessary and sufficient condition for all i to have single-peaked preferences is $\gamma \leq \frac{2}{\alpha}$. The simulations that follow all involve parameter values for which this inequality is satisfied.

Polarization. Figures B.1 and B.2 demonstrate the robustness of the substantive intuition underlying Proposition 2 in the alternative environment. Figure B1, shows, for both the baseline and alternative models, the relationship between polarization (defined as the difference in ideal points between for $\alpha_i = 0.25$ and $\alpha_j = 0.75$) as a function of the federal cost parameter, θ, for sample values of γ. (An exhaustive series of additional simulations for different parameter values yields substantively identical results.) The left panel reproduces the analytical result from the paper: that polarization is decreasing in θ (i.e., increasing in the degree of federal efficiency). The right panel shows that this result is not an artifact of that model's specification; in the alternative specification, polarization is likewise decreasing in θ. Figure B.2 shows the relationship between polarization and the distortion parameter, γ, for sample values of θ. Part 2 of Proposition 2 implies that holding fixed θ, polarization is first decreasing, then increasing in the magnitude of the distortion. As is evident from a comparison of the two panels in the figure, this intuition holds for both models.

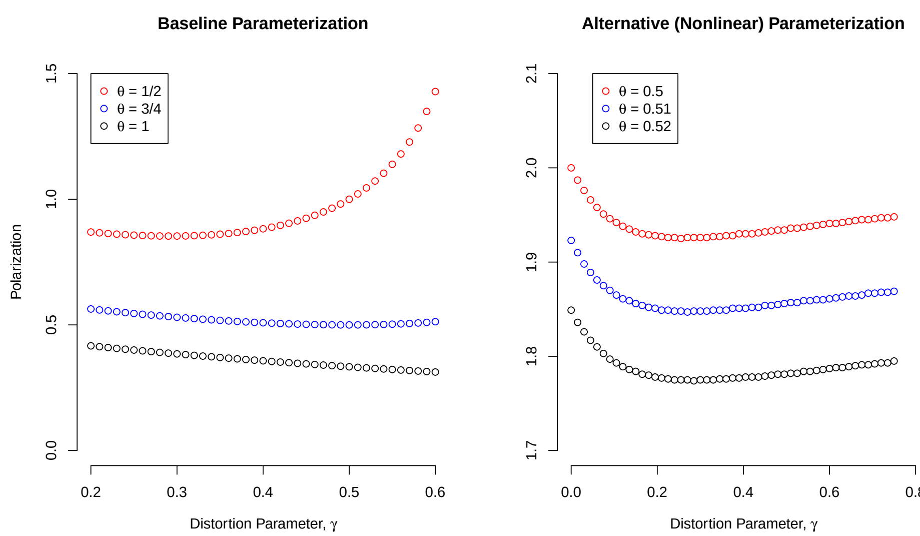
Welfare results. Figure B.3 demonstrates how the intuition underlying Propositions 3 and 4 continue to hold in the alternative model. In the baseline model, the social welfare maximizing policy is, for sufficiently high levels of preference heterogeneity, strictly less than the ideal point of the median state, and decreasing in the degree of preference heterogeneity in the polity. The figure plots, for both models, the median state ideal point against the social welfare maximizing federal policy, F^{sw}, given $\theta = 1$ and for different levels of γ. The simulation occurs in a region of the parameter space in which the median ideal point is decreasing in γ, accounting for the fact that the levels of γ (depicted on the top horizontal

Figure B.4: Ideal point polarization and federal efficiency



In the simulations, polarization is between two states with $\alpha_i = 0.25$ *and* $\alpha_j = 0.75$.

Figure B.5: Ideal point polarization and the federal fiscal distortion



In the simulations, polarization is between two states with $\alpha_i = 0.25$ *and* $\alpha_j = 0.75$.

axis) corresponding to increases in the median ideal point are themselves decreasing. Preferences are assumed to be distributed uniformly, with constant mean/median and varying dispersions. The black lines correspond to the 45° line.

Results for the baseline model are depicted in the left panel, with uniform preference distributions distributed around a constant mean/median of $\frac{1}{2}$. When the distribution has low variance ($U[\frac{1}{3}, \frac{2}{3}]$), no state is fully crowded out at the median's ideal point, and so F^{sw} corresponds to that point – this is illustrated by the correspondence between the red markers and the diagonal. For more dispersed distributions, however, full crowding out does occur at the median's ideal point, and so F^{sw} falls strictly below that point. Note also that the more dispersed the distribution, the greater the divergence between the median's ideal point and the social-welfare maximizing policy. The right panel replicates the results for the alternative specification, for distributions centered on $\alpha_m = 1$. In this model, $F^s w$ is strictly less than the median's ideal point, and decreasing in the dispersion of the preference distribution.

Figure B.6: Federal policies maximizing social welfare varying marginal fiscal distortion and type distribution