Intergovernmental Political Competition in American Federalism

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Abstract

The U.S. Constitution does not assign control over most policy areas either to the national government or to the states. This paper explores how the lack of formal constitutional assignment in American federalism affects the decisions of state and national policymakers. In the game theoretic model offered here, politicians in both the state and national governments seek credit for providing goods desired by the public, and avoid blame for the taxes necessary to provide the goods. In line with Peterson's (1995) theory of functional federalism, the level of government that is better able to supply particular goods and services tends to take the lead in their provision, even to the extent of fully crowding out much less efficient governments. However, under a broad set of circumstances, both state and national politicians seek credit via public spending, and their joint provision leads to a relative "oversupply" of public goods and services, and thus to "over-taxation." Under joint provision, states vary in their responses to changing federal spending patterns based both on the causes of the national changes and on state characteristics.

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In 1966, Morton Grodzins noted that American federalism does not resemble a "layer cake," with specific governmental functions assigned to particular levels of government, but rather a "marble cake," with governmental responsibilities intertwined among the national government, states, and localities. Numerous scholars of federalism subsequently assessed this observation across various policy areas and over time. In *The Price of Federalism*, Paul Peterson (1995) systematized this research with a focus on two theories of federalism, the functional theory and the legislative theory.

> [The functional theory] predicts that each level will expand in its area of competence but will remain limited or will diminish in its less competent area. The second, legislative theory, says that the modern federal system is shaped by the political needs of legislators responsible for its design. Legislators at all levels of government will seek to distribute government benefits for which they can claim credit…. The two theories might better be called perspectives because they are embryonic rather than full-grown…. Neither has been integrated into a mathematical model. (pp. 16-17)

In this paper, I take a further step in our analysis of marble cake federalism, exploring which government takes the lead in providing goods and services, how states respond to changing national spending patterns, and when this system of marble cake federalism is preferable to the more explicitly assigned layer cake version. To do so, I offer a game theoretic model of intergovernmental political competition between state and national policymakers in American federalism. The model captures the credit-claiming attempts that are crucial to the legislative theory and explores the competency or efficiency concerns of the functional theory.[1]

[1] While the model presented here is thus relevant to these two perspectives, it is not simply a formalization of the functional and legislative approaches described by Peterson. Rather, the theory advanced here is intended as a general characterization of intergovernmental political competition against which functional federalism or legislative federalism may be compared.

The model lays the groundwork for further systematic studies of fiscal federalism in the United States, while capturing at least four stylized facts of American federalism that have become conventional wisdom. First, because many functions of government are not specifically designated to the states or to the federal government, involvement by different levels fluctuates over time (Beer 1993, Elazar 1994, Riker 1987, Walker 1995, Zimmerman 1992). The U.S. Constitution, in Article I, Section 8, in the Tenth Amendment, and elsewhere, lends some specificity to powers of the national government and the states. Yet, subject to various interpretations by the courts over time, constitutional arrangements allow joint federal-state activities in numerous policy areas. Many federal countries constitutionally specify exclusive subnational jurisdiction over education, hospitals, or other areas; but in the U.S. many major policy functions, from environmental cleanup and natural resource protection to homeland security, are left open to cooperation or competition between the federal government and the states.

Second, frequently the more efficient level of government takes the leading role in providing the goods and services it is best able to supply, such as with the federal government providing national defense and the states and localities providing education.[2] This is the major claim of functional federalism. Under the "efficiency" umbrella, scholars have characterized many distinct concepts (McKinnon and Nechyba 1997), including the heterogeneity of preferences across states, economies of scale, externalities or "spillovers," and competition across states. Peterson (1995, 64-75) makes the case that the federal government's redistributive role is substantial and increasing, while the states and localities are increasing their

[2] Certainly the national government has not always controlled the military. Riker (1957), for instance, documents this centralization, which continued further since his writing.

developmental role, because these levels of government are respectively better able to handle policies in these areas.[3]

Third, however, for many major policy areas, the less efficient level of government provides the goods or services jointly with the more efficient level. This joint involvement can be cooperative (Elazar 1962, 1966; Grodzins 1966) or competitive (Breton 1998, Dye 1990, Kenyon and Kincaid 1991) in nature. Regardless, often the allocation of responsibility is based on credit claiming and blame avoidance, rather than on efficiency grounds. Over the past decade, for example, the federal government has passed the redistributive welfare program back to the states while enhancing its own role in developmental areas of policing and education, thus running counter to the normative claims of functional federalism.[4] Finally, states differ substantially in their responses to changes in federal spending priorities. As national spending priorities shift, some states step in to offset federal spending cuts while others do not. Varied state reactions have arisen in response to changing federal spending and grant involvement in many major areas of public spending (Wood, Crotty, and Theobald 2002).

The goal of this paper is to advance a formal model of political competition that captures these four characteristics of American federalism and explains patterns of state and national spending based on straightforward characteristics that could be examined empirically in future work. Such a model would provide the framework for further, more in-depth explorations of fiscal federalism than are presently possible, on both theoretical and empirical grounds.

To capture the features of the American federal system in a straightforward manner, the theory of intergovernmental political competition offered here relies on the following

[3] Peterson's functional federalism approach can be traced back at least as far as Oates (1968), who draws on Musgrave's (1959, 1969) three branches of public finance to argue that "distribution" and "stabilization" should be handled by the central government, while "allocation" should be handled locally.

assumptions. To allow for marble cake federalism, the model assumes that policymakers at both the national and state levels can choose to provide goods and services. However, to provide such goods, governments must raise taxes. To allow for the features of functional federalism, the model assumes that, depending on the program area, either the states or the federal government may be able to provide the goods and services in a more cost-effective manner, and may be able to raise taxes more efficiently. States may be heterogeneous in their abilities in raising taxes, in providing goods and services, and in the demands of the public for spending in a particular area. Finally, to allow for legislative federalism, the model assumes that, whether seeking good public policy or reelection, politicians must balance the benefits (credit) from providing goods against the costs (blame) from raising taxes. This credit and blame is assigned to both state-level and national politicians depending on their policies.

Based on these assumptions, the theory offered here leads to both intuitive and surprising findings. As one might expect, politicians increase public spending when programs become less expensive, when they find more effective ways to raise taxes, and when public demands for spending increase. When one level is in a much better position to provide a public good, as with the federal government handling national defense, its relative efficiency leads it to provide the good alone. When there is a closer balance in abilities between the federal government and the states, the quest for political credit entices the less efficient level of government to join in provision. Even in this competitive setting, however, the size of each government's provision increases in proportion to its relative efficiency over the other. Moreover, the governments are responsive to one another's changing spending patterns. Because states differ from one another,

[4] In many cases, this federal involvement is accomplished through grants to states and localities, which are not examined explicitly here, but which are a fruitful area for future research based on the model presented here.

this responsiveness leads to varying state responses to fluctuating national spending depending both on the causes of the national changes and on state characteristics.

Despite these favorable qualities of responsiveness and of greater provision by the better provider, the model shows how this system of competitive federalism as a whole is inefficient. Joint provision of goods and services by definition includes the actions of the less efficient government, and together the state and national governments overtax and overspend relative to the more efficient level of government acting alone. This result may be particularly surprising to students of federalism who focus on horizontal competition that, theoretically, limits the size, scope, and inefficiency of government (Tiebout 1956, Brennan and Buchanan 1980). Here it becomes clear that vertical competition yields quite the opposite effect.

Nevertheless, as demonstrated below, this system of intergovernmental political competition produces more desirable outcomes than either strict national provision or strict state-level provision when two conditions are both met: (1) when the national government is a more efficient provider, and (2) when there is substantial heterogeneity across the states. Thus, for a broad range of modern policy decisions, the American federal system is quite appropriately designed.

The formal model presented here, like all models, represents a simplified view of the world. It should be clear from the beginning that a number of features of American federalism are set aside within this analysis. The focus here is on vertical competition, thus horizontal competitive considerations, from state-to-state migration to diffusion pressures to policy learning, are excluded. Moreover, the model does not incorporate national government preemptive behavior or mandates that place statutory restrictions or demands on state action. Finally, although the logic of the model is consistent with issues of regulatory federalism and

with the use of intergovernmental grants, such aspects of American federalism are beyond the scope of the present analysis.[5] Exclusion of these features is not intended to indicate that they are unimportant in understanding American federalism; rather, their exclusion illustrates that these factors are not necessary root causes of the propositions generated here.

The rest of the paper is divided into several sections. The following three sections present three consecutively more complex versions of the model. The model is initially solved for a unitary government, as a baseline of comparison to the federal system. Then the model is examined with both a national government and a single representative state government. In its full version, the model includes multiple states with varying characteristics. Throughout, several propositions are raised that detail: (1) how government spending changes across levels of government given variations in program costs, tax efficiency, and public demands; (2) conditions under which governments jointly provide the goods or provide them in isolation; and (3) variations in state responses to changing federal spending. I then discuss conditions under which this system of vertically competitive federalism is preferred over exclusive national or state assignment, before highlighting empirical implications and concluding.

The Baseline Model of Unitary Governance

This section details the formal model for the simple case of only one level of government supplying the publicly provided goods or services. Whether scholars of federalism are interested in questions of centralization and devolution of power (Chubb 1985a, 1985b; Crémer and Palfrey 1999; Treisman 1999; Weaver 1996; Zimmerman 1992), tax and spending efficiency (Gordon

[5] As with direct provision of goods and services, when making regulations and issuing or accepting grants, policymakers weigh the costs and benefits of their actions in ways similar to that proposed in the model. Given the further complexities of such activities, however, future work, such as explicitly incorporating the details of intergovernmental grant structures into the present model, would likely be fruitful.

1983, McKinnon and Nechyba 1997, Musgrave 1983), or policy responsiveness (Boeckelman 1992, Lowry 1992, Wood 1991), their initial focus must be on the motivations of governmental officials within the various levels of government. Unfortunately, many models of federalism are not explicit about what motivates politicians and how national and state political interests interact (but see Chen and Ordeshook 1994; Crémer and Palfrey 2000, 2001; Nechyba 1997; Persson and Tabellini 1994, 1996; Treisman 1999; Weingast 1995, 1997). In this model, as formalized below, politicians receive credit for providing goods demanded by their constituents and blame for taxes.[6]

This baseline version of the model is a simple decision theoretic choice by a policymaker within a single level of government – for example a spending decision by a governor in a policy area in which there is no national involvement. This policymaker chooses what quantity of the good to provide. The decision is made to maximize the policymaker's utility, based on the following utility equation:

$$U = d\ q - t^2, \qquad (1)$$

where d is a positive real constant representing the level of public demand for the good,[7] q is the quantity chosen by the policymaker, and t is the level of taxation necessary to pay for the chosen quantity, as specified below.[8] The linear increase in utility based on the quantity provided, and quadratic decrease in utility based on the taxation, reflect the scenario in which there is an ideal level of program spending that is typically greater than zero and less than infinity.[9] At this ideal

[6] These assumptions reflect an underlying theory of voters who have preferences over spending and taxation and are willing to vote against politicians who do not display similar preferences. Because the focus here is on the actions of the politicians at various levels of government, the electoral decisions of voters are left unexamined.
[7] The ultimate level of demand for public spending within a state may be thought of as a result of public opinion (Erikson, Wright, and McIver 1993), interest group activities (Gray and Lowery 1996), and other sources (Jacoby and Schneider 2001). All of these complexities are here condensed into a single effect.
[8] All choices and parameters in the model are assumed to take non-negative values.
[9] Again, this could reflect underlying pressures from voters who have preferences over spending and taxation. Baron (1994) for example presents a model of voters with particularistic policy positions.

level, any lower quantity would give a disutility from insufficient provision of the good, and any more would give disutility based on over-taxation.[10]

The provision of a quantity of goods is costly, and that cost increases with the amount of the good provided. For example, the provision of health care involves costs of buildings, doctors, medications, supplies, and so on, all of which increase as the government expands eligibility for medical services and the level of benefits available.[11] It is assumed that these costs are paid through taxation, although the tax system may have some level of inefficiency (due to waste, oversight and monitoring, drains on economic growth, substitution effects, and so on). For example, a state seeking to raise revenue through a sales tax may find residents changing their spending behavior by buying fewer goods or making purchases out of state. Assuming a balanced budget, the following equation captures how taxes are raised to pay the costs of good provision:[12] $\alpha\, t = m\, q$. Based on the level of tax efficiency (α), taxes (t) are raised to cover the marginal costs (m) of the quantity (q) of good provision. The level of tax efficiency is given by the constant α, which ranges between 0 and 1. For a value of $\alpha = 1$, the tax system is perfectly efficient. Lower values indicate inefficiency in the ability of the government to raise taxes. The marginal costs of the good provision are given by m, a positive real constant.[13] Because m and α are constants, it is easy to solve this taxation equation for t, indicating that the level of taxation is a simple function of q: $t = \frac{m\, q}{\alpha}$.

[10] Clearly, other utility functions could be used that reflect these properties. These are used for ease of explanation and model tractability.
[11] National, state, and local provision of health care through hospitals and medical centers is often further segmented by the needs of the populations served, whether through VA hospitals for veterans, state-run mental health facilities, or county-run general hospitals.
[12] For simplicity, it is assumed that neither level of government runs a surplus or deficit.
[13] Treating marginal costs as constant is a simplification here, equivalent to setting any fixed costs equal to zero and treating variable costs as constant regardless of quantity. All propositions are robust to the inclusion of fixed costs.

Inserting this function into Equation 1 shows that the policymaker's utility is based solely on his or her choice of quantity of the good to provide:

$$U = d\ q - \left(\frac{m\ q}{\alpha}\right)^2 . \tag{2}$$

The maximum utility is gained at a chosen quantity of:[14]

$$q^* = \frac{d\ \alpha^2}{2\ m^2} . \tag{3}$$

This choice gives rise to the following proposition:

Proposition 1: *Given provision by only one level of government, a greater quantity of the good is provided when: (a) marginal costs are smaller; (b) tax efficiency is greater; and (c) demand for the good is greater.*

Proof: Proofs of all propositions are given in the appendix.

As we would expect based on the construction of the utility function, the government is responsive to the citizens in order to claim credit for the program benefits and to limit blame for taxation. As the public demands a greater amount of good provision, the government provides that higher quantity. As the tax system becomes more efficient, or as the good becomes less expensive, the government provides a greater amount of the desired good. This idealistic view of the world becomes more complicated when a second level of government is introduced.

Two-Level Federalism with a Single Representative State

This section expands the model of the previous section to include both a national and a state government within a single representative state. Intuitively, the policymakers could be

[14] Derivations for this equation and other intermediary calculations are given in the appendix.

thought of as a governor and a senator from the state with the median level of desire for national spending in the particular policy area.[15] Three additional assumptions are used in this model of intergovernmental political competition. First, the utility that the state and national policymakers receive is based on the fraction of the total provision of the goods and services and fraction of the total level of taxation for which the state and national governments are responsible, respectively. For example, if the national and state governments equally provide the goods and require the same level of taxation, they share equally in the credit and the blame; however, if only one level of government engages in public good provision, it receives the full credit and blame for the spending and taxation. Second, to better reflect reality, the state and national governments are allowed to differ from one another in their marginal costs (m) and levels of tax efficiency (α). Third, the national government is assumed to choose its level of good provision before the state government. Although this assumption does not affect the comparative statics results discussed below, it does allow for a larger range of values under which the national government engages in a type of preemption, selecting a substantial enough level of the good such that the state policymaker chooses not to join in its provision. This also serves to better reflect reality.[16]

These assumptions are formalized in the following utility equations and game structure:

$$U_S = f_{C,S}\, d\, q - f_{B,S}\, t^2 = \left(f_{C,S}\, d\right)\left(q_S + q_N\right) - \left(f_{B,S}\right)\left(t_S + t_N\right)^2, \quad (4)$$

$$U_N = f_{C,N}\, d\, q - f_{B,N}\, t^2 = \left(f_{C,N}\, d\right)\left(q_S + q_N\right) - \left(f_{B,N}\right)\left(t_S + t_N\right)^2. \quad (5)$$

These utility equations differ only slightly from the case of a unitary government. Indeed, the above unitary government model is a special case of this competitive federalism model. Here, two utility equations are given, one for the state-level policymaker (denoted by subscript S) and

[15] The case of multiple states is solved below. This single-state case is used for expositional purposes.
[16] While this serves as a step toward incorporating more substantial national abilities in the model, this assumption does not fully capture possibilities of complete national preemption of state activities or of unfunded mandates (Posner 1998) that further tip the balance of federalism toward centralization.

one for the national policymaker (denoted by subscript *N*). As above, the credit received by the policymakers is based on the level of public demand for spending (*d*) and the quantity of the good provided (*q*). The blame received by the policymakers is again based on the level of taxation (*t*). In this version of the model, however, the quantity of good supplied is the sum of the quantity provided by the state government (q_S) and the quantity provided by the national government (q_N). Likewise, the total level of taxation is the sum of the taxes raised by the state government (t_S) and the taxes raised by the national government (t_N). As noted in the first assumption above, the fractions *f* represent the portion of *credit* (subscript *C*) or *blame* (subscript *B*) given to the respective level of government (state, *S*, or national, *N*), based on its relative amount of spending and taxation. Specifically: $f_{C,S} = \frac{q_S}{q_S + q_N}$, $f_{C,N} = \frac{q_N}{q_S + q_N}$, $f_{B,S} = \frac{t_S}{t_S + t_N}$, $f_{B,N} = \frac{t_N}{t_S + t_N}$, where q_N and q_S are the quantity of good provided at the national and state levels, respectively; and t_N and t_S are the amount of taxation at these two levels of government. Thus the fractions of credit and blame are allocated in direct proportion to the quantities of good provision and taxation undertaken by the two levels of government.[17] This assumption matches reality fairly well, as various scholars have noted that the public assigns credit to governors and senators roughly in line with the degree to which states and the federal government, respectively, provide goods and services (Atkeson and Partin 2001).[18] However, all propositions continue to hold under the alternative assumption that national and state officials

[17] This is consistent with the public being aware of the relative taxing and spending amounts of the two levels of government. Therefore the underlying theory of voters has them acting in an informed fashion. Bednar (2001) examines a limited information case, exploring the possibility of politicians blurring the lines of credit assignment within a federal system. Her approach leads to encroachment by the federal government under a variety of conditions.

[18] See also Atkeson and Partin 1995; Carsey and Wright 1998; Kone and Winters 1993; Lowry, Alt, and Ferree 1998; Niemi, Stanley, and Vogel 1995; Partin 1995; and Stein 1990.

share credit and blame in *any* nonzero proportion based on their relative spending and taxing behaviors.[19]

Therefore, a policymaker considering increasing the quantity of publicly provided goods and services weighs three factors in determining the credit he or she will receive: (1) the greater quantity produced leads to a larger total amount of credit, (2) this policymaker receives a fraction of that total rise in credit depending on the proportion of the good provided by his or her government, and (3) that proportion of credit increases along with the proposed increase in quantity. The same three factors are relevant in assigning blame based on taxation.

As in the unitary government model, the amount of taxation for each level of government is determined by its chosen quantity, by its relative tax efficiency (α), and by its marginal costs (m). As noted in the second assumption above, tax efficiency and costs are allowed to differ by level of government. This reflects the real world where, for example, increases in corporate and individual income taxes by states cause the loss of tax bases across state lines in ways that national taxes do not. Thus state and national taxation, respectively, are given by the following:

$$t_S = \frac{m_S\, q_S}{\alpha_S},\ t_N = \frac{m_N\, q_N}{\alpha_N}.$$

Inserting these levels of taxation (t_S and t_N) and the credit and blame fractions ($f_{C,S}$, $f_{C,N}$, $f_{B,S}$, and $f_{B,N}$) into Equations 4 and 5 yields equations that are now only functions of state and national quantities (q_S and q_N) and constant parameters (d, m_S, m_N, α_S, and α_N):[20]

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[19] Specifically, all propositions continue to hold for the fractions of credit being $f_{C,S} = c_S \frac{q_S}{q_S + q_N}$ and $f_{C,N} = 1 - c_S \frac{q_S}{q_S + q_N}$, where $0 < c_S < \frac{q_S + q_N}{q_S}$, and for similarly broad ranges of blame assignment. The direct proportions are used here for ease of exposition, and to avoid over-parameterization in the model. Solutions and proofs are available from the author.

[20] As can be seen, the credit part of the utility equations simplifies quite nicely. This is because the three factors discussed above affecting the level of credit received are in perfect balance given the linear utility for credit

$$U_S = d\ q_S - \left(\frac{m_S\ q_S}{\alpha_S}\right)\left(\frac{m_N\ q_N}{\alpha_N} + \frac{m_S\ q_S}{\alpha_S}\right), \tag{6}$$

$$U_N = d\ q_N - \left(\frac{m_N\ q_N}{\alpha_N}\right)\left(\frac{m_N\ q_N}{\alpha_N} + \frac{m_S\ q_S}{\alpha_S}\right). \tag{7}$$

As suggested by the third assumption above, the game structure is very simple. First the national government chooses a level of provision (q_N), then the state government chooses a level of provision (q_S). Sequential games of this nature are solved through backwards induction. Doing so yields the following optimal choices of quantity, with intermediate steps shown in the appendix:

$$q_S^* = \begin{cases} \dfrac{d\ \alpha_S^2}{2\ m_S^2} & \text{if} \quad m_S \le \dfrac{m_N\ \alpha_S}{2\ \alpha_N} \\ \dfrac{d\ \alpha_S\left(3\ m_N\ \alpha_S - 2\ m_S\ \alpha_N\right)}{4\ m_N\ m_S^2} & \text{if} \quad \dfrac{m_N\ \alpha_S}{2\ \alpha_N} < m_S < \dfrac{3\ m_N\ \alpha_S}{2\ \alpha_N} \\ 0 & \text{if} \quad m_S \ge \dfrac{3\ m_N\ \alpha_S}{2\ \alpha_N} \end{cases} \tag{8}$$

$$q_N^* = \begin{cases} 0 & \text{if} \quad m_S \le \dfrac{m_N\ \alpha_S}{2\ \alpha_N} \\ \dfrac{d\ \alpha_N\left(2\ m_S\ \alpha_N - m_N\ \alpha_S\right)}{2\ m_N^2\ m_S} & \text{if} \quad \dfrac{m_N\ \alpha_S}{2\ \alpha_N} < m_S < \dfrac{3\ m_N\ \alpha_S}{2\ \alpha_N} \\ \dfrac{d\ \alpha_N\ \alpha_S}{m_N\ m_S} & \text{if} \quad \dfrac{3\ m_N\ \alpha_S}{2\ \alpha_N} \le m_S < \dfrac{2\ m_N\ \alpha_S}{\alpha_N} \\ \dfrac{d\ \alpha_N^2}{2\ m_N^2} & \text{if} \quad m_S \ge \dfrac{2\ m_N\ \alpha_S}{\alpha_N} \end{cases} \tag{9}$$

When the state government is much more efficient than the national government $\left(m_S \le \dfrac{m_N\ \alpha_S}{2\ \alpha_N}\right)$, the national government policymaker would receive more blame than credit for joint provision of the good. In such circumstances, the national government bows out leaving

claiming. An increase in quantity by the state government increases the total credit available *and* the proportion of total credit received by the state policymaker. These combined increases are offset by the division of credit between the national and state governments.

the state government to act as a sole provider, selecting the quantity derived above in the case of unitary governance. Conversely, when the national government is much more efficient than the state $\left(m_S \geq \frac{2\, m_N\, \alpha_S}{\alpha_N} \right)$, the national government acts as a sole provider, with its provision chosen as in the case of unitary governance.

When the national government is only somewhat more efficient than the state government, it can use its "first mover" position in the game to preclude any state provision. In particular, for $\frac{3\, m_N\, \alpha_S}{2\, \alpha_N} \leq m_S < \frac{2\, m_N\, \alpha_S}{\alpha_N}$, the national policymaker will choose to provide a quantity of the good in excess of what it would desire to provide on its own, in order to keep the state government from providing some of the good and capturing a share of the credit from its provision.

Finally, when the state and national government are fairly comparable in their provision abilities, they engage in joint provision. Taken together, this result leads to the following propositions.

Proposition 2: *Given intergovernmental political competition, whichever level of government is considerably more efficient at good provision will engage in its supply to the exclusion of the less efficient level. Given fairly similar levels of efficiency, both state and national governments will provide the good.*

According to this result, one attractive feature of intergovernmental political competition is that, when one level of government is much more efficient than the other, the more efficient level will act as a sole provider. For example, due to economies of scale, a national postal service is likely to gain preeminence over state-level services in any federal system. For such policy areas, a system of layer cake federalism, with constitutional assignment of specific

governmental functions to a single level of government, would yield the same result given extremely different governmental capabilities, as long as the specified assignment is to the more efficient level of government. Given dramatic changes in the relative costs of provision or taxation abilities of the state and federal governments, however, constitutional assignment could potentially result in the less efficient level of government being assigned control within a particular policy arena. For instance, a number of federal systems constitutionally assign education provision to subnational governments to preserve a diversity of standards across a heterogeneous population, as well as for other purposes. If, over time, the population becomes more homogeneous and the national government becomes better able to raise taxes and to provide educational funding and services, the previously beneficial constitutional specificity may become an undesirable constraint.

According to the model, differences between marble cake federalism and layer cake federalism emerge when the relative capabilities of the two levels of government are not significantly different from one another. This is the true case of competitive federalism, where both levels of government jointly provide the goods or services. Pleasingly, this competition is responsive to the relative abilities of the joint providers, as noted in the following.

Proposition 3: *Given good provision by both the state and national governments, each level of government increases its good provision when: (a) its marginal costs decrease; (b) its tax efficiency increases; (c) demand for the good increases; (d) marginal costs increase for the other level of government; and (e) the tax efficiency decreases for the other level of government.*

The elements of this proposition note the tradeoffs and competition across different levels of government in a federal system. As one governmental level becomes more efficient (either in the costs of provision or in its ability to raise taxes), its portion of the total good provision increases. This is in line with the theory of functional federalism (Peterson 1995). However, the

political considerations introduced in this model of intergovernmental political competition also run counter to functional federalism at times. It is not simply the case that whichever level of government is a more efficient provider of a good will provide it with other levels of government bowing out. Rather, if there is political utility to be gained by providing a good, even if another level of government provides it more efficiently, politicians will choose to provide such a good. Therefore, intergovernmental political competition introduces the possibility of inefficiency in the provision of goods. For example, national politicians seeking to build a tough-on-crime image may desire to become involved in providing policing services, despite more efficient targeted policing at the state and local levels.[21]

As noted in Proposition 3, for the case of simultaneous provision of a good, national government provision may increase for a variety of reasons, ranging from a decline in its own costs, to an increase in its relative tax efficiency, to a rise in the marginal costs of state provision, to an increase in public demand for the provided good. State responses to this increase will be very much tied to the motivation behind increased federal spending, as detailed in the following proposition.[22]

Proposition 4: *When a greater quantity of good provision by the national government results from increased public demand for the good, then state quantities will increase as well. When a greater quantity of good provision by the national government results from decreased marginal costs of national provision, decreased relative state tax efficiencies, or increased marginal costs of state provision, then state quantities will decrease.*

This proposition details the general direction of state responses to changing federal spending patterns. If the major thrust behind national spending increases or decreases is a

[21] As an alternative to direct provision, the U.S. federal government has become more involved in policing over the past decade through intergovernmental grants. Grant use presents an alternative form of joint provision that is beyond the scope of the present model.

change in the public's demand for spending in a particular program area, we should expect the same direction of movements in state and federal spending. If, on the other hand, federal spending changes in response to the relative costs or efficiencies of providing a good at one level of government or the other, then state and federal spending patterns should move in opposite directions. For example, following the terrorist attacks of 9/11, public demand for homeland security increased dramatically. Spending at the national level did not displace state and local spending. Rather, state spending on security increased as well, although it varied by state depending on the degree of budget crisis faced in each state. Earlier eras saw similar joint federal-state spending increases in response to greater public demand in such areas as education and health care.

When national provision rises due to a decrease in relative costs (such as found with increasing economies of scale) or an increase in tax efficiency, we would expect a decrease in state spending. Other than during wars, probably the greatest increase in national spending relative to state spending resulted from the Sixteenth Amendment, allowing the federal government to tax incomes.[23] This permitted the national government to raise substantial revenues with fewer adverse economic effects and less political blame than other revenue sources at its disposal. Also of great importance is the balanced budget restriction in effect in most states but not the national government (McKinnon and Nechyba 1997). The lack of such a requirement for the national government allows national politicians to raise taxes in a "politically more efficient" manner, by passing costs to future generations. When running deficits became less politically acceptable in the 1980s and early 1990s, the relative ability of the national

[22] It should be noted, throughout this section and the work above that the model presents a snapshot of federal and state spending, rather than exploring a dynamic setting. Discussions of "changing" spending patterns are therefore based on comparative statics results.
[23] See the discussion by Walker (1995, pp. 78-81).

government to raise revenue with little blame decreased, resulting in fewer intergovernmental grants, greater policy devolution, and more unfunded mandates (Gramlich 1987, Posner 1998, Quigley and Rubinfeld 1996, Weaver 1996). The fact that many states substituted their own revenues for declining federal funds was something of a mystery (Forrester and Spindler 1990, Stonecash 1990), but fits nicely with the theory presented here. Drops in federal funding were not a result of decreased demand but of tax revolts and the political inability of the federal government to continue running annual deficits in hundreds of billions of dollars. Therefore declining federal funds represented a credit-claiming opportunity at the state level.

State-by-state variation could be explained simply by parameters moving in different directions in different states over time. However, the model's results predict more systematic patterns as well. Consider the state government joint provision quantity, rewritten here:

$$q_S^* = \frac{d\,\alpha_S\left(3\,m_N\,\alpha_S - 2\,m_S\,\alpha_N\right)}{4\,m_N\,m_S^2} \tag{10}$$

If public demand (d) increases, states will differ in their responses based on their state characteristics. As can be seen, states with a greater level of tax efficiency (α_S) or lower marginal costs (m_S) will be more responsive to changing public demand. Therefore, we should expect to see states differing in their reactions to changing external conditions noted in the model's parameters and to changing federal spending patterns. Often these relationships will be quite complex. An increase in the federal government's ability to raise taxes efficiently (α_N) will yield different state-by-state responses than would an increase in the federal government's ability to provide a good at a low cost (m_N), for example.

Systemic inefficiency of intergovernmental political competition

As noted above, this system of intergovernmental political competition has many nice features. When one level of government is far more efficient than another, that efficient level of government provides the good to the exclusion of the other. When both provide the good, spending is responsive to the relative costs and tax efficiencies of the two levels of government. Despite these features, however, this system as a whole is inefficient over the broad range of conditions under which the governments jointly provide the public good. This inefficiency arises for two reasons. First, because the less efficient government provides the good in conjunction with the more efficient government, the provision is by definition more costly than were the more efficient level of government to provide the good by itself. Second, the political competition that leads to joint provision also leads to overprovision relative to provision by either level of government acting by itself.

Proposition 5: *Under joint provision, intergovernmental political competition leads to greater governmental spending and taxation than would occur were one level of government solely responsible for the public good provision.*

Because politicians in this model have utility functions that imitate efficient agents of the voters, and because they are assigned credit and blame in exact proportion to their activities, it may be surprising that the model leads to inefficient outcomes. Inefficiencies arise, however, from these multiple actors seeking to take credit that they would not receive if they had left good provision to the more efficient level of government. This inefficiency is not simply a product of the common culprits of duplication of services or of "tragedy of the commons" problems of distributive politics (Weingast, Shepsle, and Johnsen 1981). Instead, because credit and blame are shared, and because blame increases in quantity at a rate exceeding that of credit, the total

quantity at which the marginal blame from further taxation equals the marginal credit from further provision is higher. This finding illustrates how a focus on vertical competition yields very different predictions from models of horizontal competition (Tiebout 1956, Brennan and Buchanan 1980), in which competitive pressures across subnational governments rein in the leviathan of massive government spending.

Returning to Grodzins' marble cake vs. layer cake analogy, it seems that, based on the model as presented so far, proper constitutional assignment of policy control to the more efficient level of government would yield better outcomes across the board than would the system of competitive federalism brought about by lack of assignment in the U.S. Constitution. This view changes substantially, however, upon significant heterogeneity across states. To demonstrate this finding, I now turn briefly to the full model with multiple states.

Two-Level Federalism with Multiple States

To explore the model with multiple states, it is beneficial to rely on four additional assumptions. First, I here allow the states to differ from one another in their public demands (thus state *i* has public demand d_i), in their marginal costs of provision (m_{S_i}), and in their tax efficiencies (α_{S_i}). Second, I assume an odd number of states each individually represented in a national government operating under a majoritarian decision rule. This means that the national government's choice of quantity will reflect that desired by the national policymaker from the median state, with just under half of the other national politicians desiring less spending and just under half desiring greater spending. The median state is defined by its demands (d_M), costs (m_{S_M}), and tax efficiency (α_{S_M}), which in combination influence the quantity desired by the national policymaker representing this state. The median national representative, best thought of

as a senator from the median state, still bases his or her decisions on the national government's marginal costs (m_N) and tax efficiency (α_N), while realizing that credit and blame will be given based on the total good provision and taxation in his or her home (median) state. Third, I assume that the quantity chosen by the national government is the same for each state. This is not to say that the same amount of money would be spent in large and small states, only that the same level of national defense or environmental regulations would be applicable in all states.[24] Fourth, I here focus on the case of model parameters under which there is joint provision of the good by national and state governments.[25] Outside of these parameter values, only one level of government would provide the good, yielding the unitary case above.

All other assumptions remain as in the single-state model above. Once again, the national government first chooses a quantity, then the state governments choose their quantities.[26] The national quantity is chosen based on the conditions in the median state, S_M, while state-level decisions depend on the conditions within each individual state. As derived in the appendix, the quantity choices for state *i* and for the national government are as follows:

$$q_{S_i}^* = \frac{\alpha_{S_i}\left(2\, d_i\, m_N\, m_{S_M}\, \alpha_{S_i} + d_M\, m_{S_i}\, \left(m_N\, \alpha_{S_M} - 2\, m_{S_M}\, \alpha_N\right)\right)}{4\, m_N\, m_{S_i}^2\, m_{S_M}}, \tag{11}$$

$$q_N^* = \frac{d_M\, \alpha_N \left(2\, m_{S_M}\, \alpha_N - m_N\, \alpha_{S_M}\right)}{2\, m_N^2\, m_{S_M}}. \tag{12}$$

As one might expect, the decision of the national government is the same as above, where the single representative state is now the median state. Which state is the median depends on the

[24] Certainly this is a simplification of American federalism. In many cases, such as dealing with ambient air quality, the national standards and provisions differ by state and by locality. Modeling such complexities adds little to the present analysis, and is here eschewed in favor of parsimony.

[25] The equation giving conditions under which states would choose to join in provision along with the national government is given in the appendix.

[26] The order of the choice among the states is irrelevant as the states are not in competition with one another. For concreteness, assume the states select their quantities simultaneously, following the national government's decision.

combination of state characteristics. For the simplified case where the states only vary from one another based on marginal costs, for example, the median is simply the state with the median costs. National government representatives from states with higher marginal costs desire greater national spending, while those from states with lower marginal costs desire less national spending. Thus the competition for credit between state and national policymakers leads these national representatives to *appear* quite responsive to their states' conditions and to make arguments in favor of efficiency. Yet this result arises not from an assumption that politicians seek efficient policy outcomes (indeed there is no such assumption in the model); rather, politicians are motivated here simply by credit claiming and blame avoidance.

All of the conditions of Proposition 3 continue to hold. Each state increases its provision when its marginal costs decrease, its tax efficiency increases, and public demand within the state increases, as well as when the national government's costs increase and tax efficiency decreases. In addition, however, each state is now also responsive to features in the median state, as these influence the spending decisions of the national government. When marginal costs increase in the median state, the quantity chosen by each of the other states decreases in equilibrium. Higher costs in the median state lead the median national policymaker to gain an advantage from greater national spending, which in turn results in lower spending in the other states, leading to the appearance of a diffusion of spending decisions across states. This finding provides an alternative logic that complements evidence of horizontal federal competition, consistent with policy diffusion across states (Berry and Berry 1990) or the potential "race to the bottom" in social service benefits (Volden 2002; Berry, Fording, and Hansen 2003; Bailey and Rom 2004).

This multiple-state model is advanced to show that the conditions above hold beyond the case of a single representative state and to explore how heterogeneity across states affects the

relative efficiency of intergovernmental political competition within marble cake federalism compared to constitutional assignment resulting in layer cake federalism. This latter point is best illustrated in the following three-state example.

Three-state example with varying public demands

In the single-state model, it was established that competitive federalism, resulting here from the lack of explicit constitutional assignment, led to less efficient outcomes than would have occurred under proper assignment to the best provider. Does this finding hold given heterogeneity across states? The short answer is: no. To illustrate this finding and the interaction between heterogeneity and efficiency in the optimal assignment of governmental functions, consider the following three-state example. Here the states differ from one another only in terms of demand for public provision, with all states having the same marginal costs and tax efficiencies as one another. The levels of public demand in the low-demand and median-demand states are fixed at one ($d_L = d_M = 1$), with the level of demand in the high-demand state (d_H) allowed to vary. The greater this value, the more heterogeneous the states are. The states and the national government are here assumed to be perfectly efficient in their tax collection ($\alpha_N = \alpha_S = 1$). National marginal costs are fixed at one ($m_N = 1$), with state marginal costs allowed to vary. Thus the states are more efficient providers for $m_S < 1$ and less efficient for $m_S > 1$.

The goal here is to compare the utility produced by the system of competitive federalism to both national government assignment and state government assignment for the entire range of d_H and m_S. To do so, I rely on the utility function of Equation 1, $U = d\,q - t^2$, aggregated across the three states. For the cases of national assignment and state assignment, the quantities are those chosen by those two governments, respectively. For the case of joint provision, the

quantities provided (and taxes raised) by the two levels of government are added together and inserted into Equation 1.

Consider first the case of national assignment. The national government's quantity is based on the level of demand in the median state, leading to the following total utility level:[27]

$$U_{TOTAL|NATIONAL\ ASSIGNMENT} = \frac{1+2\,d_H}{4}. \tag{13}$$

Next consider the case of state assignment. Were control over this policy area assigned to the states as sole providers, their provisions would depend on state characteristics as in the unitary government model, yielding a total level of utility across the three states equal to:

$$U_{TOTAL|STATE\ ASSIGNMENT} = \frac{2+d_H^2}{4\,m_S^2}. \tag{14}$$

Finally, for the case of joint provision under intergovernmental political competition, the quantities chosen are as in Equations 11 and 12 above, yielding an overall utility of:

$$U_{TOTAL|COMPETITIVE\ FEDERALISM} = \frac{20\,m_S^2 - 36\,m_S + 4\,d_H^2 + 21 + 8\,d_H\left(2\,m_S^2 - 3\,m_S + 1\right)}{16\,m_S^2}. \tag{15}$$

Comparing these utilities allows an understanding of conditions under which marble cake federalism may be preferred over layer cake federalism. Figure 1 shows the regions over which each of these three assignment regimes produces the best outcome. Boundary conditions between the regions are determined by setting the utility equations equal to one another and solving for m_S.

[Insert Figure 1 about here]

Assignment of policy control to the state governments is preferred for the entire range over which states can provide the good more cheaply ($m_S < m_N = 1$), and even for slightly higher costs given enough heterogeneity across states. In this region, state assignment precludes

national provision, which would be more costly and not responsive to state heterogeneity. Indeed, national assignment is only optimal in the upper left region of the figure, where state heterogeneity is quite low and the national government can provide the good at a lower cost. Finally, the system of competitive federalism is preferred when the national government is a more efficient, lower cost provider, but when there is also substantial variation across states. Here, the national government establishes a baseline level of provision for all states, which it can achieve with fairly low costs. Unlike in the case of national assignment, however, here the states can engage in additional provision beyond the national minimum. Although the states face higher costs, state-level policymakers are able to be more responsive to local conditions than are national policymakers, thus yielding a more desirable pattern of good provision. This illustration can be represented by the following proposition.[28]

Proposition 6: *A system of intergovernmental political competition is preferred over explicit assignment to the state or national government when: (a) the national government is a more efficient provider of the public good, and (b) there is substantial heterogeneity across states.*

Under such circumstances, joint provision occurs with the national government providing some federal baseline level of goods and services, while the various states add their own level of provision on top of national activities. While this model focuses on direct provision of goods, rather than on regulatory federalism, this finding is also consistent with many regulatory policies. For example, in environmental standards or in minimum wages, the national government issues minimum standards at or above which states can set their policies. When the national government is more efficient at setting such standards (because of better information, for

[27] Intermediate calculations are straightforward, and are excluded for space considerations.
[28] This approach and main finding are consistent with Oates (1972), who explores conditions under which federal systems are efficient in their fiscal activities.

example), and when the states are heterogeneous in their policy preferences, such joint regulatory policy is more beneficial than sole state-level or national-level policy determination.

Empirical Implications and Conclusions

Zimmerman (2001) calls for a general theory of federalism that "emphasizes the continuous readjustment of the respective competences of Congress and the states, and explains that relations between the national government and a state and its political subdivisions are not uniform in each state and are affected by a variety of factors" (p. 29). This paper takes a major step toward that goal, by advancing a new model of American federalism based on the concept of political competition among politicians in different levels of government. Properly characterizing the motivations of politicians at various levels of government is crucial to understanding the workings of federal systems. Relying on such explicit characterizations of political motivations, this paper explores state and national government responses to changes in program costs, public demands, and tax efficiency. It characterizes conditions under which the more efficient level of government will take the lead in programmatic spending. And it explains why states react differently to changes in national spending patterns.

The model presented here thus offers a number of normative claims and positive propositions. Normatively, the theory suggests conditions under which clear allocation of authority to the states or to the national government would be preferable to lack of assignment. Where states are able to raise taxes efficiently and to provide specific goods and services at low costs relative to the national government, state assignment is preferred, as it precludes meddling by national politicians. Likewise, where the national government is a more efficient provider and the states are quite homogeneous, national assignment keeps state politicians from becoming

involved in the policy area in a quest for credit. This is consistent with reform proposals to allocate programmatic responsibility to specific levels of government that perform best in particular areas (Rivlin 1992, Peterson 1995). However, the model shows that lack of assignment leading to joint provision is actually desirable when the national government can efficiently set a base standard that heterogeneous states can exceed with their own provision.

In positive terms, the model presented here offers predictions that are relevant comparatively across countries and specifically within American federalism. Proposition 5 predicts a larger public sector in federal systems with joint provision than in unitary systems with single-level provision. This stands in contrast with work focused on horizontal competition predicting that decentralized systems will limit the size of government. For example, Brennan and Buchanan (1980) offer the Leviathan Hypothesis – that when expenditures and taxes are decentralized the size of government will be smaller. Yet the empirical work on the relationship between federalism and/or decentralization and the growth of government has produced quite mixed results, plausibly because vertical intergovernmental competition offsets horizontal competition. Such a possibility points to the benefit of work like Rodden (2003), which separates horizontal competition (degree of decentralization) from vertical pressures (intergovernmental transfers), finding support consistent with both the Leviathan Hypothesis and the model presented here. Future studies breaking down expenditures by policy area and determining the degree of joint provision within those areas would advance our understanding even further.

In the realm of American politics, the model's predictions range from obvious (more spending on highly demanded services that can be provided at low cost) to unexpected (varied state responses to changing national priorities). The latter could be tested with data on national

and state spending, public demands, marginal costs, and tax efficiency. Depending on the policy area, spending data are available from many sources, and public demands could be calculated nationally (and occasionally by state) through surveys about spending priorities. Marginal costs could be calculated by program area, as teacher salaries, construction costs, land values, health care costs, and the like vary substantially across states. And tax efficiency could be calculated through data exploring the tax capacity and tax effort of each state (Berry and Fording 1997). Taken together, a suitable research design would focus on major spending increases or cuts by the national government. If the theory presented here is correct, the state response should be a function of national factors as well as state demands, costs, and tax efficiency, as stipulated in Equation 10. As indicated in that equation, some of these effects will be nonlinear and complicated. Nevertheless, it is important to uncover these relationships if we are to determine the likely effects of changing national spending priorities over time. Moreover, such predicted responses could shed light on which states' representatives in Congress are most likely to support which spending proposals.

In summary, limited constitutional assignment in American federalism creates a complicated system. The political nature of decisions within this system results in legislative federalism tempered by functional federalism. The complex patterns of state and national spending and taxation make sense only in light of these considerations. The model of intergovernmental political competition advanced here thus provides a clearer conceptualization of the marble cake that is American federalism.

Appendix

Unitary Government

Maximizing Equation 2 with respect to q yields the first order condition:

$$d - 2\frac{m^2\, q}{\alpha^2} = 0.$$

Solving for q yields Equation 3:

$$q^* = \frac{d\, \alpha^2}{2\, m^2}.$$

Proof of Proposition 1: Evaluating comparative statics results from this optimal quantity choice yields:

$$(a) \quad \frac{\partial q^*}{\partial m} = \frac{-d\, \alpha^2}{m^3} < 0,$$

$$(b) \quad \frac{\partial q^*}{\partial \alpha} = \frac{d\, \alpha}{m^2} > 0,$$

$$\text{and } (c) \quad \frac{\partial q^*}{\partial d} = \frac{\alpha^2}{2\, m^2} > 0. \blacksquare$$

Two-Level Federalism with a Single State

Solving through backwards induction, we first examine the quantity choice by the state, based upon the given national provision. Thus we examine the maximization of Equation 6 with respect to q_S. The first order condition is:

$$d - \frac{m_S}{\alpha_S}\left(2\frac{m_S\, q_S}{\alpha_S} + \frac{m_N\, q_N}{\alpha_N}\right) = 0.$$

Solving this for the choice of q_S generates:

$$q_S = \frac{\alpha_S\left(d\, \alpha_N\, \alpha_S - m_N\, m_S\, q_N\right)}{2\, m_S^2\, \alpha_N}.$$

(It is useful to note that $q_S = 0$ when $q_N = \frac{d\, \alpha_N\, \alpha_S}{m_N\, m_S}$.)

Taking the next step backward in the analysis, we insert this chosen quantity q_S into Equation 7, yielding the following maximization equation:

$$\max_{q_N} U_N = d\, q_N - \left(\frac{m_N\, q_N}{\alpha_N}\right)\left(\frac{m_N\, q_N}{\alpha_N} + \frac{d\, \alpha_N\, \alpha_S - m_N\, m_S\, q_N}{2\, m_S\, \alpha_N}\right).$$

The first order condition for this maximization is:

$$d - \frac{m_N}{\alpha_N}\left(\frac{m_N\, q_N}{\alpha_N} + \frac{d\, \alpha_S}{2\, m_S}\right) = 0.$$

Solving this for the choice of q_N generates:

$$q_N^* = \frac{d\, \alpha_N\left(2\, m_S\, \alpha_N - m_N\, \alpha_S\right)}{2\, m_N^2\, m_S}.$$

Inserting this optimal choice of national government's quantity back into the state government's quantity choice yields:

$$q_S^* = \frac{d\,\alpha_S\left(3\,m_N\,\alpha_S - 2\,m_S\,\alpha_N\right)}{4\,m_N\,m_S^2}.$$

These choices of quantities are positive under the following conditions.

$$q_N^* > 0 \quad \Leftrightarrow \quad m_S > \frac{m_N\,\alpha_S}{2\,\alpha_N}.$$

$$q_S^* > 0 \quad \Leftrightarrow \quad m_S < \frac{3\,m_N\,\alpha_S}{2\,\alpha_N}.$$

When these conditions are not met, only one level of government provides the good.

For $m_S \geq \frac{2\,m_N\,\alpha_S}{\alpha_N}$, the state policymaker cannot receive a positive utility from joint provision when the national policymaker chooses the optimal quantity derived in the unitary government version of the model: $q_N = \frac{d\,\alpha_N^2}{2\,m_N^2}$. For $\frac{3\,m_N\,\alpha_S}{2\,\alpha_N} \leq m_S < \frac{2\,m_N\,\alpha_S}{\alpha_N}$, however, the state policymaker would receive a positive payoff from joint provision were the national policymaker to select this same quantity. Instead, to hold the state government's provision at zero, and thus to attain its highest utility, the national government selects $q_N = \frac{d\,\alpha_N\,\alpha_S}{m_N\,m_S}$, shown above to hold the state quantity at zero. Finally, for $m_S \leq \frac{m_N\,\alpha_S}{2\,\alpha_N}$, the state government acts as a unitary provider.

Putting these conditions together yields Equations 8 and 9, given in the text.

Proof of Proposition 2: Self evident from Equations 8 and 9.

Proof of Propositions 3 and 4: For the entire range of joint provision, the following comparative statics hold:

$$(a) \quad \frac{\partial q_S^*}{\partial m_S} = \frac{d\,\alpha_S\left(m_S\,\alpha_N - 3\,m_N\,\alpha_S\right)}{2\,m_N\,m_S^3} < 0,$$

$$(b) \quad \frac{\partial q_S^*}{\partial \alpha_S} = \frac{3\,d\,m_N\,\alpha_S - d\,m_S\,\alpha_N}{2\,m_N\,m_S^2} > 0,$$

$$(c) \quad \frac{\partial q_S^*}{\partial d} = \frac{\alpha_S\left(3\,m_N\,\alpha_S - 2\,m_S\,\alpha_N\right)}{4\,m_N\,m_S^2} > 0,$$

$$(d) \quad \frac{\partial q_S^*}{\partial m_N} = \frac{d\,\alpha_N\,\alpha_S}{2\,m_N^2\,m_S} > 0,$$

$$\text{and } (e) \quad \frac{\partial q_S^*}{\partial \alpha_N} = \frac{-d\,\alpha_S}{2\,m_N\,m_S} < 0.$$

Similar comparative statics hold for the national government (here excluded for space considerations).■

Proof of Proposition 5: The total quantity given joint provision is:

$$q = q_N{*} + q_S{*} = \frac{d\,\alpha_N\left(2\,m_S\,\alpha_N - m_N\,\alpha_S\right)}{2\,m_N^2\,m_S} + \frac{d\,\alpha_S\left(3\,m_N\,\alpha_S - 2\,m_S\,\alpha_N\right)}{4\,m_N\,m_S^2} = \frac{d\,\alpha_N^2}{m_N^2} - \frac{d\,\alpha_N\,\alpha_S}{m_N\,m_S} + \frac{3\,d\,\alpha_S^2}{4\,m_S^2}.$$

Compare this quantity to that from unitary state provision, $q_S = \frac{d\,\alpha_S^2}{2\,m_S^2}$.

The quantity chosen under joint provision exceeds that from unitary state provision iff:

$$\frac{d\,\alpha_N^2}{m_N^2} - \frac{d\,\alpha_N\,\alpha_S}{m_N\,m_S} + \frac{3\,d\,\alpha_S^2}{4\,m_S^2} > \frac{d\,\alpha_S^2}{2\,m_S^2}$$

$$\Leftrightarrow \frac{d\left(-2\,m_S\,\alpha_N + m_N\,\alpha_S\right)^2}{4\,m_N^2\,m_S^2} > 0$$

This equation holds for the entire range of joint provision, $\frac{m_N\,\alpha_S}{2\,\alpha_N} < m_S < \frac{3\,m_N\,\alpha_S}{2\,\alpha_N}$.

Now compare to the quantity from unitary national provision, $q_N = \frac{d\,\alpha_N^2}{2\,m_N^2}$.

The quantity chosen under joint provision exceeds that from unitary national provision iff:

$$\frac{d\,\alpha_N^2}{m_N^2} - \frac{d\,\alpha_N\,\alpha_S}{m_N\,m_S} + \frac{3\,d\,\alpha_S^2}{4\,m_S^2} > \frac{d\,\alpha_N^2}{2\,m_N^2}$$

$$\Leftrightarrow \frac{d\left(2\,m_S^2\,\alpha_N^2 - 4\,m_N\,m_S\,\alpha_N\,\alpha_S + 3\,m_N^2\,\alpha_S^2\right)}{4\,m_N^2\,m_S^2} > 0$$

This equation holds for the entire range of joint provision, $\frac{m_N\,\alpha_S}{2\,\alpha_N} < m_S < \frac{3\,m_N\,\alpha_S}{2\,\alpha_N}$.■

Two-Level Federalism with Multiple States

As in the case above, politicians in each state seek to maximize the credit minus blame they receive from providing the good, conditional on the level of national provision. This again yields the quantity choice:

$q_{S_i} = \frac{\alpha_{S_i}\left(d_i\,\alpha_N\,\alpha_{S_i} - m_N\,m_{S_i}\,q_N\right)}{2\,m_{S_i}^2\,\alpha_N}$, where the quantity chosen varies by state based on the states' differing demands (d_i), marginal costs of provision (m_{S_i}), and tax efficiencies (α_{S_i}).

National provision is also found as above, with the optimal choice dependant on the conditions in the median state, denoted S_M. Thus:

$$q_N{*} = \frac{d_M\,\alpha_N\left(2\,m_{S_M}\,\alpha_N - m_N\,\alpha_{S_M}\right)}{2\,m_N^2\,m_{S_M}}.$$

Inserting this optimal choice of national government's quantity back into each state government's quantity choice yields:

$$q_{S_i}{*} = \frac{\alpha_{S_i}\left(2\,d_i\,m_N\,m_{S_M}\,\alpha_{S_i} + d_M\,m_{S_i}\left(m_N\,\alpha_{S_M} - 2\,m_{S_M}\,\alpha_N\right)\right)}{4\,m_N\,m_{S_i}^2\,m_{S_M}},$$

This quantity is positive under the following condition.

$$q_{S_i}{*} > 0 \quad \Leftrightarrow \quad m_{S_i} < \frac{2\,d_i\,m_N\,m_{S_M}\,\alpha_{S_i}}{d_M\left(2\,m_{S_M}\,\alpha_N - m_N\,\alpha_{S_M}\right)}.$$

Assuming states have marginal costs below this level, there is joint provision, with the following comparative statics holding:

$$(a)\quad \frac{\partial q_{S_i}{}^*}{\partial m_{S_i}} = \frac{-\alpha_{S_i}\left(4\, d_i\, m_N\, m_{S_M}\, \alpha_{S_i} + d_M\, m_{S_i}\left(m_N\, \alpha_{S_M} - 2\, m_{S_M}\, \alpha_N\right)\right)}{4\, m_N\, m_{S_i}^3\, m_{S_M}} < 0,$$

$$(b)\quad \frac{\partial q_{S_i}{}^*}{\partial \alpha_{S_i}} = \frac{4\, d_i\, m_N\, m_{S_M}\, \alpha_{S_i} + d_M\, m_{S_i}\left(m_N\, \alpha_{S_M} - 2\, m_{S_M}\, \alpha_N\right)}{4\, m_N\, m_{S_i}^2\, m_{S_M}} > 0,$$

$$(c)\quad \frac{\partial q_{S_i}{}^*}{\partial d_i} = \frac{\alpha_{S_i}^2}{2\, m_{S_i}^2} > 0,$$

$$(d)\quad \frac{\partial q_{S_i}{}^*}{\partial m_N} = \frac{d_M\, \alpha_N\, \alpha_{S_i}}{2\, m_N^2\, m_{S_i}} > 0,$$

$$(e)\quad \frac{\partial q_{S_i}{}^*}{\partial \alpha_N} = \frac{-d_M\, \alpha_{S_i}}{2\, m_N\, m_{S_i}} < 0,$$

$$(f)\quad \frac{\partial q_{S_i}{}^*}{\partial m_{S_M}} = \frac{-d_M\, \alpha_{S_i}\, \alpha_{S_M}}{4\, m_{S_i}\, m_{S_M}^2} < 0,$$

$$(g)\quad \frac{\partial q_{S_i}{}^*}{\partial d_M} = \frac{\alpha_{S_i}\left(m_N\, \alpha_{S_M} - 2\, m_{S_M}\, \alpha_N\right)}{4\, m_N\, m_{S_i}\, m_{S_M}} < 0,$$

$$\textit{and } (h)\quad \frac{\partial q_{S_i}{}^*}{\partial \alpha_{S_M}} = \frac{d_M\, \alpha_{S_i}}{4\, m_{S_i}\, m_{S_M}} > 0.$$

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Figure 1: Optimal Assignment in a Federal System