Federal Fiscal Constitutions: Risk Sharing and Redistribution

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The paper studies the political and economic determinants of regional public transfers. Specifically, it focuses on how such transfers are shaped by alternative fiscal constitutions, where a constitution is an allocation of fiscal instruments across different levels of governments plus a procedure for the collective choice of these instruments. Realistic restrictions on fiscal instruments introduce a trade-off between risk sharing and redistribution. Different constitutions produce very different results. In particular, a federal social insurance scheme, chosen by voting, provides overinsurance, whereas an intergovernmental transfer scheme, chosen by bargaining, provides underinsurance.

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I. Introduction

In virtually every country, the public sector transfers large amounts across regions and localities. Sometimes these transfers emanate from institutions and programs that have been designed precisely for that purpose, such as the intergovernment fiscal equalization schemes that are present in many federal states. Sometimes the regional transfers are instead a by-product of a general government program, such as a centralized and tax-financed social insurance system. Whatever their nature, these interregional transfers are huge and central to the current process of integration in Europe or Germany, as well as to the current process of disintegration in Belgium, Canada, Italy, or the former Soviet Union. In both Italy and Germany, for instance, the overall regional redistribution induced by government policies around 1990 exceeded +60 percent of the poorest regions' gross domestic product and −5 percent of the richest regions' GDP (see Fondazione Agnelli 1992; Bröcker and Raffelhuschen 1993).

Our goal in this paper is to study the political and economic determinants of regional public transfers. We take the notion of a region (or state in a federation) as a primitive entity, given by historical or geographical circumstances. Each region controls a local fiscal policy instrument that redistributes among local residents under regional majority rule. We focus less on these intraregional policy choices than on the way in which alternative fiscal constitutions shape interregional transfers. By a fiscal constitution we mean a set of fiscal instruments, which govern—directly or indirectly—the extent of interregional transfers, as well as a procedure for the collective choice of these fiscal instruments.

In the same vein as much of the public choice literature, we thus ask a positive, not a normative, question. We do believe, however, that many public programs of interregional redistribution also serve an efficiency-enhancing role, namely to enable different regions to share macroeconomic risks. With this motivation, Section II of the paper lays out a stylized model of a federation consisting of two regions. Inhabitants of each region are heterogeneous in that they face different risks of suffering an income loss. Regional outputs are also risky, but perfectly negatively correlated across regions. Therefore, there is no aggregate risk in the federation, and there are obvious opportunities to share the regional risks. The paper focuses on asymmetries between regions, so that the federal risk-sharing program may favor one region over the other.

With a rich enough menu of fiscal instruments, the risk-sharing and redistributive aspects of federal policy can be kept separate even if the regions are different. In this case, which we discuss in Section

III of the paper, everyone agrees that the risk-sharing arrangement should provide full regional insurance, even though there is a natural disagreement over how to redistribute resources across regions.

Separation of risk sharing and redistribution might require that the federal policy be fully contingent on all aggregate states of nature. But full state contingency is difficult or impossible to embody in the laws governing fiscal policy, for the familiar reason that it is hard to foresee and verify all possible contingencies. If regions are very asymmetric, state-contingent policies may be hard to implement for another reason: federal constitutions typically require that residents or firms in different regions be treated equally. This requirement—which protects minorities against exploitation—imposes additional constraints on the instruments of federal fiscal policy. But if federal policy instruments are constrained, residents in the federation face a trade-off between risk sharing and redistribution. They may accept an inefficient risk-sharing arrangement, with over- or underprovision of insurance, if the policy embodies an ex ante redistribution in their favor. The main contribution of this paper is to clarify how this trade-off is resolved in political equilibrium under alternative fiscal constitutions.

Specifically, in Section IV of the paper, we consider a scheme of simple non-state-contingent transfers between regional governments. We prove two results. First, this kind of intergovernment transfer scheme exacerbates interregional conflict, in the sense that no coalition of voters is formed across borders: all voters in the region with a more favorable output distribution want smaller transfers than all voters in the other region. Federation-wide voting is therefore a bad procedure for choosing intergovernment transfers. A more natural procedure is to let representatives of each region bargain over the policy. The second result is that, if autarky is the threat point, a political equilibrium under bargaining entails incomplete insurance. The reason is that this is preferred by the low-risk region, which has more bargaining power.

Section V then goes on to consider a centralized social insurance scheme at the level of the federal government. This system distributes indirectly between regions, and it is superficially equivalent to a simple intergovernment transfer scheme, in the sense that the same interregional allocations are feasible under the two systems. The political incentives are very different, however, and both previous results are reversed. We now see interregional coalitions of voters being formed. And, more important, voting tilts the program in favor of the high-risk region, so that we get overinsurance rather than underinsurance in political equilibrium. Moreover, the greater the asymmetries across regions, the larger the program. The reason is that a large number of voters in the high-risk region want a large federal program because it redistributes in their favor. Against this, a majority of the voters in the low-risk region would like to trim the program down, but under empirically plausible assumptions about the distribution of income risks, the coalition of high-risk voters prevails.

Thus the paper points to an important difference between two alternative federal fiscal constitutions. Interregional transfers can be determined by a federation-wide vote over a centralized social insurance system or by bargaining over intergovernment transfers. When the regions are asymmetric, the former system leads to a larger fiscal program.

These results suggest a number of practical implications for institution design in real-world federations or confederations. Consider, for instance, the ongoing debate on "political union" in Europe. One of the central issues is whether and how to enhance the role of the European Parliament in policy formation. An enhanced role really requires that European Parliament representatives form coalitions across national borders. But giving the European Parliament more authority or more right of initiative over intergovernmental relations and agreements is unlikely to bring this about. The results of Sections IV and V suggest that cross-border coalitions are more likely to arise if the European Parliament has jurisdiction on policies that directly affect individual citizens. That would entail quite a change in the mode of operations of the European Union. In particular, there is a fear that this kind of centralization might lead to a larger-size government. The results of Section V suggest that this fear is well grounded.

The results of this paper also carry implications for single countries that seek more decentralization, such as Italy and Belgium. Italy and, to a lesser extent, Belgium display hugh asymmetries in average per capita income across regions. Politically feasible decentralization has to be accompanied by a system of regional redistribution; otherwise the poorest regions would stand to lose too much. What would be the properties of alternative systems of regional redistribution? Moreover, both countries are also trying to reduce their large budget deficit. Should decentralization wait until the fiscal adjustment has been completed? And if not, which redistribution system is more likely to lead to smaller equilibrium expenditures? The results of Sections IV and V shed some light on these difficult questions. They suggest that decentralization could make the fiscal adjustment politically easier to carry out because it reduces equilibrium redistribution, and hence it should not be postponed. But a mere transfer of authority to lower-level governments may not be sufficient unless it is accompanied by deeper constitutional change. Horizontal redistribution by means of intergovernment transfers requires that decisions over these transfers be delegated to representatives of regional governments. A nationwide vote would lead to sharp regional divisions and would not protect the smaller regions. Hence, the creation of an upper house of regional representatives, like that in most federal structures, may be an essential part of fiscal decentralization.

There is, of course, a large literature on fiscal federalism, a great part of which studies mobility of voters or tax bases. This paper abstracts from mobility, not because we think that it is important, but because it has already received a great deal of attention (see, e.g., Boadway 1982; Wilson 1987; Epple and Romer 1991). There would be more than one way to add an individual choice of location to the model of this paper. Individuals could move ex ante, before knowing their pretax income. Or they could move ex post, once their income is known. In both cases, the mobility choice would add an incentive constraint on the local and the federal governments. It could also create new spillover effects and thus modify the interregional transfers chosen in the political equilibrium.

A more recent group of contributions takes an approach similar to the approach in this paper, focusing on the political consequences of instrument assignment to different levels of government and of the procedures for collective choice.[1] The closest antecedent is Persson and Tabellini (1996), which uses a similar model to analyze the normative problem of how to design a federal constitution so as to resolve the trade-off between interregional risk sharing and moral hazard of local governments. Casella (1992) studies the economic and political integration of two asymmetric regions, each populated by heterogeneous individuals, but focuses on public-goods provision. Perotti (1993) and Persson and Tabellini (1994) investigate how centralization of government programs changes their equilibrium size, but neither paper studies social insurance or risk sharing between regions. Finally, Buchanan and Faith (1987) and Bolton and Roland (1995) address issues of regional redistribution in purely redistributive models, where the threat of secession imposes a binding constraint on federal policy.

II. The Model

A. *The Basic Model*

Consider a federation that includes two regions of equal population size. We describe the home region first. Individuals are risk averse;

[1] See, in particular, Inman and Fitts (1990), Inman and Rubinfeld (1992), and Weingast (1993). An early analysis of insurance arrangements among collective bodies appears in Wilson (1968).

they all have the same preferences for consumption, captured by a concave utility function $U(\cdot)$. They live only one period and are indexed by i. Their income is one with probability p^i and zero with probability $1 - p^i$. Individuals with income are called "employed"; those with no income, "unemployed." Individual income is not verifiable, which means that individuals cannot self-insure through the market. This strong assumption has two advantages. First, it provides a potential role for a public policy of risk sharing. Second, it enables us to compare different policy environments on the basis of individual welfare, while retaining simplicity and tractability.[2]

Individuals are exposed to aggregate as well as idiosyncratic risk. Moreover, individuals differ in their idiosyncratic risk: some individuals are exposed to more risk than others. This assumption makes the political equilibria nontrivial, in the sense that individuals differ over their preferred policy.

Specifically, we assume that $p^i = p\pi^i$, where π^i is distributed in the population according to a known distribution $G(\pi^i)$. Furthermore, we make the following assumption.

ASSUMPTION 1. The distribution $G(\pi^i)$ has a mean value of one but is skewed to the left, such that the median value $\pi^m > 1$ and such that $G(\pi^m + \Delta) - 1/2 > 1/2 - G(\pi^m - \Delta)$ for any positive Δ.

By the law of large numbers, p is the fraction of employed individuals in the population, and hence p also denotes average income. The assumption that π^i is skewed to the left is realistic. It implies that the unemployment risk is concentrated in a relatively small number of individuals in the population.

To allow for aggregate risk in a simple way, we assume that p can take only two values: $p = \gamma$ with probability Q and $p = \beta$ with probability $1 - Q$, with $\gamma > \beta$. Hence, γ denotes the good aggregate state in the home region, and β denotes the bad aggregate state.

We assume away all aggregate risk in the federation by taking the regional shocks to be perfectly negatively correlated. So the probability of being in the good aggregate state in the foreign region is $Q^* = 1 - Q$. But in all other respects the two regions are symmetric. In particular, the two regions have the same values for γ and β, the same preferences, and the same distribution $G(\cdot)$ of individual risks. Thus aggregate output is always equal to $\gamma + \beta$ and is distributed

[2] It would be more convincing to base the market failure in private insurance on adverse selection (p^i in the model unobservable) or moral hazard (some private action affecting the probability p^i unobservable), rather than on prohibitively costly state verification. The major argument for the present formulation is convenience: with imperfect private insurance, we would have to keep track of an endogenous private contract equilibrium and its interaction with fiscal policy across different federal constitutions.

according to $p = \gamma$ and $p^* = \beta$ with probability Q; $p = \beta$ and $p^* = \gamma$ with probability $1 - Q$, with an asterisk denoting the foreign region. The results of the paper also hold if average regional incomes are imperfectly negatively correlated, although their derivation is more complicated.[3]

In this setup there is clearly scope for risk sharing across regions. In our stark formulation of the model, there are no private markets that can serve this function. The formulation is motivated by plausibility and simplicity. It is a well-known fact that private international risk sharing is far from perfect: domestic portfolios have a much greater share of domestic securities, and domestic consumption shows a far greater correlation with income than standard models of risk sharing suggest. Our formulation should therefore be viewed as a simplified version of a more complicated model, where some, but not all, domestic risk could be diversified away via private markets. Note, however, that private contingent contracts among residents of different regions could undo some of the effects of government policies. In a simple economy like this, with no distorting taxation, unrestricted private financial arrangements are likely to result in neutrality of public financial policies.

Policies are chosen before the state of nature is revealed. There are two policies: one regional, the other federal. Throughout the paper the *regional* policy always consists of a "social insurance" program, chosen under majority rule by the residents of each region. This regional policy is contingent on the state of nature and redistributes among individuals of that region. Redistribution is achieved by means of an *output* tax (subsidy), accompanied by a lump-sum transfer (tax) to every individual, and thus it has only limited informational requirements. In particular, it is *not* necessary for the regional government to observe nonverifiable individual income. In this way, the regional government chooses an allocation of consumption between the employed and unemployed individuals, $c(p, p^*)$ and $b(p, p^*)$, re-

[3] We have considered the case in which $p = \gamma$ with probability Q and $p = \beta$ with probability $1 - Q$, and likewise $p^* = \gamma$ with probability Q^* and $p^* = \beta$ with probability $1 - Q^*$, for arbitrary probabilities Q and Q^*. Thus the distribution of aggregate output becomes

$$Y(p, p^*) = \begin{cases} 2\gamma & \text{with probability } Q \cdot Q^* \\ \gamma + \beta & \text{with probability } Q \cdot (1 - Q^*) \\ \beta + \gamma & \text{with probability } (1 - Q) \cdot Q^* \\ 2\beta & \text{with probability } (1 - Q)(1 - Q^*). \end{cases}$$

Regions are asymmetric if $Q \neq Q^*$. Propositions 1–6 below hold identically for this case as well. Proposition 7 also holds, but in a neighborhood of $Q = Q^* = 1/2$ and provided that the utility function $U(\cdot)$ is sufficiently concave. The proofs for this more general case are available from the authors on request.

spectively, contingent on the realization of the state of the world, p, p^*.[4]

Regional policy is always set under direct democracy, that is, by a vote of the regional residents. In Sections III and IV, strategic aspects play a role, and it matters whether individuals vote on the output tax rate or on the size of lump-sum transfers. Throughout the paper we assume that they vote on the latter. That is, the regional policy fixes the (state-contingent) "replacement rate" of the local unemployment insurance system, and the (state-contingent) tax rate is residually determined by the budget constraint. This assumption resembles how policies are set in the real world. We discuss how the results would be affected by alternative assumptions below (see nn. 7 and 9).

In the paper we consider alternative *federal* policy instruments. Their economic role is to share risks and possibly to redistribute income across the two regions. We investigate how the political equilibria differ under alternative policy instruments and under alternative procedures for choosing them. To preserve comparability of these alternative instrument assignments, we assume the same timing of events throughout the paper: the regional and the federal governments always move simultaneously. Thus the federal fiscal constitutions considered in this paper differ in terms of instrument assignments to government levels (i.e., of centralization of policies) and in terms of collective choice procedures (voting vs. bargaining), but not in terms of commitment capacity. The role of federal precommitment is studied in Persson and Tabellini (1996), albeit in a somewhat different context.

Whatever the federal policy instrument, the resource constraint of the home region can be written as

$$pc(p, p^*) + (1 - p)b(p, p^*) = p - \frac{\tau(p - p^*)}{2} + \kappa. \tag{1}$$

The left-hand side denotes the consumption of the employed and unemployed; there are p employed and $1 - p$ unemployed. The right-hand side denotes average per capita income, p, plus the transfer from the other region. Thus τ is the proportion of the difference in regional income that is transferred across the two regions and is determined by the federal policy. And κ is a lump-sum transfer,

[4] For instance, we could assume that the government does not observe individuals' employment status, but does observe firms' output. Note also that $c(\cdot)$ and $b(\cdot)$ are allowed to depend on the state in both regions, not just at home. As will become clear below, the reason is that the federal arrangement can bring about transfers across regions, whose size depends on both p and p^*.

unrelated to the state of the world, that can be thought of as an insurance premium. Together, these two federal instruments, τ and κ, can achieve any state-contingent allocation of income across the two regions. The resource constraint for the foreign region is analogous to (1), except that the terms in τ and κ have the reverse sign.

Even though the regional resource constraint is given by (1) irrespective of the federal policy regime, the interpretation of τ and κ depends on the exact nature of the federal policy. In Section III, we study interregional risk sharing via a system of unrestricted intergovernment transfers. In Section IV, the intergovernment transfer scheme is operated under the constraint $\kappa = 0$. In Section V, finally, we study a system of federal social insurance. In that system, equation (1) with $\kappa = 0$ still holds, but τ represents an output tax that finances transfers to individuals rather than to governments.

In other words, different federal arrangements for sharing regional risks lead to the same form of regional resource constraint. Given the simplicity of the underlying model, these arrangements are thus *economically* equivalent, in the sense that they can implement the same allocations. This equivalence is only superficial, however: it neglects the difference in the incentive constraints perceived by the voters or federal policy makers in different *political* regimes. As the paper will show, different procedures for collectively choosing the federal policy instruments lead to very different equilibrium allocations.

B. *Regional Social Insurance*

It is easy to characterize the *regional* social insurance policies chosen in a political equilibrium (see also Persson and Tabellini 1996). The voters' preferences—their expected utility function—in the home region can be written as

$$v^i = QV^i(\gamma, \beta) + (1 - Q)V^i(\beta, \gamma), \tag{2}$$

where $V^i(p, p^*)$ is the expected utility of the ith voter in state (p, p^*):

$$V^i(p, p^*) = p^i U(c(p, p^*)) + (1 - p^i) U(b(p, p^*)). \tag{3}$$

The only source of heterogeneity among voters is the parameter π^i that enters linearly in the voters' preferences. It is then easy to show that the median-voter result applies despite the multidimensional issue space (see Persson and Tabellini 1996). The regional political equilibrium is the policy preferred by the median voter, namely the individual with the median value of π, π^m. The equilibrium regional policy can then be computed by maximizing the median-voter expected utility function (defined as in [2] and [3]), subject to the resource constraint (1) and for a given federal policy (τ, κ). The choice variable is the replacement rate or, equivalently and more simply, the function $b(p, p^*)$. The first-order condition characterizing the solution to the median-voter optimum problem can be written as

$$\frac{U_c(c(p, p^*))}{U_c(b(p, p^*))} = \frac{p}{1-p}\frac{1-p^m}{p^m}, \tag{4}$$

where a subscript denotes a derivative. To pin down both c and b, we of course also need the budget constraint (1). Since by assumption $p^m \geq p$, the equilibrium policy satisfies $c \geq b$ for all p, p^*. That is, a majority of the voters prefer incomplete risk sharing across individuals, even though full risk sharing through the government would be feasible at no loss of efficiency. The reason is that individual risk is concentrated in a few "high-risk" subjects.[5] More generally, the smaller p^m (i.e., the closer π^m is to one), the more generous equilibrium social insurance is. The equilibrium social insurance in the foreign region is completely analogous.

As will be shown in the subsequent sections, changing the federal fiscal constitution does not change the domestic optimization problem faced by the regional median voters in any relevant respects. The reason is that under the assumed simultaneous timing, the regional policy maker always takes the federal policy as given. Throughout the paper, thus, equation (4) continues to hold and characterize the regional social insurance and the allocation of consumption between employed and unemployed individuals in both regions.

III. State-Contingent Intergovernment Transfers

The simplest risk-sharing arrangement between the two regions is a direct state-contingent transfer from one regional government to the other. As explained in the previous section, this corresponds to a combination of federal instruments τ and κ on the right-hand side of equation (1). What are the features of efficient transfers? What particular efficient transfer is selected if the two countries bargain with each other, with autarky as the threat point? And how does this bargaining outcome compare to an actuarially fair insurance system when the two regions differ from each other in the probability Q? These are the questions addressed in this section, to provide a normative benchmark for the more positive analysis that follows.

[5] See Wright (1986) for a related result on unemployment insurance.

A. *Efficient State-Contingent Transfers*

The set of efficient transfers is a pair (τ, κ) that maximizes the following social welfare function:

$$\int_{\pi^i} (\lambda^i v^i + \delta\lambda^i v^{*i})\, dG(\pi^i), \tag{5}$$

where λ^i is an individual-specific weight and δ is the relative weight on the foreign region; we have relied on the assumption that the regional distribution of π is the same in the two regions. Naturally, efficiency here is subject to the constraint of a given regional social insurance policy.

Let us denote by $c^m(p, p^*)$, $c^{*m}(p, p^*)$ and $b^m(p, p^*)$, $b^{*m}(p, p^*)$ the consumption of the employed and unemployed individuals in the home and foreign regions in state (p, p^*) and given the regional medians $\pi^m = \pi^{*m}$. Under the assumed timing, the regional replacement rate is taken as given when the federal policy is determined. Thus c^m and c^{*m} are perceived to change one for one with the extra resources accruing to the regional government, but instead b^m and b^{*m} are taken as given and are unaffected at the margin by the federal policy.

Finally, and for future reference, let τ^S be the value of τ that achieves full consumption smoothing of the employed individuals; that is, when $\tau = \tau^S$, $c^m(\gamma, \beta) = c^m(\beta, \gamma) = c$, and $c^{*m}(\gamma, \beta) = c^{*m}(\beta, \gamma) = c^*$. Note that τ^S will in general not equal one. Full consumption smoothing of the employed does not require full income equalization across the two regions because the number of employed individuals differs.

The following proposition proves that efficient allocations always achieve full interregional insurance. But consumption is equalized across regions if and only if the two regions receive equal weighting in the social welfare function ($\delta = 1$).

PROPOSITION 1. For any individual weighting λ^i, an efficient federal policy sets $\tau = \tau^S$ and $\kappa = K(\delta)$, with $K(1) = 0$ and $K_\delta < 0$.

To prove this proposition, simply take the first-order conditions for the problem of maximizing (5) with respect to τ and κ, subject to (1)–(3). After some rewriting, one obtains[6]

[6] Under the assumed timing,

$$\frac{\partial v^i}{\partial \tau} = \frac{\pi^i(\gamma - \beta)[QU_c(c^m(\gamma, \beta)) - (1 - Q)U_c(c^m(\beta, \gamma))]}{2}$$

and

$$\frac{\partial v^i}{\partial \kappa} = \pi^i[QU_c(c^m(\gamma, \beta)) + (1 - Q)U_c(c^m(\beta, \gamma))].$$

$$\frac{U_c(c^m(\gamma,\beta))}{U_c(c^m(\beta,\gamma))} = \frac{U_c(c^{*m}(\gamma,\beta))}{U_c(c^{*m}(\beta,\gamma))} \tag{6a}$$

and

$$\frac{U_c(c^m(\gamma,\beta))}{U_c(c^{*m}(\gamma,\beta))} = \delta. \tag{6b}$$

Equation (6a) characterizes the allocation of consumption across states in both regions. Clearly, it does not depend on the individual weights λ^i. Since there is no aggregate risk in the federation as a whole, the resource constraint for the whole federation is satisfied only if both sides of (6a) are equal to one, that is, only if there is full consumption smoothing across the two states of the world within each region. Equation (6b) describes the allocation of consumption across regions. Clearly, the home and foreign regions consume in equal amounts only if $\delta = 1$, and more generally, the home region consumes more relative to the foreign one the smaller the relative weight δ. Hence κ is set as stated in the proposition, and the function $K(\cdot)$ is defined implicitly by (6). Q.E.D.

Proposition 1 is quite intuitive. Since there is no aggregate risk in the federation and given that, at the margin, intergovernment transfers affect consumption of only the employed, every federal voter agrees that it is optimal to equalize consumption across aggregate states.[7] There is, however, a conflict over the interregional allocation of resources. Since both regions have the same social insurance policy, determined by the same median voter π^m, every individual in the home region evaluates this regional conflict in the same way, and likewise in the foreign region. Hence, the efficient allocation of consumption across regions reflects only the relative weight parameter δ, and not the individual weights. Finally, it is important to note that efficient policies do not depend on Q and Q^*. Given δ, asymmetries in the stochastic distribution of output across the two regions are not reflected in the efficient federal policy.

[7] Unanimity thus depends on the assumption that the regional vote fixes the replacement rate. If the regional vote is instead on the tax rate and the replacement rate is residually determined, then the intergovernment transfer is allocated among both employed and unemployed individuals. Individuals with different employment risks would then generally evaluate the federal policy differently, and unanimity would be lost. For the regional median voters, this issue does not arise. Since they are really in charge of the regional policy, they agree that $\tau = \tau^S$ is optimal, irrespective of which instrument is being voted on at the regional level.

B. Nash Bargaining

What point on the Pareto frontier is likely to be selected? The answer depends on the procedures for determining the federal policy. A natural case is the one in which the two regions bargain with each other, with autarky as the threat point.[8] This subsection then characterizes the Nash bargaining solution for this game. For simplicity, we assume that bargaining takes place between the two regional medians.[9] Since Nash bargaining picks a point on the Pareto frontier, we continue to have $\tau = \tau^S$ and $\kappa = K(\delta)$. The question is what value of δ, say δ^N, corresponds to the Nash bargaining outcome. The following proposition states that the low-risk (high-Q) region has more bargaining power.

PROPOSITION 2. The Nash bargaining solution with unrestricted intergovernment transfers implies that δ^N is decreasing in Q and that $\delta^N \gtreqless 1$ as $Q \lesseqgtr Q^*$.

For the proof, first of all note that the Nash bargaining outcome is the point on the Pareto frontier that maximizes $(v^m - \bar{v}^m)(v^{*m} - \bar{v}^{*m})$. The terms $\bar{v}^m$ and $\bar{v}^{*m}$ denote the expected utilities in autarky of the home and foreign medians, respectively. The solution to this optimization problem gives

$$\delta^N = \frac{v^m - \bar{v}^m}{v^{*m} - \bar{v}^{*m}}. \tag{7}$$

From proposition 1, we know that

$$\begin{aligned} c^m(\gamma, \beta) &= c^m(\beta, \gamma) = c, \\ c^{*m}(\gamma, \beta) &= c^{*m}(\beta, \gamma) = c^*. \end{aligned} \tag{8}$$

Moreover, by the resource constraint for the federation as a whole, $c^* = C^*(c)$, with $C^*_c < 0$. Let $J^m(c)$ be the indirect utility function of

[8] This is the natural threat point for regions that are considering whether to form a union, as the European countries now. For regions in countries that are reconsidering their fiscal arrangement, such as Germany, Canada, or Italy, the threat point could be very different depending on the status quo and the form of the constitution.

[9] This assumption does involve some loss of generality, since both regions have an incentive to increase their bargaining power by delegating the bargaining to a "tough" representative, namely one who does not suffer much in autarky. This issue of strategic delegation is already well understood (cf. Persson and Tabellini 1996) and is not central to our analysis. Therefore, we choose to neglect it. Note, however, that dealing adequately with it would not raise any indeterminacy of equilibrium in this model, since the distribution of possible agent types has bounded support. Finally, since the individuals who bargain are the same as those who set the regional policy, the assumption of what is being voted on at the regional level (whether tax rates or lump-sum transfers) becomes irrelevant. See also n. 7 above.

the home-region median voter when $c(p, p^*) = c$ and $b(p, p^*)$ is given by the domestic social insurance condition (4). Similarly, let $A^m(p)$ be indirect utility in state p under autarky, namely the (c, b) allocation that maximizes $p^m U(c) + (1 - p^m) U(b)$ subject to (1), with the right-hand side equal to p. Using the definitions of v^m and $\bar{v}^m$ and (6b) to replace δ^N, we can rewrite (7) as

$$\frac{U_c(c)}{U_c(C^*(c))} = \frac{J^m(c) - QA^m(\gamma) - (1 - Q)A^m(\beta)}{J^m(C^*(c)) - QA^m(\beta) - (1 - Q)A^m(\gamma)}. \tag{9}$$

When $Q = 1/2 = Q^*$, equation (9) is satisfied for $c^* = c$, and both sides (and hence also δ^N) are equal to one. Moreover, the left-hand side of (9) is decreasing in c, whereas the right-hand side is increasing in c and decreasing in Q. Thus $c \gtreqless c^*$ as $Q \gtreqless 1/2$, and the inequalities get stronger as the distance $|Q - 1/2|$ increases. This, together with (6b) and the fact that $Q^* = 1 - Q$, completes the proof. Q.E.D.

Combining propositions 1 and 2, we obtain a very intuitive result. In a Nash bargaining equilibrium, the two regions achieve full insurance. But the high-risk (low-Q) region pays a lump-sum transfer $K(\delta)$ to the low-risk region, as compensation for its higher risk. The larger the asymmetry between the two regions, the larger this compensation is.

Thus a Nash bargaining equilibrium has the same qualitative feature as an actuarially fair insurance system, in that the high-risk country pays a premium to the low-risk country. An actuarially fair system would set κ so that the expected value of the transfers across regions is zero. This would imply that $\kappa = \tau^S(\gamma - \beta)(Q - 1/2)/2$. But the premium under Nash bargaining can be larger or smaller than the actuarially fair premium, depending on the curvature of the utility function. The reason is that the bargaining power of a region depends on its welfare in autarky versus its welfare when insured. And that relation depends on the degree of risk aversion of the regional median voters at different levels of income.

C. *Voting*

What would happen if the intergovernment transfers were instead chosen by a federation-wide vote? Without any formal argument, it is clear that this would be a bad mechanism for selecting the intergovernment transfers. The reason is that the policy preferences of all voters in the home region are in stark conflict with the policy preferences of all voters in the foreign region. Deciding noncooperatively on the desired transfers, every home-region voter wants to drive κ to its uppermost corner, and every foreign-region voter wants to drive

κ to its lowermost corner. Some restrictions on the redistributive component in the risk-sharing scheme, or some modifications of the principle of simple majority, are thus necessary to make a voting mechanism viable without one region ending up completely exploited by the other.

IV. Simple Intergovernment Transfers

Suppose that the intergovernment transfer scheme is indeed restricted so that only some interregional income allocations across states of the world can be implemented. Actual intergovernment transfer schemes in existing federations, such as Canada and Germany, do in fact rely on preset formulas, which allocate equalization grants across regions according to the relation between regional and average tax bases or incomes.

In our model, a natural restriction is to set the lump-sum component κ in the regional resource constraints equal to zero. With this constraint, the output tax and transfer to each regional government are state-independent and equal across regions. As a result, risk sharing and redistribution become intertwined and cannot be separated as in the previous section. This section shows that such asymmetries lead to sharp interregional disagreement over the extent of risk sharing. Moreover, the equilibrium with bargaining typically exhibits incomplete insurance, the more so the greater the asymmetries. We maintain the assumption that the regional social insurance policy is determined by a vote over the replacement rate and that the regional vote occurs simultaneously with the determination of the federal policy.

A. Voting

To start, suppose that the transfer is chosen under majority rule in a federation-wide vote. Thus all voters simultaneously cast two ballots: one over the federal policy, the other over the regional policy. The federal vote determines the intergovernment transfer rate τ; here citizens of both regions participate in the vote. The regional vote determines the replacement rate; here only regional residents participate in the vote. The regional voting equilibrium is as in the previous sections: a replacement rate that allocates consumption of employed and unemployed individuals according to (4) in each region, given the equilibrium federal policy. This policy is defined as follows.

DEFINITION 1. The equilibrium restricted intergovernment transfer under voting is a value of τ that is preferred to any other value by a majority of the voters in the two regions combined, given the equilibrium replacement rates.

Consider the preferences of an arbitrary federal voter π^f in the home region. The optimal value of τ for this voter maximizes her expected utility function (2) subject to (1), with $\kappa = 0$ and given the equilibrium replacement rate in each region. As in the previous section, under the assumed timing, intergovernment transfers reshuffle consumption among employed individuals only. Consumption of the unemployed is determined by the replacement rate. The first-order condition corresponding to this optimization problem is

$$\frac{\pi^f(\gamma - \beta)[-QU_c(c^m(\gamma, \beta)) + (1 - Q)U_c(c^m(\beta, \gamma))]}{2} = 0. \qquad (10)$$

Notice that the term within brackets is the same for all voters, independently of their π^f. Thus all home-region voters agree that the optimal value of τ should satisfy

$$\frac{Q}{1 - Q}\frac{U_c(c^m(\gamma, \beta))}{U_c(c^m(\beta, \gamma))} = 1. \qquad (11)$$

The intuitive reason for this agreement is that the consumption allocation across employed and unemployed individuals is decided by the domestic pivotal voter π^m, who sets the replacement rate. The value of τ affects only the distribution of *aggregate* income across states, which all voters in the home region agree on.

To interpret (11), notice that when $\kappa = 0$, the rate at which income *can* be transferred across the two states of nature with a direct intergovernment transfer is equal to unity. The left-hand side measures the marginal rate at which the individual voters *wish* to transfer income across the two aggregate states: their marginal rate of substitution between income in the two states. At the voter optimum, these two rates must be equal. Clearly, home voters' marginal rate of substitution is decreasing in τ: a large value of τ shifts income from state (γ, β) to state (β, γ), leading to more consumption in the former state. By (11), under the restricted transfer scheme, voters want full consumption smoothing only when $Q = Q^* = 1/2$. Otherwise, they want to tilt consumption toward the state that is more likely to occur. Thus the more favorable the aggregate distribution of output in the home region (the higher Q), the less voters in the home region want to insure (the lower their preferred τ).

What about the voters in the foreign region? Going through the same steps and recalling that $Q^* = 1 - Q$, one obtains that foreign voters also want to set their marginal rate of substitution between income in the two states equal to unity. The only difference is that, for any foreign voter, the analogous expression is

$$\frac{1-Q}{Q}\frac{U_c(c^{*m}(\beta,\gamma))}{U_c(c^{*m}(\gamma,\beta))}=1. \tag{12}$$

Foreign voters are thus also unanimous in their desired value for τ. As in (11), the left-hand side of (12) is decreasing in τ. The reason is that a higher value of τ shifts income from the foreign high-income state (β, γ) to the foreign low-income state (γ, β). But in (12), in contrast to (11), the left-hand side is decreasing in Q. A higher Q therefore entails a preference for a higher τ by residents in the foreign region.

We are now ready to prove some simple but important results.

PROPOSITION 3. Under voting over simple intergovernment transfers, there is unanimity within each region. Unless $Q = Q^*$, there is disagreement in the federation; the disagreement is increasing in the distance $|Q - Q^*|$. The higher Q is, the lower the desired value of τ in the home region; the reverse holds in the foreign region.

We have already proved unanimity within each region. The proof of the remainder is very simple once we note that the resource constraints and the domestic social insurance conditions with identical medians $p^m = p^{*m}$ imply that $c^m(\gamma, \beta) = c^{*m}(\beta, \gamma)$ and $c^{*m}(\gamma, \beta) = c^m(\beta, \gamma)$. That is, consumption of employed individuals in the good aggregate state must be equal in the two regions. Thus we can rewrite (12) as

$$\frac{1-Q}{Q}\frac{U_c(c^{m}(\gamma,\beta))}{U_c(c^{m}(\beta,\gamma))}=1. \tag{13}$$

It follows immediately from (11), (13), and $Q^* = 1 - Q$ that home and foreign voters prefer the same value of τ only if $Q = \frac{1}{2} = Q^*$. If not, the discrepancy between their desired solutions is larger, the larger the distance $|Q - Q^*|$. Moreover, the left-hand sides of (11) and (13) are both decreasing in Q. Hence, a higher value of Q leads to a preference for a lower τ in the home region but a higher τ in the foreign region. Q.E.D.

In summary, if $Q > Q^*$, the restricted intergovernment transfer scheme makes the home region more likely to pay a transfer to the other region. Hence, it wants less risk sharing. Exactly the reverse is true for the foreign region. What is perhaps more striking is the unanimity within each region, even though the voters are heterogeneous. This suggests that voting in the federation is still a very poor procedure for choosing the size of direct intergovernment transfers. The nature of the policy instrument, even when restricted, exacerbates interregional conflict, since it emphasizes the redistributive implications of asymmetries between regions. No coalition of voters is formed across borders, and the largest region wins. A more natural way of choosing the size of intergovernment transfers is instead bargaining between representatives of each region.

B. *Nash Bargaining*

Suppose that the size of the restricted intergovernment transfer is determined by a bargaining process. We assume, as in Section III, that the bargaining takes place between the median voters in the two regions.

DEFINITION 2. A political equilibrium with restricted intergovernment transfers under bargaining is given by the Nash bargaining solution for the home and foreign median voters, with autarky as the threat point.

Let τ^N be the Nash equilibrium value of τ. We then have the following result.

PROPOSITION 4. With the restriction $\kappa = 0$, $\tau^N = \tau^S$ if $Q = Q^*$, but $\tau^N < \tau^S$ if $Q \neq Q^*$; and with τ^N smaller, the larger the distance $|Q - Q^*|$.

The proof is contained in Appendix A.

Proposition 4 relies on the same kind of intuition as proposition 3. The region with a more favorable distribution of output has more bargaining power because autarky is less harmful for it. But here the bargaining occurs over the extent of insurance, τ, not over the insurance premium κ. When the risk-sharing scheme is restricted to the parameter τ, the low-risk region wants a smaller value because, on average, it ends up paying rather than receiving. Therefore, the more different the regions, the smaller the Nash bargaining equilibrium level of risk sharing. Thus the trade-off between risk sharing and redistribution plays a key role in the argument.

V. Federal Social Insurance

An alternative risk-sharing arrangement is to centralize social insurance at the level of the federal government. A centralized social insurance system indirectly redistributes across regions by collecting more taxes in the rich region than in the poor. In existing federations, centralized fiscal programs typically operate under the constraint that individuals and firms in different regions be treated equally. A simple way to capture this restriction in our model is to assume that the federal social insurance scheme is non-state-contingent.[10]

[10] In our simple model, with only two aggregate states and perfectly negatively correlated shocks, a centralized social insurance scheme with state-contingent taxes and

This restriction creates a trade-off between risk sharing and redistribution similar to the one in the previous section. In fact, federal social insurance under this restriction turns out to be *economically* equivalent to the previous system with restricted intergovernment transfers, in the sense that any allocation reached with intergovernment transfers can also be reproduced by federal social insurance. The coalitions of voters that are formed under the two systems are very different, however, and hence the equilibrium allocations also differ. We now turn to an investigation of the nature of these political differences.

Individual income and preferences are the same as in the previous sections. Now, however, both the local and federal governments levy output taxes to finance lump-sum payments to individuals. Thus there is social insurance at both levels of government. As explained above, we assume that the federal tax rate is not state-contingent and the federal transfer to individuals is residually determined. To facilitate comparisons with our previous results, the local tax rate, on the other hand, is state-contingent, and so is the associated local replacement rate. We continue to assume simultaneous policy making. There are no intergovernment transfers.

It is easy to show that under these assumptions, consumption of the employed and unemployed individuals in the home region can be written as

$$\begin{aligned} c(p,p^*) &= 1 - t(p,p^*)(1-p) - \tau(1-\hat{p}), \\ b(p,p^*) &= t(p,p^*)p + \tau\hat{p}, \end{aligned} \tag{14}$$

where t and τ denote the local and federal tax rates, respectively, and $\hat{p} \equiv (\gamma + \beta)/2$ is average income in the federation. The foreign region is analogous in all respects. Besides (14), both levels of government are subject to constraints on t and τ that correspond to nonnegativity constraints on c and b. Throughout the section we consider only interior equilibria in which these corner constraints are not binding. This amounts to assuming that the $U(\cdot)$ function has sufficient concavity as consumption approaches zero.

What is the equilibrium in this setup? That turns out to depend on the procedure for choosing the federal policy.

payments would treat *individuals* in the two regions differently, in the sense that their expected net payments would depend on the probability of a bad shock in the region in which they reside, even though the state-dependent tax rates would be equal across regions. As in Sec. III, two policy instruments would be enough to span the two-dimensional state space and hence effectively separate risk sharing from redistribution. However, in a less stylized world, spanning by fully state-contingent policy instruments would be much harder to achieve, particularly under a constraint of equal treatment across regions.

A. *Nash Bargaining*

With Nash bargaining the nature of the federal policy instrument is irrelevant.

PROPOSITION 5. If the federal tax rate is set under Nash bargaining by the two regional medians, the equilibrium with federal social insurance is identical to the equilibrium with intergovernment transfers described in proposition 4.

The proof is contained in the discussion above. Combining the two equations in (14), we obtain the resource constraint (1) with $\kappa = 0$, where τ now denotes the same federal tax rate that enters (14). That is, the regions' resource constraints are identical to what they are in a system with intergovernment transfers. As the regional medians not only have the same threat points but also perceive exactly the same constraints as with a system of intergovernment transfers, the Nash bargaining outcome is the same. Q.E.D.

B. *Voting*

The equivalence is broken if federal social insurance is instead chosen by a majority vote. The reason is that the equilibrium outcome now depends on the voters' coalitions. And with federal social insurance, voters form different coalitions than under a system of intergovernment transfers. To address this issue we investigate a political equilibrium, defined as follows.

DEFINITION 3. Federal and regional policies are chosen simultaneously under majority rule. Equilibrium federal policy is a value of τ preferred to any other by a majority of federal voters, given the equilibrium regional tax rate (or replacement rate) in both regions.

The equilibrium regional policy is analogously defined, except that the quorum is now made up of residents of that region only. Note that here it does not matter whether the regional vote is taken over the tax rates or the replacement rates. The reason is that the federal policy now deals directly with the individuals. Therefore, at the margin, its allocative effects do not depend on the local policy setting.

Consider domestic voter π^f. Her preferred federal tax rate is obtained by taking the first-order condition of her expected utility function with respect to τ, subject to (14) and given the regional tax rate t:

$$\begin{aligned} Q&\left[-\gamma^f U_c(c(\gamma,\beta))\left(1-\frac{\beta+\gamma}{2}\right)+(1-\gamma^f)U_c(b(\gamma,\beta))\frac{\beta+\gamma}{2}\right] \\ &+(1-Q)\left[-\beta^f U_c(c(\beta,\gamma))\left(1-\frac{\beta+\gamma}{2}\right)\right. \\ &\left.+(1-\beta^f)U_c(b(\beta,\gamma))\frac{\beta+\gamma}{2}\right]=0. \end{aligned} \tag{15}$$

A similar condition holds for the foreign voter π^{*f}. In an interior equilibrium, regional social insurance must continue to satisfy (4). Combining (4) and (15), we see that an interior optimum defines the preferred tax rate for domestic voter π^f implicitly by

$$QU_c(c^m(\gamma, \beta))F^m(\gamma, \pi^f) + (1 - Q)U_c(c^m(\beta, \gamma))F^m(\beta, \pi^f) = 0, \quad (16)$$

where $F^m(p, \pi^f) \equiv -(\pi^f/\pi^m)p\{1 - [(\beta + \gamma)/2]\} + [(\beta + \gamma)(1 - p)(1 - p\pi^f)/2(1 - p\pi^m)]$, $p = \gamma, \beta$, and it is understood that $c^m(p, p^*)$ is a function of τ through the resource constraint.

In equilibrium, however, not every voter π^f is at an interior optimum. In a neighborhood of $\pi^f = \pi^m$, we do have an interior optimum since $F^m(\gamma, \pi^m) < 0 < F^m(\beta, \pi^m)$. But if π^f is much larger or much smaller than π^m, then $F^m(\gamma, \pi^f)$ and $F^m(\beta, \pi^f)$ could have the same sign, so that (16) cannot hold. Throughout the section we assume that the pivotal federal voter is at an interior optimum (i.e., π^f is not too far from π^m). As shown below, this amounts to studying the properties of a political equilibrium in a neighborhood of $Q = 1/2 = Q^*$.[11]

Equation (16) defines the optimal federal tax rate τ for voter π^f, given Q and given the equilibrium regional policy. Or, alternatively and more conveniently, (16) implicitly defines a function $\pi^f = \Pi(\tau, Q; \pi^m)$, identifying the domestic federal voter π^f for whom τ is optimal, given Q, and given that regional policy is set by the median voter π^m. The analogous function defined for the foreign region $\pi^{*f} = \Pi(\tau, 1 - Q; \pi^m)$ is identical except that its second argument is $1 - Q$ rather than Q. Thus, for any τ, there is a combination of π^f and Q that makes that particular τ optimal, and similarly for the foreign region. Single-peakedness of the voters' preferences follows from the second-order conditions.

In Appendix B we prove that the function $\Pi(\cdot)$ has the following local properties.

LEMMA 1. For any voter π^f such that (16) holds with equality (i.e., such that $\lambda(\beta) \geq \pi^f \geq \lambda(\gamma)$; see n. 11), (i) $\pi^f = \Pi(\tau, Q; \pi^m)$ is decreasing in τ; (ii) $\pi^f = \Pi(\tau, Q; \pi^m)$ is decreasing in Q and, at $\tau = \tau^S$, convex in Q; and (iii) $\Pi(\tau^S, 1/2; \pi^m) = \pi^m$.

Intuitively, the voters' preferences for the federal tax rate τ are affected by two risk components: an individual component, captured by the probability π^f, and a regional component, captured by the probability Q. Under the assumed timing—that is, for given regional tax rates—the federal tax redistributes across individuals as well as across regions. Hence, both risk components affect the optimal τ. The higher either risk component (i.e., the lower π^f or the lower Q),

[11] Specifically, (16) holds with equality if $\lambda(\beta) \geq \pi^f \geq \lambda(\gamma)$, where $\lambda(p) \equiv \pi^m\hat{p}(1 - p)/p[1 - \hat{p} + \pi^m(\hat{p} - p)]$ and $\hat{p} = (\beta + \gamma)/2$.

the greater the amount of redistribution desired by a given federal voter. This explains property i: as τ rises, to find a voter π^f who finds the higher τ optimal, we need to move toward a higher-risk (lower-π^f) voter. Property ii is illustrated for the home region in figure 1, which draws the locus of points π^f and Q for which τ^S is optimal. This locus is downward sloping because a drop in regional risk (a higher Q) induces a preference for a lower federal tax τ. To find a voter who still finds τ^S optimal, we must move to a higher-risk (lower-π^f) individual. The foreign region has the same curve except that the horizontal axis is labeled $1 - Q = Q^*$. The convexity of the locus means that the regional risk component becomes less important, relative to the individual risk component, as Q rises. By property i, all points above the downward-sloping curve correspond to voters (in either region) who would prefer a *lower* federal tax rate, whereas all points below it correspond to voters who would like a *higher* federal tax rate. Finally, property iii says that this curve passes through the point (π^m, ½), point S in figure 1.

We can now define the political equilibrium more precisely. Since preferences are single-peaked (see App. B), the equilibrium has the usual median-voter property. The equilibrium is a tax rate τ^V that is preferred by the median voters in the federation. Since $G(\cdot)$ denotes the distribution function of the individual risk parameter within each region, the equilibrium is a value of τ^V that satisfies the following equation:

$$G(\Pi(\tau^V, Q; \pi^m)) + G(\Pi(\tau^V, 1 - Q; \pi^m)) = 1. \tag{17}$$

The first term on the left-hand side of (17) measures the size of the coalition of home voters who want taxes higher than τ^V (i.e., the voters with $\pi^i \leq \Pi(\tau^V, Q; \pi^m)$). The second term measures the size of the corresponding foreign coalition. For τ^V to be an equilibrium, these two coalitions must make up half of the electorate (recall that each region has the same population, unity).

Consider first the case in which the two regions are identical. Lemma 1 immediately implies the following proposition.

PROPOSITION 6. If $Q = Q^*$, $\tau^V = \tau^S$.

For the proof, $Q = Q^*$ implies $Q = ½$. Hence, by property iii in lemma 1, the two regional medians agree that τ^S is optimal. That is, they find themselves in full agreement at point S in figure 1. Hence, τ^S is a median-voter equilibrium in the federation. Q.E.D.

Consider next the case in which the two regions have a different distribution of average output (say $Q > Q^*$). Then the two regional medians disagree. Clearly, the equilibrium federal tax must be in between the tax rate preferred by the two regional medians. For at the tax rate preferred by π^m, the coalition of federal voters in favor

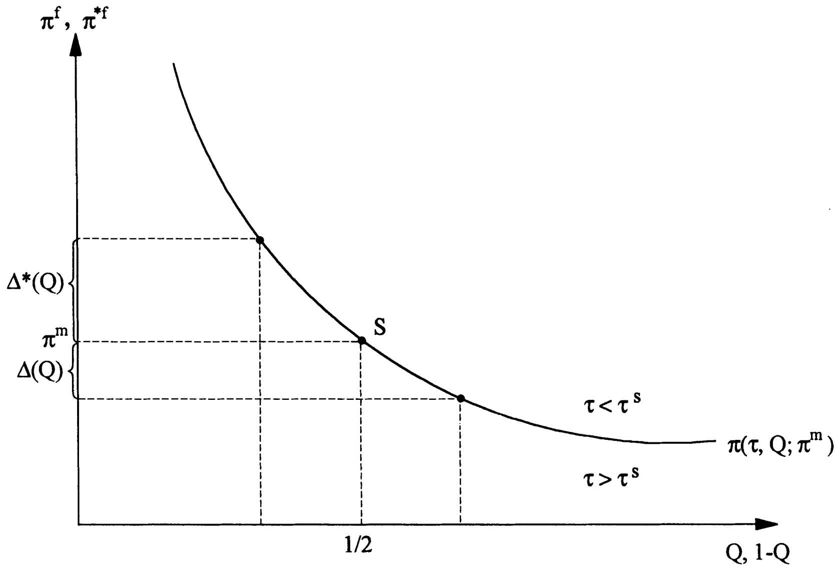

FIG. 1

of higher federal taxes consists of exactly 50 percent of the home voters plus a strict majority of foreign voters. The opposite is true at the tax rate preferred by π^{*m}, where a majority of federal voters prefer lower federal taxes.

In other words, when the two regions differ, voters with the same risk parameters π^f and π^{*f}, but residing in different regions, vote in different ways: residents of the domestic (low-risk) region tend to prefer lower federal tax rates than their foreign counterparts. This regional disagreement, however, is milder than in the case of intergovernmental transfers; it is mitigated by the fact that a centralized social insurance system also redistributes across individuals, whereas an intergovernment transfer redistributes only across regions. For this reason, the voters form coalitions across regions under federal social insurance, whereas this was not true for intergovernment transfers (cf. proposition 3).

The political equilibrium with asymmetries satisfies the following proposition.

PROPOSITION 7. If $Q \neq Q^*$, $\tau^V > \tau^S$. Furthermore, in a neighborhood of $Q = Q^*$, τ^V is higher the larger the distance $|Q - Q^*|$.

To prove it, consider first what happens as Q rises above ½. From figure 1, we know that voters in the home region now prefer a lower value of τ. To find someone who still favors τ^S, one has to look for a higher-risk (lower-π) individual. And the opposite happens in the foreign region. To capture this, formally define

$$\Delta(Q) \equiv \pi^m - \Pi(\tau^S, Q; \pi^m),$$
$$\Delta^*(Q) \equiv \Pi(\tau^S, 1 - Q; \pi^m) - \pi^m.$$

Thus, for any Q, $\Delta(Q)$ measures by how much one has to move to the left of π^m to find a home-region voter for whom τ^S is optimal, given Q. By figure 1, $\Delta(Q) > 0$ if $Q > 1/2$; $\Delta^*(Q)$ is similarly defined for the foreign region. Since, by lemma 1, $\Pi(\cdot)$ is downward sloping and convex in Q, we immediately have the following lemma.

LEMMA 2. If $Q > Q^*$, $\Delta^*(Q) \geq \Delta(Q) > 0$.

The higher value of Q means that one loses $1/2 - G(\pi^m - \Delta(Q))$ high-risk voters in the home region who were earlier prepared to vote for a higher tax rate. But one also gains $G(\pi^m + \Delta^*(Q)) - 1/2$ low-risk voters in the foreign region who are now prepared to vote for a higher tax rate than before. If the distribution G were symmetric, the fact that $\Delta^*(Q) \geq \Delta(Q)$ would mean that the coalition prepared to support a higher tax rate than τ^S is now larger, which would naturally imply $\tau^V > \tau^S$. But in assumption 1 we instead assumed that the distribution was skewed to the left. That assumption can be reformulated as lemma 3.

LEMMA 3. For any $\Delta^* \geq \Delta > 0$, $G(\pi^m - \Delta) + G(\pi^m + \Delta^*) > 1$.

Thus the skewness assumption implies that one in fact gains more voters in the foreign region than one loses in the home region, even when $\Delta(Q) = \Delta^*(Q)$. This only reinforces the pressure for a higher federal tax rate.

We can put the pieces above together formally. Lemmas 2 and 3 together imply that the right-hand side of equation (17) evaluated at $\tau = \tau^S$ is above unity, when $Q > 1/2$ (i.e., when $Q > Q^*$). Going through the same steps, one can easily show that the same is true for $Q < 1/2$. It follows from figure 1 that $\Delta(Q)$ and $\Delta^*(Q)$ are both increasing in the distance $|Q - 1/2|$ (or, equivalently, in $|Q - Q^*|$). Since the left-hand side of (17) is decreasing in τ, by lemma 1, proposition 7 follows. Note, however, that the proof is valid only locally, in a neighborhood of $Q = Q^* = 1/2$. The reason is that we have established the convexity of $\Pi(\cdot)$ in Q only in a neighborhood of $\tau = \tau^S$ (cf. lemma 1 and App. B). Q.E.D.

The conclusion is thus that τ^V is higher than τ^S for two reasons. The distribution of voters is denser to the right than to the left of π^m (cf. lemma 3). And to find a voter who favors τ^S when $Q > Q^*$, one has to move further to the right in the foreign (high-risk) region than to the left in the home (low-risk) region (cf. lemma 2). Taken together, these properties increase the size of the coalition that supports a higher federal tax rate.

In summary, regional asymmetries have opposite effects on the equilibria in a federal social insurance system under voting and under bargaining. Under bargaining, regional asymmetries reduce the equilibrium value of τ. Under voting, these asymmetries instead increase the equilibrium value of τ. The reason is that under bargaining the balance of power shifts toward the low-risk region, which weakens the demands for redistribution; the opposite happens under voting.

C. *Participation Constraints*

There is another interesting difference between voting and bargaining. Bargaining clearly guarantees that the participation constraint of both regions is satisfied. Since the bargaining outcome, by definition, is better than autarky for the pivotal voter, it follows that a referendum in each region would validate the federal arrangement.[12] Voting, as we have dealt with it above, has no such guarantee. For large enough asymmetries between the regions, the median voter in the low-risk region may actually be better off in autarky, so that the federal arrangement would be rejected in a local ratification vote. Let us therefore briefly discuss how a subsequent ratification vote could alter the political equilibrium. Specifically, consider the following simple two-stage extension of the previous policy game. In the first stage, federal and regional policies are chosen simultaneously under majority rule. In the second stage, the federal tax rate is subject to a simultaneous ratification vote in each region with a simple majority requirement. Rejection in any of the two regions repeals the federal arrangement. We assume that the regional policy *cannot* be reset, in the event of rejection.

DEFINITION 4. The equilibrium federal tax rate with ratification is a value τ^R that beats any other τ in the first-stage federal vote and is subsequently approved in the second-stage regional ratification vote in both regions. If no such value exists, $\tau = 0$.

Let $\tau^A > 0$ be the value of τ such that the median-risk type in the low-risk country is indifferent between τ^A and the autarky solution $\tau = 0$, given the best regional policy response to τ^A for π^m. And let τ^V be the unrestricted equilibrium of the previous model. The equilibrium outcome, when regions differ, then satisfies the following proposition.

PROPOSITION 8. If $Q \neq Q^*$, $\tau^R = \min(\tau^V, \tau^A)$.

Thus either the participation constraint does not bind ($\tau^V \leq \tau^A$), in which case $\tau^R = \tau^V$ coincides with the unrestricted voting equilibrium,

[12] If the bargaining game had a different threat point than autarky, validation of the federal arrangement would obviously not be automatically guaranteed (cf. n. 8 above).

or it does bind ($\tau^V > \tau^A$), in which case the majority of the voters who prefer high federal taxes realize that they cannot get them approved in the second stage and accept $\tau^R = \tau^A$. That is, they get taxes as high as possible without inducing secession.

To prove proposition 8, consider first the low-risk region. Suppose that $Q > 1/2$. Because $\Pi(\cdot)$ is decreasing in Q and τ (cf. lemma 1), π^m has a preferred value $\tau^m < \tau^V$. But if Q is not too far from $1/2$, τ^m is close enough to τ^V that $\tau^A \geq \tau^V$, implying that the participation constraint is not binding.

Suppose instead that Q is high enough that $\tau^A < \tau^V$. Because the *unrestricted* preferences over τ are single-peaked and $\Pi(\cdot)$ is monotonic, any $\tau > \tau^A$ would be rejected in the domestic ratification vote by everyone with $\pi^f \geq \pi^m$, whereas any τ such that $0 \leq \tau \leq \tau^A$ would be accepted. Hence the participation constraint binds.[13]

Consider now the first-stage federal vote over τ. Let the pivotal voter in the unrestricted federal vote of the prior model be a risk type π^V, and let τ^V be his (unrestricted) bliss point. By monotonicity of preferences, π^V prefers τ^A to any other value $0 \leq \tau \leq \tau^A$. Because the voters with $\pi^f \leq \pi^V$ have bliss points even higher than τ^V, they too prefer τ^A to any alternative τ in the acceptance interval $0 \leq \tau \leq \tau^A$. Thus whoever supported a higher tax rate than τ^V in the unrestricted vote will now vote for τ^A against any alternative in the acceptance interval.

Finally, consider the high-risk region. There a majority of the voters have an unrestricted bliss point for τ higher than τ^V. By monotonicity, they would all prefer τ^A to zero. Thus again every voter who supported federal tax rates above τ^V in the unrestricted vote of the previous model will vote for τ^A in the first-stage vote of the present model. It follows that a majority of voters in the federation prefer τ^A to any implementable alternative. Q.E.D.

With large differences in regional risks, the threat of secession thus imposes an upper bound on the extent of overinsurance in this simple model. (Note that in this model, in contrast to Bolton and Roland [1995], secession is not an equilibrium outcome.) This mechanism is also likely to survive in more realistic models; they would allow for resetting regional policy after a negative ratification vote, or for voting on regional representatives, something that would open the door for strategic voting or strategic delegation in the first-stage regional

[13] This means that some voters with $\pi^f > \pi^m$ will have non-single-peaked preferences in the first-stage federal vote over τ. More precisely, these voters prefer $\tau > \tau^A$ to $\tau < \tau^A$, despite $\tau < \tau^A$ being closer to their bliss point, because they correctly anticipate that $\tau > \tau^A$ will be rejected in the second-stage vote, including the autarky outcome $\tau = 0$. As we shall see below, however, this does not produce any nonexistence problems.

vote. An interesting question is whether the simple majority, equal representation voting mechanism that we have studied could be modified to eliminate the threat of secession or whether it would be necessary to alter the assignment of policy instruments.

VI. Conclusion

Realistic restrictions on the policy instruments for interregional risk sharing introduce a trade-off between efficiency and redistribution. How the conflicting interests of the regions are resolved depends critically on the mechanism for collective choice. As we have seen, the equilibrium solutions under bargaining and voting are pushed in opposite directions relative to an efficient unrestricted risk-sharing scheme. The model predicts that federal social insurance schemes decided on by voting will oversupply regional risk sharing, whereas federal intergovernment transfer schemes decided on by bargaining will undersupply it.

The key to this result is that a system of intergovernment transfers redistributes income along one dimension only: across regions. Thus the rich region and the poor have opposite interests. If autarky is the threat point, the rich region has more bargaining power and the equilibrium is closer to its preferred outcome. A centralized social insurance system, on the other hand, redistributes along two dimensions simultaneously: geographically and across rich and poor individuals within each region. The resulting geographical redistribution is less transparent, and the voters' coalitions cross the regional borders. Under the assumption that unemployment risk is concentrated in a minority of the population within each region, the voting equilibrium is closer to the outcome preferred by a majority of the residents in the poor region.

Even though the paper has focused on the voters' perceived trade-off between risk sharing and redistribution, the same insight could apply to other public choices in a federation. Consider, for instance, the provision of a federal public good valued by both regions. The public good could be financed directly by means of federal income taxes on the citizens of both regions or by transfers from the regional governments. Moreover, the quantity of the public good could be chosen by a federation-wide vote or by bargaining. A trade-off similar to that of this paper is likely to arise. With centralized public good provision and financing, voters' coalitions are likely to be formed on the basis of income, not residence. If, on the other hand, the public good is financed through intergovernment transfers, then the regional dimension will be more likely to dominate. The properties of the decentralized and centralized equilibria are then likely to depend on the same fundamental variables identified in this paper, namely, the relative bargaining power of the regional governments and the shape of the voters' distribution within each region, respectively.

More generally, the public finance arrangement determines whether the policy redistributes along one dimension or many. Under some collective choice mechanisms, this distinction matters. Hence, policies that appear to be economically equivalent, in the sense that they can implement exactly the same allocations, nevertheless result in different political equilibria.[14]

The positive results of this paper could be confronted with data on the variation of fiscal programs across existing federations and time. In particular, many modern federations have evolved from looser confederations to stronger national systems. At an early stage, the federal institutions mainly provided a forum for state negotiations. But later on, the federal government came to represent all voters to a much greater extent. This evolution has generally coincided with a tendency toward fiscal centralization. It would be interesting, but difficult, to study the comparative performance of these federations over time in the light of the positive results summarized above.

Does the paper yield normative conclusions for federal constitutional choices? If so, they are certainly difficult to draw, because neither the decentralized nor the centralized arrangements produce efficient outcomes. As explained in Section III, efficiency requires sufficient instruments to separate risk sharing and redistribution. Nevertheless, some normative trade-offs are apparent. An attractive feature of a centralized social insurance system is that it fosters integration, provided that the participation constraint is met. A system of intergovernment transfers, on the other hand, makes the redistribution more transparent and thus may exacerbate regional conflict. For countries that seek to reduce the size of government, however, a decentralized arrangement may be more attractive because it leads to less equilibrium redistribution. Our preliminary results on participation constraints can perhaps be taken as suggesting that constitutional checks and balances, say in the form of bicameral legislatures, may play a similar part in a centralized system.

Can we say something about the positive question of which constitution is more likely to be chosen? When citizens evaluate alternative arrangements, they compare equilibrium outcomes. Thus, in the model of this paper, the main difference among constitutions concerns the equilibrium amount of interregional transfers. The reason

[14] Tabellini (1991) has shown that a similar idea applies to the comparison of public debt and social security. Both instruments redistribute across generations. Moreover, they can be economically equivalent in the sense described above. But the *intra*generational redistribution induced by debt and social security is generally different, and this matters for the voting equilibria.

is that the equilibrium allocation of income between employed and unemployed individuals within each region does not depend on the federal arrangement. As a consequence, residents in the rich region prefer intergovernment transfers with bargaining, whereas residents in the poor region prefer voting on a centralized social insurance. The reason is that the size of interregional transfers is larger under the second arrangement than under the first. How this conflict is resolved depends on the procedure for constitutional choice.

Appendix A

Proof of Proposition 4

To prove proposition 4, we proceed in steps. First, we compute the Pareto frontier of the bargaining game. Next, we find the point on the frontier that corresponds to the Nash bargaining solution.

The Pareto frontier is the solution to the problem of choosing τ so as to maximize a weighted sum of the expected utilities of the median voters of both regions, $v^m + \delta v^{*m}$, for an arbitrary weight δ. The first-order condition for a maximum can be written as

$$\delta = \frac{QU_c(c^m(\gamma, \beta)) - (1 - Q)U_c(c^m(\beta, \gamma))}{QU_c(c^{*m}(\gamma, \beta)) - (1 - Q)U_c(c^{*m}(\beta, \gamma))}. \tag{A1}$$

By the discussion in the proof of proposition 3, we can write $c^m(\gamma, \beta) = c^{*m}(\beta, \gamma) \equiv \bar{c}$ and $c^{*m}(\gamma, \beta) = c^m(\beta, \gamma) \equiv \underline{c}$. Furthermore, from the world resource constraint, it follows that $\underline{c} = \underline{C}(\bar{c})$, with $\underline{C}_c < 0$. We can thus rewrite (A1) as

$$\delta = \frac{QU_c(\bar{c}) - (1 - Q)U_c(\underline{C}(\bar{c}))}{QU_c(\underline{C}(\bar{c})) - (1 - Q)U_c(\bar{c})}. \tag{A2}$$

The point on the Pareto frontier that corresponds to the Nash bargaining solution is still given by (7). Let $J^m(\bar{c})$, $J^m(\underline{c})$, and $A^m(p)$ be the indirect utility of the median voters in the good aggregate state, in the bad aggregate state, and in state p under autarky, respectively. We can then characterize the equilibrium point by

$$\delta = \frac{QJ^m(\bar{c}) + (1 - Q)J^m(\underline{C}(\bar{c})) - QA^m(\gamma) - (1 - Q)A^m(\beta)}{QJ^m(\underline{C}(\bar{c})) + (1 - Q)J^m(\bar{c}) - QA^m(\beta) - (1 - Q)A^m(\gamma)}. \tag{A3}$$

Combining (A2) and (A3), we have

$$\begin{aligned} &\frac{QU_c(\bar{c}) - (1 - Q)U_c(\underline{C}(\bar{c}))}{QU_c(\underline{C}(\bar{c})) - (1 - Q)U_c(\bar{c})} \\ &= \frac{QJ^m(\bar{c}) + (1 - Q)J^m(\underline{C}(\bar{c})) - QA^m(\gamma) - (1 - Q)A^m(\beta)}{QJ^m(\underline{C}(\bar{c})) + (1 - Q)J^m(\bar{c}) - QA^m(\beta) - (1 - Q)A^m(\gamma)}. \end{aligned} \tag{A4}$$

We start by assuming $Q > 1/2$. Let us then evaluate (A4) at the point $\bar{c} = \underline{c}$. At that point, the left-hand side is equal to unity and decreasing in $\bar{c}$. The right-hand side is smaller than unity—since $A^m(\gamma) > A^m(\beta)$—*and* increasing in $\bar{c}$. Thus the equilibrium must have $\bar{c} > \underline{c}$, which in turn requires $\tau^N < \tau^S$. Furthermore, the left-hand side of (A4) is increasing in Q, whereas the right-hand side is decreasing in Q. It follows that τ^N is lower if Q is higher.

Repeating the same argument for $Q < 1/2$, we find that τ^N is smaller than τ^S and smaller in value the smaller Q is. Finally, if $Q = 1/2$, the only possible solution to (A4) has $\bar{c} = \underline{c}$, implying $\tau^N = \tau^S$. This completes the proof of proposition 4. Q.E.D.

Appendix B

Proof of Lemma 1

Rewrite (16) as

$$H(\tau, \pi^f, Q; \pi^m) = 0. \tag{B1}$$

Simple algebra proves that $H_{\pi^f} < 0$. Moreover,

$$H_\tau = QU_{cc}F^m(\gamma, \pi^f)\frac{\partial c^m(\gamma, \beta)}{\partial \tau} + (1 - Q)U_{cc}F^m(\beta, \pi^f)\frac{\partial c^m(\beta, \gamma)}{\partial \tau}, \tag{B2}$$

where $\partial c^m(p, p^*)/\partial \tau$ denotes the equilibrium response of c to τ in state (p, p^*), given π^m. Such an equilibrium response is obtained from the system of equations (4) and (1) with $\kappa = 0$. It is easy to verify that

$$\frac{\partial c^m(\gamma, \beta)}{\partial \tau} < 0 < \frac{\partial c^m(\beta, \gamma)}{\partial \tau}.$$

Moreover, as discussed in the text, when (16) holds (i.e., under the conditions stated in n. 11), we have $F^m(\gamma, \pi^f) \leq 0 \leq F^m(\beta, \pi^f)$.Hence (B2) implies $H_\tau < 0$. By the implicit function theorem, we then obtain property i.

To prove property ii, apply the implicit function theorem to (B1) to obtain

$$\frac{\partial \pi^f}{\partial Q} = -\frac{H_Q}{H_{\pi^f}},$$

$$\frac{\partial^2 \pi^f}{\partial Q^2} = -\frac{H_{QQ}}{H_{\pi^f}} + \frac{H_{Q\pi^f}}{(H_{\pi^f})^2}.$$

By (16) in the text, it can be shown that $H_Q \leq 0$, $H_{\pi^f} \leq 0$, $H_{QQ} = 0$, and $H_{Q\pi^f} \leq 0$ if $\tau = \tau^S$. Thus

$$-\frac{\partial \pi^f}{\partial Q} < 0 < \frac{\partial^2 \pi^f}{\partial Q^2}.$$

This proves property ii.

Finally, property iii is obtained by noting that $H(\tau^S, \pi^m, 1/2; \pi^m) = 0$ is satisfied for any value of π^m.

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