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FEDERAL FISCAL CONSTITUTIONS. PART II: RISK SHARING AND REDISTRIBUTION

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ABSTRACT

Federal Fiscal Constitutions. Part II: Risk Sharing and Redistribution*

The paper studies the political and economic determinants of inter-regional public transfers. It points to an important difference between two alternative federal fiscal constitutions. The paper shows that inter-regional transfers can be determined either by a federation-wide vote over a centralized social insurance system, or by bargaining over intergovernmental transfers. When regions are asymmetric, the federal social insurance system leads to a larger fiscal programme.

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NON-TECHNICAL SUMMARY

In virtually every country the public sector transfers huge amounts across regions and localities. On the one hand, specially designed institutions and programmes, like the intergovernment fiscal equalization schemes in federal states, can organize the regional transfers. On the other hand, these transfers can evolve from a general government programme such as a centralized and tax-financed social insurance system. Whatever their nature, the inter-regional transfers are huge and central both to the current process of integration, as we observe in Germany and in Europe, and to the process of disintegration in Belgium, Canada, Italy and also the former Soviet Union.

The goal of this paper is to study the political and economic determinants of the regional transfers. A region is defined here as a primitive entity, determined by historical and geographical factors. It has control over a local fiscal policy instrument, with which it redistributes among local residents under regional majority rule. The emphasis lies not so much on the intraregional policy choices, but on how alternative fiscal constitutions shape the inter-regional transfers. By a fiscal constitution, we mean a set of fiscal instruments, which govern – directly or indirectly – the extent of regional transfers, as well as a procedure for the collective choice of these fiscal instruments.

In the same vein as the public choice literature, we thus ask a positive, rather than normative, question. We do believe, however, that many public programmes of inter-regional redistribution also serve an efficiency enhancing role, namely that they enable different regions to share macroeconomic risks. With this motivation we develop a stylized model of a federation consisting of two regions. Inhabitants of each region are heterogeneous in the sense that they face different risks of suffering an income loss. Regional outputs are also risky, but negatively correlated across regions. There is thus 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 programme may favour one region over the other.

If a rich set of fiscal instruments is available, it is possible to keep separate the risk sharing and redistributive aspects of federal policy even if regions are different. In this case everyone agrees that an efficient 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 requires that the federal policy is fully contingent on all aggregate states of nature. Full state contingency is difficult, however, and almost impossible to incorporate in laws concerning fiscal policy because it is hard to foresee and verify all possible contingencies. In the case of very asymmetric regions, state-contingent policies may be hard to implement as federal constitutions normally require that residents or firms in different regions are treated equally. This requirement imposes additional constraints on the instruments of fiscal policy. If the federal policy is constrained to be less than fully state contingent, 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 favour. The main contribution of this paper lies in the fact that it clarifies how this trade-off is resolved in political equilibrium under alternative fiscal constitutions.

Specifically, we consider a scheme of simple non-state-contingent transfers between regional governments. Under the voting procedure, this type of intergovernment transfer scheme increases inter-regional conflict. There is no formation of inter-regional voting coalitions, and the largest region wins. The region with a more favourable output distribution wants the transfers to be smaller than the voters in the other region. This suggests that federation-wide voting is a bad procedure for choosing the size of direct intergovernment transfers. A more natural procedure is to let representatives of each region bargain over the policy. If autarky is the threat point, a political equilibrium under bargaining entails incomplete insurance. This result is optimal for the low-risk region and follows from the fact that this region has more bargaining power, because autarky is less harmful to it.

An alternative risk-sharing agreement is to centralize social insurance at the federal government level. This type of scheme distributes indirectly between regions. It is superficially equivalent to a simple intergovernment transfer scheme in the sense that the same inter-regional allocations are feasible under the two systems. Under bargaining, the result is the same as with simple intergovernment transfers. Under the voting procedure, the coalitions of voters that form under the two systems are very different. Hence the equilibrium allocations also differ. Under this federally-organized scheme voters form inter-regional coalitions. The programme is tilted in favour of the high-risk region so that there exists overinsurance in political equilibrium. Moreover, the programme is larger the greater are the asymmetries across regions. This results from the fact that a large number of voters in the high-risk region want a large federal programme because it redistributes in their favour. Against this, a majority of the low-risk voters want to trim the programme down, but under empirically plausible assumptions about the distribution of risks the coalition of the high-risk voters prevails.

1. 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, like the intergovernment fiscal equalization schemes that are present in many federal states. Sometimes, the regional transfers are instead a byproduct of a general government program, like 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 in 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 % of the poorest regions' GDP and –5% of the richest regions' GDP (See Fondazione Agnelli (1992) and 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 which redistributes among local residents under regional majority rule. We focus not so much on these intraregional policy choices, as on how interregional transfers are shaped by alternative fiscal constitutions. 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 they enable different regions to share macroeconomic risks. With this motivation, Section 2 of the paper lays out a stylized model of a federation consisting of two regions. Inhabitants of each region are heterogeneous in the sense 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 3 of the paper, everyone agrees that an efficient 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 requires that the federal policy is fully contingent on all aggregate states of nature. 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 aims at avoiding exploitation of minorities—imposes additional constraints on the instruments of federal fiscal policy. But if the federal policy is constrained to be less than fully state contingent, residents in the federation face a tradeoff 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. To clarify how this tradeoff is resolved in political equilibrium under alternative fiscal constitutions is the main contribution of this paper.

Specifically, in Section 4 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 forms across borders: all voters in the region with a more favorable output distribution want smaller transfers than all the 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. If autarky is the threat point, a political equilibrium under bargaining entails incomplete insurance, because this is optimal for the low–risk region which has more bargaining power.

Section 5 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 forming. And—more importantly—under voting the program is tilted in favor of the high–risk region, so that we get over–insurance, rather than under–insurance, in political equilibrium. Moreover, the program is larger the greater are the asymmetries across regions. 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.

There is, of course, a large literature on fiscal federalism. Much of it studies mobility of voters or tax bases. This paper abstract from mobility, not because we think it is important, but because it has already received a great deal of attention—see for instance Wilson (1987) or Epple and Romer (1991). A more recent group of contributions takes a similar approach as 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 (1992), who use a similar model to analyze the normative problem of how to design a federal constitution so as to resolve the tradeoff between interregional risk sharing and moral hazard of local governments. Casella (1992) studies 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 (1993) 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 (1993) address issues of regional redistribution in purely redistributive models, where the threat of secession imposes a binding constraint on federal policy.

2. The Model

2.1 The Basic Model

Consider a federation made up of two regions of equal population size. We describe the home region first. Individuals are risk averse, 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 1 with probability p^i and 0 with probability $(1-p^i)$. Individuals with income are called "employed"; those with no income are called "unemployed". Individual income is not verifiable, which means that individuals cannot

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

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]

There is both aggregate and idiosyncratic risk. Moreover, individuals differ in their idiosyncratic risk: some individuals are exposed to more risk than others. This assumption makes the political equilibria non-trivial, 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 assume

Assumption 1

The distribution $G(\pi^i)$ *has a mean value of* 1, *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.

Thus, p denotes the fraction of employed individuals in the population, and hence it 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 p can take only two values:

$$p = \gamma \quad \text{with probability} \quad Q,$$
$$p = \beta \quad \text{with probability} \quad 1 - Q\,,$$

where we set $\gamma > \beta$. Hence, γ denotes the good aggregate state in the home region, while β denotes the bad aggregate state.

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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 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.

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 $1 - Q$. 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 according to:

$$p = \gamma \text{ and } p^* = \beta \quad \text{with probability} \quad Q$$
$$p = \beta \text{ and } p^* = \gamma \quad \text{with probability} \quad 1 - Q,$$

with an asterisk "*", denoting the foreign region.

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.

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. We leave the exact nature of the policy unspecified and we take the outcome of the policy to be an allocation of consumption between the employed and unemployed individuals within the region. Thus, the regional government chooses an allocation of consumption between the employed and unemployed individuals, $c(p, p^*)$ and $b(p, p^*)$ respectively, contingent on the realization of the state of the world, p, p^*. This allocation can be implemented by the government for instance 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, the regional government does *not* have to observe non–verifiable individual income.[3]

In the paper we consider different *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 different policy instruments and under different procedures for choosing them.

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

(1) $$p\ c(p,p^*) + (1-p)\ b(p,p^*) = p - \tau(p - p^*)/2 + \kappa\,.$$

The left–hand side denotes the consumption of the employed and unemployed; there are p and $(1-p)$ respectively of them. 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, 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 country 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 3 we study interregional risk sharing via a system of unrestricted intergovernment transfers. In Section 4, the intergovernment transfer scheme is operated under the constraint $\kappa = 0$. In Section 5, finally, we study a system of federal social insurance. In that system equation (1) with $\kappa = 0$ still holds, but τ represents an

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3 For instance, we could assume that the government does not observe individuals' employment status, but does observe firms' output.

output tax that finances transfers to individuals rather than to governments.

In other words, different federal arrangements for sharing regional risks may lead to the same form of the 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 policymakers in different *political* regimes. As the paper will show, different procedures for collectively choosing the federal policy instruments lead to very different equilibrium allocations.

2.2 Regional Social Insurance

It is easy to characterize the *regional* social insurance policies chosen in a political equilibrium (see also Persson and Tabellini (1992)). The voters preferences—their expected utility function—in the home region can be written as:

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

where $V^i(p, p^*)$ is the expected utility of the i^{th} 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 voters preferences are single peaked, and the median–voter result applies (see Persson and Tabellini (1992)). 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 variables are the functions $c(p, p^*)$ and $b(p, p^*)$. The first order condition characterizing the solution to the median–voter optimum problem can be written as:

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

where a subscript denotes a derivative. To pin down both c and b we also need the budget constraint (1), of course. 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 prefers 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.[4] More generally, the smaller is p^m (i.e., the closer is π^m to 1) the more generous is equilibrium social insurance. 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 in any relevant respects the domestic optimization problem faced by the regional median voters. The reason is that in all cases we consider, the regional policy is never determined before the federal policy. Hence the regional policymaker always takes the federal policy as given. Throughout the paper, then, equation (4) continues to hold and to characterize the regional social insurance and the allocation of consumption between employed and unemployed individuals in both regions.

3. 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

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4 See Wright (1986) for a related result on unemployment insurance.

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 in the rest of the paper. We assume throughout that the regional social insurance policy is set after the federal risk sharing arrangement has been chosen, and thus that it always satisfies the equilibrium condition in (4).

3.1 Efficient state contingent transfers

The set of efficient transfers is a pair $(\tau\ ,\ \kappa)$ that maximizes the following social welfare function:

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

where λ^i is an individual specific weight, δ is the relative weight on the foreign region, and where we have relied on the assumption that the regional distribution of π is the same in the two regions.

Let us denote by $c^m(p,p^*)$, $c^{*m}(p,p^*)$ the consumption of the employed individuals in the home and foreign regions in state $(p,\ p^*)$ and given the regional medians $\pi^m = \pi^{*m}$. Naturally, both c^m and c^{*m} are functions of the federal policy instruments τ and κ. 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 in general will not equal 1. To achieve full consumption smoothing of the employed, we do not want to have full income equalization across the two regions. The reason is that the number of employed individuals is different across regions.

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 it, 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:

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

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

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 1—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 is the relative weight δ. Hence κ is set as stated in the proposition, and the function $K(\cdot)$ is defined implicitly by (6). *QED.*

Proposition 1 is quite intuitive. Since there is no aggregate risk in the federation, everyone agrees that it is optimal to achieve full consumption smoothing. There is a conflict, however, 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 only reflects 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.

3.2 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 that in which the two regions bargain with each other, with autarky as the threat point.[5] This subsection then characterizes the Nash Bargaining solution for this game. For simplicity, we assume that bargaining takes place between the two regional medians.[6] 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 proves 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 $\delta^N \lesseqgtr 1$ as $Q \lesseqgtr 1/2$.

To prove it, note first of all 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 :

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

From Proposition 1, we know that

$$c^m(\gamma, \beta) = c^m(\beta, \gamma) = c \tag{8}$$

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

[6] 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 (1992)—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 equlibrium in this model, since the distribution of possible agent types has bounded support.

$$c^{*m}(\gamma, \beta) = c^{*m}(\beta, \gamma) = c^*.$$

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 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 $J^m(p)$ 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 of $\bar{v}^m$ and (6b) to replace δ^N, we can rewrite (7) as:

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

When $Q = 1/2$, equation (9) is satisfied for $c^* = c$, and both sides (and hence also δ^N) are equal to 1. Moreover, the left–hand side of (9) is decreasing in c, while 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) completes the proof. *QED.*

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 a compensation for its higher risk. The larger is the asymmetry between the two regions, the larger is this compensation.

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.

3.3 Voting

What would happen if the intergovernment transfers were instead chosen by a federation–wide vote? Without going through 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 non–cooperatively on the desired transfers, every home–region voter wants to drive κ to its uppermost corner, while 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.

4. Simple Intergovernment Transfers

Suppose that the intergovernment transfer scheme is indeed restricted such 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 assume throughout that the regional social insurance policy is set after the federal risk sharing policy has been chosen, and thus that it always satisfies the equilibrium condition in (4).

4.1 Voting

To start, suppose that the transfer is chosen by a majority vote.

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.*

Consider the preferences of an arbitrary voter π^f in the home region. The optimal value of τ for this voter maximizes her expected utility function (2) subject to (1), given that $\kappa = 0$ and that the regional social insurance policy satisfies the equilibrium condition (4). The first-order condition corresponding to this optimization problem is:

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

Notice that the term within square 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:

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

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. The value of τ only affects the distribution of *aggregate* income across states, which is something all voters agree upon.

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 larger 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 $Q=1/2$. Otherwise, they want to tilt consumption towards the state which is more likely to occur. Thus, the more favorable is the aggregate distribution of output in the home region (the higher is Q), the less voters in the home region want to insure (the lower is their preferred τ).

What about the voters in the foreign region? Going through the same steps, one obtains that foreign voters too 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. This is because a higher vale of τ shifts income from the foreign high–income state $(\beta,\ \gamma)$ to the foreign low–income state $(\gamma,\ \beta)$. But in (12), unlike in (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 $Q=1/2$ there is disagreement in the federation; the disagreement is increasing in the distance $|Q-1/2|$. The higher is Q, the lower the desired value

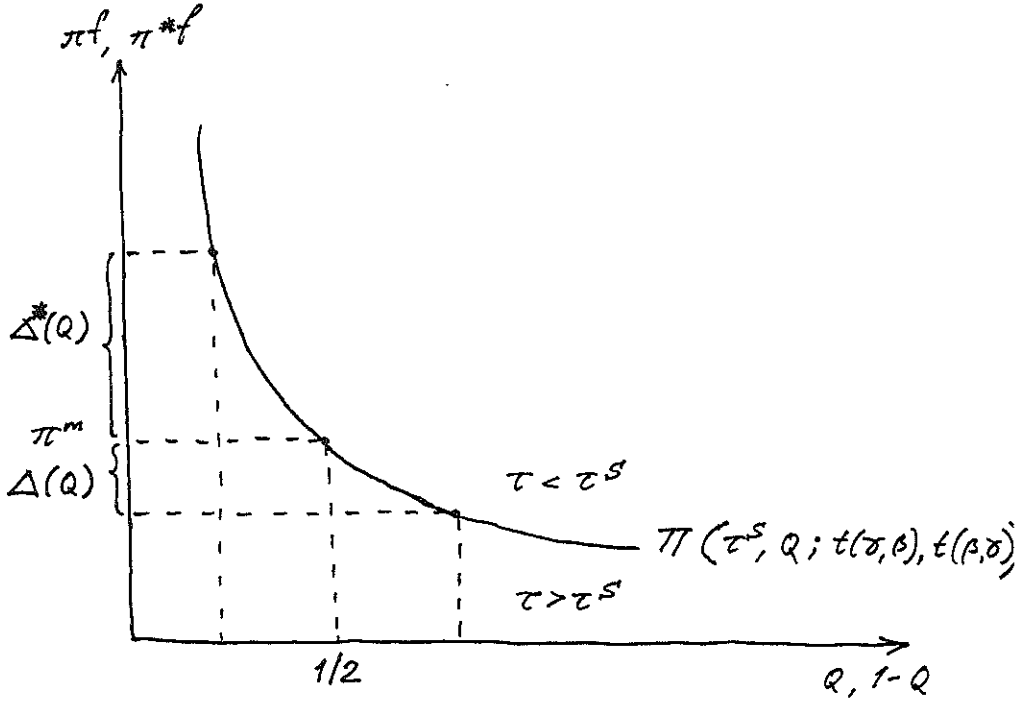

Figure 1

of τ in the home region, while the reverse holds in the foreign region.

We have already proved unanimity within each region. The proof of the rest 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:

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

It follows immediately from (11) and (13) that home and foreign voters prefer the same value of τ only if $Q = 1/2$. If not, the discrepancy between their desired solutions is larger, the larger is the distance $|Q - 1/2|$. 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. *QED*

To summarize, if $Q > 1/2$, 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 forms across the 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. This procedure is discussed next.

4.2 Nash Bargaining

Suppose that the size of the restricted intergovernment transfer is determined by a bargaining process. We assume, as in Section 3, 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 $Q = 1/2$, *but* $\tau^N < \tau^S$ *if* $Q \neq 1/2$ *and with* τ^N *smaller, the larger the distance* $| Q - 1/2 |$.

The proof is contained in Appendix 1.

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 is over τ, not over κ. When the risk–sharing scheme is restricted to the parameter τ, the low–risk region wants a smaller value of τ, because on average it ends up paying rather than receiving. The more different are the countries, the smaller is therefore the Nash bargaining equilibrium level of risk sharing. Thus, the tradeoff between risk sharing and redistribution plays a key role in the argument.

5. 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 automatically redistributes across regions, by collecting more taxes in the rich than in the poor region. 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.[7]

This restriction will create a tradeoff between risk sharing and redistribution similar to the one studied 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 form under the two systems, however, are very different, and hence the equilibrium allocations also differ. The nature of these political differences is investigated in this section.

Individual income and preferences are exactly like in the previous sections. Now, however, both the local and the federal government 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 transfer to individuals. 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:

$$(14) \qquad c(p,p^*) = 1 - t(p,p^*)(1-p) - \tau(1-\hat{p})$$
$$b(p,p^*) = t(p,p^*)p + \tau\hat{p} \,,$$

where t and τ denote the local and federal tax rates, respectively, and $\hat{p} \equiv (\gamma + \beta)/2$ is

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[7] In our simple model, with only two aggregate states and perfectly negatively correlated shocks, a centralised social insurance scheme with state–contingent taxes and 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 where they reside, even though the state–dependent tax rates would be equal across regions. As in Section 3, 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 stylised world, spanning by fully state–contingent policy instruments would be much harder to achieve, particularly under a constraint of equal treatment across regions.

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 non–negativity constraints on c and b. Throughout the section we only consider interior equilibria where 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 policy in this setup? That turns out to depend on the procedure for choosing the federal policy.

5.1 Nash Bargaining

With Nash bargaining the nature of the 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 of this equivalence is contained in the above discussion. 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. The regional medians therefore perceive exactly the same constraints as with a system of intergovernment transfers, and have the same threat points. Hence, the Nash bargaining outcome is the same. *QED.*

5.2 Voting

The equivalence is broken if instead federal social insurance is chosen by a majority vote in the federation. The reason is that the equilibrium outcome now depends on the coalitions of voters that will form. And the coalitions with federal social insurance differ from those that form under a system of intergovernment transfers. To address this issue we now 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 in both regions.

The equilibrium regional policy is analogously defined, except that the quorum is now made up of residents of that region only.

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

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

A similar condition holds for the foreign voter π^{*f}. In an interior equilibrium regional social insurance must continue to satisfy (4). Equation (15) defines the optimal federal tax rate τ for voter π^f, given Q and given the regional tax rates $t(\gamma,\beta)$ and $t(\beta,\gamma)$. Or—alternatively and more conveniently—(15) implicitly defines a function $\pi^f = \Pi(\tau, Q; t(\gamma,\beta), t(\beta,\gamma))$, identifying the domestic federal voter π^f for whom τ is optimal, given Q, $t(\gamma,\beta)$ and $t(\beta,\gamma)$. The analogous function defined for the foreign country $\pi^{*f} = \Pi(\tau, 1-Q; t^*(\beta,\gamma), t^*(\gamma,\beta))$ is identical—except that that its second argument is $(1-Q)$ rather than Q. Thus, for any τ, there is a combination of π^f and Q, which makes that particular τ optimal; and similarly for the foreign country.

In Appendix 2 we prove that the voters preferences are single–peaked, and that the function $\Pi(\cdot)$, evaluated at the *equilibrium* values of $t(\gamma,\beta)$ and $t(\beta,\gamma)$, has the following properties:

Lemma 1

(i) $\quad \pi^f = \Pi(\tau, 1-Q; t(\beta,\gamma), t(\gamma,\beta))$ *is decreasing in* τ

(ii) $\pi^f = \Pi(\tau, 1-Q; t(\beta,\gamma), t(\gamma,\beta))$ *is decreasing in* Q *and, at* $\tau = \tau^S$, *convex in* Q

(iii) $\Pi(\tau^S, 1/2; t(\beta,\gamma), t(\gamma,\beta)) = \pi^m$.

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 is either risk component (i.e. the lower is π^f or the lower is Q), the greater is 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 towards 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 smaller 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 $1-Q$. 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 $(\pi^m, 1/2)$, point S in Figure 1.

We can now define more precisely the political equilibrium. Since preferences are single-peaked (see Appendix 2), 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. Recalling that $G(\cdot)$ 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:

$$(16)\qquad G(\Pi(\tau^V, Q; t(\gamma,\beta), t(\beta,\gamma))) + G(\Pi(\tau^V, 1-Q; t^*(\beta,\gamma), t^*(\gamma,\beta))) = 1.$$

The first term on the left–hand side of (16) measures the size of the coalition of home tic voters who want taxes higher than τ^V (i.e., the voters with $\pi^i \leq \Pi(\tau^V, Q; t(\gamma,\beta), t(\beta,\gamma))$). 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:

Proposition 6

If $Q = 1/2$, $\tau^V = \tau^S$.

By Property (iii) in Lemma 1, the two regional medians agree that τ^S is optimal. Hence, it is a median–voter equilibrium in the federation. *QED.*

In this case both regional medians find themselves in full agreement at point S in Figure 1. Consider instead the case in which the two countries have a different distribution of average output (say $Q > 1/2$). Then, the two regional medians disagree. Clearly, the equilibrium federal tax must be in between that preferred by the two regional medians. For at the tax rate preferred by π^m, the coalition of federal voters in favor of higher federal taxes consists of exactly 50% 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 prefers 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 manners: 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 intergovernment transfer; it is mitigated by the fact that a centralized social insurance system also redistributes across individuals, while an intergovernment transfer only redistributes across regions. For this reason, under federal social insurance the voters form coalitions across regions, whereas that was not true for intergovernment transfers—cf. Proposition 3.

The political equilibrium with asymmetries satisfies:

Proposition 7

If $Q \neq 1/2$, $\tau^V > \tau^S$. *Furthermore, in a neighborhood of* $Q = 1/2$, τ^V *is higher the larger the distance* $| Q - 1/2 |$.

To prove it, consider first what happens as Q rises above $1/2$. From Figure 1, we know that voters in the home region now prefer a smaller 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:

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

Thus, for any Q, $\Delta(Q)$ measures by how much you have 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:

Lemma 2

If $Q > 1/2$, $\Delta^*(Q) \geq \Delta(Q) > 0$.

The higher value of Q means that you loose $1/2 - G(\pi^m - \Delta(Q))$ high–risk voters in the home region who were earlier prepared to vote for a higher tax rate. But you also gain $G(\pi^m + \Delta^*(Q)) - 1/2$ 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 naturally would 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

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

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

We can put the above pieces formally together. Lemmas 2 and 3 together imply that the right–hand side of equation (16) evaluated at $\tau = \tau^S$ is above unity, when $Q > 1/2$. Going through the same steps, it is easy to 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 $| Q - 1/2 |$. Since, the left–hand side of (16) is decreasing in τ, by Lemma 1, Proposition 7 follows. Note however that the proof is valid only locally, in a neighborhood of $Q = 1/2$. The reason is that we have only established the convexity of $\Pi(\cdot)$ in Q in a neighborhood of $\tau = \tau^S$—cf. Lemma 1 and Appendix 2. *QED.*

The conclusion is thus that τ^V is higher than τ^S for two reasons. The distribution of voters is more dense to the right than to the left of π^m c.f. Lemma 3. And to find a voter who favors τ^S when Q is above 1/2 one has to move further to the right in the foreign (high–risk) region than one has to move left in the home (low–risk) region—cf. Lemma 2. Taken together, these properties increase the size of the coalition who supports a higher federal tax rate.

The conclusion is that regional asymmetries have opposite effects on the equilibria in a federal social insurance system under voting and under bargaining. Under bargaining, we have seen that regional asymmetries reduce the equilibrium value of τ. Under voting, they increase it. The reason is that under bargaining, the balance of power shifts towards the low–risk region, something which weakens the demands for redistribution, whereas under voting the opposite happens.

There is another interesting difference between the two collective choice mechanisms. The bargaining mechanism clearly guarantees that the participation constraint of both countries 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.[8] The voting mechanism 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 referendum. This suggests two questions for further work. First, how would a requirement that the participation constraint be respected modify the federal policy outcome in political equilibrium with voting?[9] Second, could the simple–majority, equal–representation voting mechanism that we have studied be modified to eliminate the threat of secession, or would it be necessary to alter the assignment of policy instruments?

6. Conclusions

Realistic restrictions on the policy instruments for interregional risk sharing introduce a tradeoff 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 upon by voting will oversupply regional risk sharing, whereas federal intergovernment transfer schemes decided upon by bargaining will undersupply it. It would be interesting, but difficult, to confront these predictions with data on the variation of fiscal programs across existing federations and time.

Even though the paper deals with positive issues, its demonstration of how federal fiscal constitutions shape policy outcomes obviously points towards the normative problem

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8 If the bargaining game had a different threat point than autarky, validation of the federal arrangement would obviously not be automatically guaranteed (cf. Footnote 4 above).

9 See the papers by Buchanan and Faith (1987) and Bolton and Roland (1993) mentioned in the Introduction.

of institution design. When thinking about assigning policies to different levels of government, many economists would resort to Musgrave's classical scheme, which separates the public policy instruments into different branches dealing with allocation, distribution and stabilization, respectively. That framework is based on a Pigovian perspective of benevolent government. But if policy decisions at different levels of government are treated as political equilibrium outcomes—as they have been here—the Musgravian logic is unlikely to survive. In a companion paper (Persson and Tabellini (1992)) we have made a preliminary attempt to address the institution–design issues as a hierarchical principal–agent problem augmented with collective choice.

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Appendix 1

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 maximizing a weighted sum of the expected utilities of the median voters of both regions, $(v^m + \delta v^{*m})$, with respect to τ, for an arbitrary weight δ. The first–order condition for a maximum can be written as:

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

By the discussion in the proof of Proposition 3, we can write $c^m(\gamma, \beta) = c^{*m}(\beta, \gamma) \equiv \overline{c}$ and $c^{*m}(\gamma, \beta) = c^m(\beta, \gamma) \equiv \underline{c}$. Furthermore, from the world resource constraint, it follows that $\underline{c} = \underline{C}(\overline{c})$, with $\underline{C}_c < 0$. We can thus rewrite (A.1) as

$$\delta = \frac{QU_c(\overline{c})) - (1-Q)\, U_c(\underline{C}(\overline{c}))}{QU_c(\underline{C}(\overline{c})) - (1-Q)\, U_c(\overline{c})}. \tag{A.2}$$

The point on the Pareto frontier that corresponds to the Nash bargaining solution is still given by (7). Let $J^m(\overline{c})$, $J^m(\underline{c})$ and $J^m(p)$ 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

$$\delta = \frac{QJ^m(\overline{c}) + (1-Q)J^m(\underline{C}(\overline{c})) - QJ^m(\gamma) - (1-Q)J^m(\beta)}{QJ^m(\underline{C}(\overline{c})) + (1-Q)J^m(\overline{c}) - QJ^m(\beta) - (1-Q)J^m(\gamma)}. \tag{A.3}$$

Combining (A.2) and (A.3), we have

$$\frac{QU_c(\overline{c})) - (1-Q)\, U_c(\underline{C}(\overline{c}))}{QU_c(\underline{C}(\overline{c})) - (1-Q)\, U_c(\overline{c})} = \frac{QJ^m(\overline{c}) + (1-Q)J^m(\underline{C}(\overline{c})) - QJ^m(\gamma) - (1-Q)J^m(\beta)}{QJ^m(\underline{C}(\overline{c})) + (1-Q)J^m(\overline{c}) - QJ^m(\beta) - (1-Q)J^m(\gamma)}. \tag{A.4}$$

We start by assuming $Q > 1/2$. Let us then evaluate (A.4) 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 $J^m(\gamma) > J^m(\beta)$—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 (A.4) 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 is Q. Finally, if $Q = 1/2$, the only possible solution to (A.4) has $\bar{c} = \underline{c}$, implying $\tau^N = \tau^S$. This completes the proof of Proposition 4. *QED.*

Appendix 2

Proof of Lemma 1

Rewrite (15) as:

(A.5) $$H(\tau, \pi^f, Q; t(\gamma,\beta), t(\beta,\gamma))) = 0 .$$

Simple algebra proves that $H_{\pi^f} < 0$. By the second–order conditions, $H_\tau < 0$. By the implicit function theorem, we then obtain property (i). Single–peakedness of preferences follows from the second–order conditions and from noting that the preferences belong to the class of intermediate preferences studied by Grandmont (1978).

When evaluated at the *equilibrium* values of $t(\gamma,\beta)$ and $t(\beta,\gamma)$, obtained from (4), equation (15) can be rewritten as

(A.6) $$QU_c(c^m(\gamma,\beta))F^m(\gamma, \pi^f) + (1-Q)U_c(c^m(\beta,\gamma)F^m(\beta, \pi^f) = 0,$$

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 where it is understood that, $c^m(p,p^*)$ is a function of τ. Holding τ constant, (A.6) can in turn be rewritten as

(A.7) $$K(\tau, \pi^f, Q; \pi^m).$$

Some algebra proves that $K_Q < 0$ and that $K_{QQ} < 0$ for $\tau = \tau^S$. This proves property (ii). Finally, property (iii) is obtained by noting that $K(\tau^S, \pi^m, 1/2; \pi^m) = 0$ is satisfied for any value of π^m.