Federalism, equalization and risk aversion

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Received 1 September 1995; received in revised form 1 June 1997; accepted 2 July 1997

Abstract

What causes a group of countries to agree to form a federation? Other alternative arrangements, which often are chosen instead, are to form a unitary state or to remain autonomous. Federations usually allow for considerable freedom of movement among constituent regions. They also provide a fairly limited redistribution of any rents earned in these regions. These two features together imply that residents of poor regions can share in the rents in rich regions by migration. This fiscal migration may waste resources. Why not simply share the rents equally among residents of all regions? Such a unitary arrangement, although efficient, would not appeal to residents of a country which is likely to be the best-off region in a federation. Complete autonomy may expose residents of the separate countries to considerable idiosyncratic risk. Here I demonstrate that federation may be chosen by a group of countries, even though it is a more wasteful arrangement than either other alternative, if asymmetries among countries, and the degree of risk aversion, are large. Federal states also often implement transfers among the regions. These transfers can be viewed as substitutes for fiscal migration. I also show that the possibility of transfers, even without any commitment to specifics, makes federalism a more attractive option. A federal constitution which requires transfers in excess of what would be made voluntarily may make federalism more attractive still. © 1998 Elsevier Science S.A.

Keywords: Federalism; Migration; Fiscal coinsurance

JEL classification: H11; H77; H87

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1. Introduction

Federal structures are quite common in the developed world. Since the Maastricht treaty, the European Union shares several features with sovereign federal states such as the United States, Canada, and Australia. The two features which this paper emphasizes are:

(i) Residents of the federation are free to move among the constituent regions.¹
(ii) The constituent regions’ governments retain considerable power to set their own redistributive policies.

The first feature was certainly one of the major aspects in the Maastricht treaty. While impediments to mobility may remain in practice, freedom to move within the federation seems an important part of most federal constitutions.

The second feature is perhaps less prominent in federal nations than in the European Union. But states in the United States choose their own tax systems (in particular, the mix among sales, personal income, and corporate income taxation). A large number of transfer programmes are left to state or provincial governments in most federal nations. Moreover, a large share of a state’s (or province’s) natural resource rents can be taxed by the state’s government, to the benefit of residents of that state.

What are the advantages of federal structures with these features? One big advantage is the insurance provided against region-specific shocks. Federation of sovereign regions may serve to reduce uncertainty, if the different states are exposed to random shocks which are less than perfectly correlated.² In the literature on monetary integration, this notion has been referred to as “fiscal coinsurance”.³

But this sort of federation is not the only way to pool risk. An alternative arrangement is a “unitary” state, in which the central government has complete control over all natural resource revenues in any of the regions. Typically, these rents are distributed “equally”, so that a citizen’s share in the revenues does not depend on the region in which they were earned, or the region in which the citizen lives.

The main question addressed in this paper is the prevalence of federal arrangements, instead of unitary arrangements (or no fiscal arrangements at all

¹Throughout this paper, I will use the term “federation” to denote the senior level of government (the European Union, the United States, etc.) and “region” to denote the junior level (France, California, etc.). As well, I will ignore the fact that many of the regions are themselves divided among constituent departments, counties or Länder.
²See Wildasin (1995) for a model of the effects of mobility on risk-sharing.
³See Eichengreen (1993), who attributes the idea to Ingram (1959).
among regions). In a federation, differences among regions lead to migration. This migration imposes several costs. First of all, there are real resources used up by migration. Revenue-sharing among regions could provide insurance more cheaply, by not using up these resources. Second, fiscally-induced migration may lead to an inefficient resource allocation, even when mobility is costless. Third, assignment of redistributive policies to regional governments leads to an inefficiently low level of redistribution when people are heterogeneous and mobile. All three of these problems would disappear if either of the features of federalism were eliminated. Inefficient fiscally-induced migration requires both some regional autonomy, and freedom of movement among regions.

Of course, not all migration is fiscally induced. If productivity differences lead to wage differences, then migration induced by these wage differences will raise the overall value of output in the federation.

In this paper, this sort of efficient migration will be ignored. The fiscal arrangements among regions considered here will be ways of allocating resource rents in the regions, rents which are not affected by the location of workers.

Three types of arrangement will be considered. One is separation, an arrangement in which the regional governments have complete control over resource revenues earned within their boundaries, and can ban immigration. Here, of course there is no problem with fiscal migration.

An opposite arrangement is to give all authority over the distribution of resource rents to a senior level of government. Then the issue of migration among regions is unimportant; there are no fiscal inducements to migration.

Federalism is the middle arrangement, in which the regional governments have authority over resource rents, but not over immigration. Only here is fiscal migration an issue. Given the potential problems such migration might cause, why choose such an arrangement? The answer given here is “risk aversion”.

Specifically, what will be required for federalism to be chosen in the model developed here are:

(i) uncertainty about resource rents
(ii) differences among regions (ex ante) in their expected resource rents
(iii) risk aversion.

In the remainder of the paper, the choice of fiscal arrangements by two sovereign regions is considered. The regions’ incomes are subject to some uncertainty, and regions’ residents are risk averse. The nature of the uncertainty may differ between regions. Specifically, one region is more likely to be “rich”
than the other. The arrangements are decided before the resolution of the uncertainty.

The main issue is whether the two regions would agree to a federation, as opposed to one of the other two arrangements.

The structure of the paper is as follows. Section 2 presents the basic model. Section 3 considers the effect of voluntary transfer payments from the rich state to the poor state, after the uncertainty has been resolved. Section 4 discusses the choice of transfer payment which might be specified in a constitution ex ante, before the uncertainty has been resolved. Section 5 discusses some generalizations of the model, and Section 6 discusses some of its limitations.

2. The basic model

Residents of two regions choose the fiscal structure of relations between the regions. As described in the introduction, there are three possible arrangements: separation, federalism, and a unitary state. A regional government is assumed in this section not to be able to make any unilateral transfers to the other region, whatever is the constitutional arrangement.

The process of choosing a system of inter-government relations will not be modelled here. It will be assumed that the two regions must choose one of the three possible arrangements. No side payments between regions will be allowed. It is also assumed that the disagreement point is separation. No region has the power to force another region into deviating from this status quo, and the absence of side payments precludes bribing another region.

Therefore, whatever the exact process of determining fiscal arrangements, the arrangement chosen must be one that each region’s policy makers like at least as much as separation. That is, any arrangement must be individually rational, where “individuals” here are the regions’ policy makers. The one other requirement imposed on the arrangement is that it be Pareto optimal.

The way regions are numbered here, the assumptions will imply region 2 will always prefer (strictly) a unitary system to a federal system, and a federal system to separation. Therefore, federalism will be individually rational if and only if region 1 does not prefer separation to federalism. Federalism will be Pareto optimal if and only if region 1 prefers federalism to a unitary state. That is, the conditions under which federalism might be chosen are exactly the conditions that region 1 rank federalism as the most attractive of the three options.

Of course, even then, the qualification “might be chosen” is necessary. If region 1 ranks federalism as its best option, followed by a unitary super-state, with separation ranked last, then there are two arrangements which are both individually rational and Pareto optimal: unitary and federal. If region 1’s ranking was federal followed by separate followed by unitary, then federalism would be the only arrangement which is both individually rational and Pareto optimal. The
other 4 possible rankings\(^6\) of the 3 alternatives for region 1 mean federalism will not be chosen.

All residents of a given region are assumed identical to each other. Thus the payoff to each region under any arrangement is the expected utility of its representative agent.

At the time of the decision, residents are unsure of the relative incomes of the two regions. However, it is common knowledge that region 1 will become “rich” with probability \(\pi > 0.5\). With probability \(1 - \pi\) it is region 2 which will become rich. Thus exactly one region will become rich, the other will be poor, and it is more likely that the lucky region will be region 1. The aggregate income in each region, conditional on the region being rich or poor, is exogenous.\(^7\)

The initial population of each region is the same, and is normalized to 1. I also set the income per capita in the poor region equal to 1, and denote by \(\rho > 1\) the income in the rich region.\(^8\)

Since there is no aggregate uncertainty, the average income for the two regions is

\[
\bar{y} = \frac{(1 + \rho)}{2}
\]

for certain.

Residents all have the same concave utility-of-income function \(U(y)\), which exhibits a constant index of relative risk aversion \(\beta\):

\[
U(y) = \frac{y^{1-\beta}}{1-\beta} \quad \beta > 0
\]

The expected utility of a resident of region 1 – if the regions remain separate – is

\[
EU_1 = \pi U(\rho) + (1 - \pi)U(1)
\]

If the regions remain separate, residents of region 2 would attain the utility

\[
EU_2 = (1 - \pi)U(\rho) + \pi U(1)
\]

which is less than \(EU_1\).\(^5\)

An arrangement which residents of each region would prefer to separation (or to federalism) would be a contract which paid the expected value of the rents in each

\(^6\)These are: U preferred to F preferred to S, U preferred to S preferred to F, S preferred to F preferred to U, S preferred to U preferred to F. In addition, of course, there are many other possible rankings involving indifference between forms of government.

\(^7\)As in Persson and Tabellini (1996).

\(^8\)This normalization of incomes will not matter if people have a constant coefficient of relative risk aversion – as will be assumed.
region to people born in that region (that is, \( \pi (\rho - 1) + 1 \) to people born in region 1, and \((1 - \pi)(\rho - 1) + 1\) to people born in region 2). Alternatively, if the structure of the uncertainty were common knowledge, private firms could provide insurance. Here no risk-neutrality is required of insurers because of the absence of aggregate uncertainty. An insurance contract is no different from a “pairing” arrangement between people born in different regions to pool their incomes (with actuarially fair payouts).

It is essential in what follows that such insurance arrangements not be available. Their availability would make the fiscal structure irrelevant.

A unitary state is assumed to divide rents equally among all its residents. It seems a reasonable characterization of a truly unitary state that a citizen’s income not depend on her place of birth within the state. Because of the identical populations in the two regions, then

\[
EU_{1}^{U} = EU_{2}^{U} = U(\bar{y})
\]  

Clearly residents of region 2 will prefer merger to separation. Their expected income would be at least as high under merger as under separation. This income is certain under merger, and uncertain under separation. Residents of region 1 would prefer merger to separation only if they were very risk averse, or if the ex ante differences between regions were small.

A federal state is defined as one in which the total income of each region is under the control of the region’s own government, but shared equally by all who choose to reside in that region, with all residents of the federation free to move within it. Thus regions are precluded by definition from basing transfers upon people’s place of birth, or length of stay in the region. Such proscriptions are included in the constitutions of many federal states. However here I take them as part of the definition of federalism, without explaining why they are chosen.9 If mobility were completely costless, people would move from the poor region to the rich region until per capita income were the same in each. The average income in the federal state would just equal \( \bar{y} \). There would be no difference in people’s utility between a federal and a unitary state.

To capture the inefficiencies associated with fiscally-induced migration, it will be assumed that migration costs are positive. These costs make federalism different from merger. Denote migration costs as \( c \) per person, where \( c < \rho - 1 \).

Moving from the poor region to the rich region gives one a share in the higher income of the rich region, but entails costs of \( c \). If all people are identical, and people make their location decisions simultaneously, after the resolution of the uncertainty (and if the population of each region can be treated as continuously variable), then in equilibrium some proportion \( n \) of the people born in the poor

9See Jehiel and Scotchmer (1996) for a discussion of the endogenous choice of rules of exclusion for immigrants.
region will have chosen to move to the rich region. The equilibrium migration proportion \( n \) is the solution to the equation
\[
\frac{\rho}{1 + n} - c = \frac{1}{1 - n}
\]  
which serves to define the migration share \( n \) as a function of the income disparity \( \rho \) and the migration cost \( c \).

Not surprisingly the proportion \( n \) of people who choose to migrate from the poor region to the rich region is a decreasing function of the cost \( c \) of migration (and an increasing function of the income ratio \( \rho \)).

The income of an original resident of the rich region is
\[
i_r = \frac{\rho}{1 + n}
\]
in equilibrium in a federal state, and the income of an original resident of the poor region is
\[
i_p = \frac{1}{1 - n}
\]
so that the expected utility of a resident of region 1 under a federal constitution is
\[
EU_1^F = \pi U(i_r) + (1 - \pi)U(i_p)
\]
or
\[
EU_1^F = \pi U \left( \frac{\rho}{1 + n} \right) + (1 - \pi)U \left( \frac{1}{1 - n} \right)
\]  
(5)
Federalism is individually rational if and only if
\[
EU_1^F \geq EU_1^R
\]
It is Pareto optimal if and only if
\[
EU_1^F > EU_1^U
\]

One way of viewing region 1’s choices is to consider \( EU_1^F \) as a function of the migration cost \( c \). When \( c = 0 \), migration would occur until incomes were equalized between regions, so that \( i_r = i_p = \bar{y} \), and federation would be the same as a unitary state. If \( c \) is high enough, in particular if it is \( \rho - 1 \) or greater, no migration would occur. (Eq. (4) shows that \( n = 0 \) when \( c = \rho - 1 \).) Thus federation would be the same as separation if \( c \geq \rho - 1 \).

Consider now the graph of the expected utility \( EU_1^F \) from federation of people from region 1, viewed as a function of the migration cost \( c \). An example is illustrated in Fig. 1. For a given level of migration cost, somewhere between the extremes of 0 and \( \rho - 1 \), federalism will be individually rationally if and only if \( EU_1^F(c) \geq EU_1^R(\rho - 1) \), and will be Pareto optimal if and only if \( EU_1^F(c) > EU_1^U(0) \).
The shape of the curve $EU_i^F$ is determined by Eq. (5), where the migration share $n$ is determined by Eq. (4). Lemma 1, proved in Appendix A, shows that the shape of this curve depends on the coefficient $\beta$ of relative risk aversion.

**Lemma 1.** When the coefficient of relative risk aversion $\beta > 2\ (<2)$, expected utility under federalism $EU_i^F$ is a quasi-concave (quasi-convex) function of the migration cost $c$.

If the curve is quasi-convex, then federalism cannot be both individually rational and Pareto optimal. Either $EU_i^F(c) < EU_i^F(\rho - 1)$ or $EU_i^F(c) > EU_i^F(0)$. 

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Fig. 1.
Therefore, a coefficient of relative risk aversion greater than 2 is necessary for federalism to be chosen.

If \( \beta > 2 \), a necessary condition for Pareto optimality is that \( EU^F_i(c) \) be increasing in \( c \) at \( c = 0 \). A necessary condition for individual rationality is that \( EU^F_i(c) \) be decreasing in \( c \) at \( c = \rho - 1 \). If one of these conditions does not hold, \( EU^F_i(c) \) will be strictly monotonic over the interval \([0, \rho - 1]\). But if both of these conditions hold, then \( EU^F_i(c) \) will be single-peaked, with a global maximum at some interior \( c^* \), as in Fig. 1. If the migration cost equaled \( c^* \), or was close to it in value, then federalism would be preferred to either of the other alternatives by people born in region 1.

Differentiation of Eq. (5) shows that the following conditions are equivalent, respectively, to \( EU^F_i \) increasing in \( c \) at \( c = 0 \) and decreasing in \( c \) at \( c = \rho - 1 \):

\[
\frac{\pi}{1 - \pi} \geq \rho \quad \text{(PO)}
\]

\[
\rho^{\beta - 1} \geq \frac{\pi}{1 - \pi} \quad \text{(IR)}
\]

When both of these conditions hold, there will be some range of migration costs for which federalism will be in the choice set. What this range is depends on the ranking of the two alternatives. If region 1 prefers a unitary state to separation, then Pareto optimality is the binding constraint. Conditions PO and IR imply that \( EU^F_i(c) \) is greater than \( EU^F_i(0) \) up to some level of \( c \) to the right of the value \( c^* \) which maximizes \( EU^F_i \), a point \( \tilde{c} \) such that \( EU^F_i(\tilde{c}) = EU^F_i(0) = EU^F_i \). This is the case depicted in Fig. 1. If region 1 prefers separation to a unitary state, then individual rationality will be the binding constraint, and federalism will be chosen for high values of the migration cost \( c \), as in Fig. 2. Summarizing the above discussion,

**Proposition 1.** If the coefficient of relative risk aversion \( \beta \) is less than or equal to 2, federalism will not be chosen. If it exceeds 2, condition (PO) above is necessary for Pareto optimality of federalism, and condition (IR) is necessary for individual rationality. If (IR) and (PO) both hold, and if \( \beta > 2 \), then there is some interval of values for \( c \)-either \( (0, \tilde{c}) \) or \( (\tilde{c}, \rho - 1) \) – such that federalism is both Pareto optimal and individually rational if the migration cost \( c \) lies in the interval.

### 3. Ex post equalization payments

One of the classic results in the literature on fiscal federalism is that payments from one state to another could be welfare-improving. As emphasized by Myers

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10 If \( \beta = 2 \), then it can be shown that \( EU^F_i \) is either constant or strictly monotonic in \( c \), so that either \( EU^F_i(c) < EU^F_i(\rho - 1) \) or \( EU^F_i(c) > EU^F_i(0) \).
Fig. 2.

(1990), and by Krelove (1992), when mobility is costless such payments will be made voluntarily. If equilibrium utility is the same everywhere, then all residents of the federation will want a set of fiscal policies which maximize this everywhere-equal utility.

Here this commonality of interest holds, even when mobility is costly.\textsuperscript{11} Consider now a transfer of $T$ made from the government of the rich region to the...

\textsuperscript{11}Hercowitz and Pines (1991) discuss the efficiency of voluntary transfers with costly mobility in a similar model to this one. Due to differences in the assumptions about the nature and timing of the uncertainty, they come to somewhat different conclusions than this section. However, the transfers arising in their model are constrained Pareto optimal, as they are here.
government of the poor region. This is an aggregate transfer, not a per capita one. The government of the rich region splits the cost of the transfer among all residents (residents born in the region and new migrants alike). The government of the poor region pays out the transfer equally to all remaining residents. I assume that the magnitude of the transfer is decided before migration decisions are made. Potential migrants, as in the previous section, forecast correctly the equilibrium pattern of migration. But in this section, the transfers are decided after it has been learned which region is the rich region.

The timing of decisions (for this section) is as follows. First the regions decide on the form of the national government. Second, nature chooses one region to be rich, and the other to be poor. Third, if a federal structure was chosen in the first stage, the rich region chooses the level $T$ of aggregate transfer payments to the poor region. Fourth (if a federal structure was chosen), people choose simultaneously where to live.

The income of a resident of the rich region, after subtracting her share of the cost of the transfers is now

$$i_R = \frac{\rho - T}{1 + n}$$

and of an original resident of the poor region, who has chosen to stay there

$$i_P = \frac{1 + T}{1 - n}$$

As in the previous section, costly mobility ensures that in equilibrium

$$i_P = i_R - c$$

(6)

if the proportion $n$ of erstwhile residents of the poor region who migrate is non-negative.

From Eq. (6), the choice of transfer $T$ which maximizes the utility $U(i_P)$ of someone born in the poor region will also be the policy which maximizes the utility $U(i_P + c)$ of someone born in the rich region. No matter how high the migration costs, there will be complete unanimity that transfers which increase $i_P$ should be implemented.12

This unanimity implies transfers should completely eliminate migration. Aggregate income in the federation is $2\bar{y} - nc$ which is certainly maximized when $n$ is minimized. If all residents agree on the best transfer, it will be the one which maximizes per capita aggregate income. (There is no longer any uncertainty here; the transfer is chosen after it has been revealed which region is the rich one.)

That minimal transfer which eliminates migration is

12This unanimity disappears when migration costs vary among individuals, as will be discussed briefly in Section 5.
Transfers slightly larger than $T^*(c)$ will not reduce aggregate income. Until transfers are so large that reverse migration becomes attractive, then increases in $T$ above $T^*(c)$ serve merely to redistribute from those born in the rich region to those born in the poor region. Obviously there is no incentive for residents of the rich region to make such transfers voluntarily after the uncertainty has been resolved.

The possibility of these (ex post) transfers must make federalism a more attractive option than it was in Section 2, where these transfers were not allowed. (The above argument showed that increasing transfers from 0 to $T^*(c)$ increased income under federalism in both the rich and the poor region.) Therefore the possibility of these transfers makes it more likely that federalism is both individually rational for region 1, and Pareto optimal.

So consider again the expected utility under federalism to a native of region 1, as a function of the migration cost $c$. Denote this expected utility when ex post transfers can be made as $EU^*_1(c)$. Fig. 3 illustrates the graph of $EU^*_1(c)$, and shows that it is everywhere at least as high as the corresponding $EU^*_1(c)$ resulting when there are no transfers.

From the definition above of the transfer $T^*(c)$ which cuts off all migration then the ex post incomes under federalism of those born in the two regions are

$$i_h = \bar{y} + \frac{c}{2} = \frac{1}{2} (1 + c + \rho)$$

$$i_p = \bar{y} - \frac{c}{2} = \frac{1}{2} (1 - c + \rho)$$

so that

$$EU^*_1(c) = \pi U\left[\frac{1}{2} (1 + c + \rho)\right] + (1 - \pi) U\left[\frac{1}{2} (1 - c + \rho)\right]$$

Eq. (7) implies that $EU^*_1(0) = EU^*_1$ and $EU^*_1(\rho - 1) = EU^*_1$, just as in Section 2 (and just as in Fig. 3).

As in Section 2, if $EU^*_1(c)$ is quasi-concave, then a necessary condition for Pareto optimality of federalism is that $EU^*_1(c)$ be increasing at $c=0$, and a necessary condition for individual rationality is that $EU^*_1(c)$ be decreasing at $c=\rho-1$. But the possibility of ex post transfers alters the previous results in three ways:

(i) The function $EU^*_1(c)$ must be concave, not just quasi-concave, regardless of the value of the coefficient of relative risk aversion.

(ii) The function $EU^*_1$ must be increasing in $c$ at $c=0$, so that federalism must be Pareto optimal if the migration costs are small enough.

(iii) The necessary condition for individual rationality is easier to satisfy.
All these results follow from differentiation of Eq. (7). Proposition 2, proved in Appendix A, spells them out formally.

**Proposition 2.** When voluntary transfers are possible, a necessary condition for federalism to be individually rational is

\[ \rho^\beta > \frac{\pi}{1 - \pi} \quad (IR - T) \]

If migration costs are small enough, federalism must be Pareto optimal.

If (IR - T) holds, then there is some interval of values for \( c \) – either \( (0, \tilde{c}) \) or \( (\tilde{c}, \infty) \).
\(\rho - 1\) – such that federalism is both Pareto optimal and individually rational if the migration cost \(c\) lies in the interval.

4. Ex ante transfer payments

An alternative arrangement to that considered in the previous section might be to decide on the transfer system before the uncertainty is resolved. It will be assumed here that the transfer system must be anonymous, in the sense that the transfer from region 1 to region 2, should region 1 be rich, is specified to equal the transfer from 2 to 1 should region 2 be rich. Everyone would agree that the level of payments should be at least \(T^*(c)\), since decreases from this level will lower people’s incomes, whether the region in which they were born turns out to be rich or poor. But what of further increases?

Someone born in region 2 would like further increases in transfers above \(T^*(c)\), since she is likely to be residing in a poor (transfer-receiving) region when the uncertainty is resolved. The only argument in favour of further transfers for residents of region 1 is that they reduce the risk associated with the unlucky case of region 2 being the rich region.

If transfers are larger than \(T^*(c)\), but not so large as to promote reverse migration, then the expected utility of a person born in region 1 is

\[
\pi U(\rho - T) + (1 - \pi)U(1 + T)
\]

Provided that \(T > T^*(c)\), this expected utility does not depend on the migration cost \(c\).

Suppose that \(T > T^*(c)\). Unless \(T > T^*(0)\), there is some other migration cost \(b < c\) such that \(T = T^*(b)\). If \(c > b\), specifying a transfer of \(T^*(b)\) ex ante will give residents of region 1 the same expected utility as if the migration cost had been \(b\), and the transfers had been decided ex post.

Let \(EU^A_1(c)\) be the maximum expected utility a resident of region 1 will get under federalism, if transfers can be decided ex ante, in other words

\[
EU^A_1(c) = \max_T \left[\pi U(\rho - T) + (1 - \pi)U(1 + T)\right]
\]

It then follows from the above observation that

\[
EU^A_1(c) = \max_{b < c} EU^T_1(b)
\]

That makes the graph of \(EU^A_1(c)\) appear as depicted in Fig. 4. The function \(EU^A_1\) must be non-decreasing. It is not necessarily true that the utility under federation approaches the utility from separation as the migration cost \(c\) approaches \(\rho - 1\). If condition \((IR - T)\) holds, as in Fig. 4, then people born in region 1 would like to commit to transfers greater than \(T^*(c)\) when the cost of migration \(c\) is high. More
Fig. 4.

precisely, if the utility attained with ex post transfers $EU_1(c)$ reaches an interior maximum at some $c^*$, then the optimal ex ante transfer for people born in region 1 is $T(c^*)$, whenever $c \geq c^*$.

Therefore, when (anonymous) transfers can be specified ex ante, as part of a federal constitution, three cases arise, summarized in Proposition 3.

**Proposition 3.** If regions can commit ex ante to (anonymous) transfers in a federal constitution, and these are chosen to maximize the expected utility of region 1’s residents under federalism

(i) If region 1 prefers a unitary state to separation, then federalism will be both
Pareto optimal and individually rational, for any positive value of the migration cost \( c \).

(ii) If region 1 prefers separation to a unitary state, and if condition \((IR-T)\) holds, then federalism will be both Pareto optimal and individually rational, if the migration cost \( c \) is greater than \( C \), where \( C \) is positive, and less than the level of migration costs \( c^* \) which maximizes \( EU_1^U(c) \), the level of expected utility attainable with only ex post transfers.

(iii) If region 1 prefers separation to a unitary state, and if condition \((IR-T)\) does not hold, then federalism is not individually rational.

Fig. 4 illustrates the first case, and Fig. 5 the second. An algebraic proof of the proposition is provided in Appendix A.

Proposition 3 has several implications. Suppose that federalism was less attractive to the rich region than separation when transfer payments were decided ex post. Then an ex ante constitutional commitment to some level of transfer payments cannot reverse this ranking. But these ex ante transfers can make federalism more attractive than a unitary state, if migration costs are high. In such a case (that is, when \( c > c^* \), and when \( EU_1^U > EU_1^T \)), region 2 would be better off if a federal constitution could not commit to transfer payments; then a unitary state might result, instead of a federal state. This result should not be too surprising. When migration costs are high, federalism (in the absence of ex ante transfers) is similar to separation. Here region 2 effectively offers an “all-or-nothing” contract: either a unitary state, with complete equalization of incomes, or separation with its high risks. Ex ante transfers in a federal state allow for a third option, some risk sharing with less-than-full equalization. This may reduce the market power of region 2.

In this section, I have assumed that the transfer scheme must be anonymous. An alternative would be a constitution which specified two transfers, some \( T_1 \) payable from 1 to 2 if 1 were rich, and some other \( T_2 \) payable from 2 to 1 if 2 were rich. Allowing this asymmetry, in particular the possibility that \( T_1 < T_2 \), would make federalism even more attractive to region 1.

5. Generalizations

So far, it has been assumed that productivity shocks are perfectly negatively correlated across regions, and that all citizens of a region are identical (ex ante). In this section I consider the implications of relaxing these assumptions. But the basic economic model, with its very limited structure, and very limited choice of fiscal instruments, is maintained. Discussion of these more fundamental assumptions is deferred until the next section.

The assumption of perfect negative correlation can be relaxed very easily. Suppose that there are still only two possible levels of income, 1 and \( \rho \), but that the joint distribution of regions’ income is arbitrary. Let \( P_{ij} \) be the probability the
region 1 is of type $i$, and region 2 of type $j$, where $i$ and $j$ are either “rich” or “poor”. In this model, the constitution does not matter if the two regions’ incomes are the same. Residents of each region get utility $U(1)$ if both regions are poor, and $U(\rho)$ if both regions are rich, under separation, federalism, or a unitary state. No transfers will be made voluntarily.

Thus the expected utility calculations need be made only if the incomes in the two regions are different. If $\pi$ is now defined as

$$\pi = \frac{P_{RP}}{P_{RP} + P_{PR}}$$
then all the results of Sections 1–3 carry through exactly as before.

Matters are somewhat complicated if there are more than two levels of income possible. Let \( f(y_1, y_2) \) be the probability density function for income in the two regions. The probability \( \pi \) that region 1 is richer than region 2 should now be defined for every pair \((x, y)\) of incomes with \( x > y \) as \( \pi(x, y) = f(x, y)/[f(x, y) + f(y, x)] \). I will assume that the condition \( \pi > 0.5 \), a harmless convention when only two income levels are possible, now holds for all pairs \((x, y)\) in the support of the income distribution. That is

\[
f(x, y) > f(y, x) \quad \text{for all } (x, y) \text{ such that } f(y, x) > 0
\]

When many levels of income are possible, it remains true that federalism is the same as separation if the migration cost \( c \) is equal to the income difference between the two regions, \( x - y \). But when the constitution is being decided, before the resolution of the uncertainty, there is no single “cut-off” level of migration costs. It certainly is true that whenever the realized income difference \( x - y \) is less than the migration cost \( c \), no migration will occur (whether or not there are transfers).

Assuming that the support of the possible income realizations is bounded by some \( Y \), then a migration cost equal to this maximal \( Y \) will cut off all migration. Therefore, federation would be the same as separation if \( c = Y \).

But consider now the expected utility in region 1, given that \( x \) is the maximal income and \( y \) the minimum—that is given that either \((x, y)\) or \((y, x)\) occurs. This expected utility, as a function of the migration cost \( c \), is depicted in Fig. 6. This figure looks just like Fig. 2, except that it has been extended right to the migration cost \( Y \) which cuts off all migration for all possible income pairs.

If \( EU_1^F(c, x, y) \) denotes this expected utility, then the expected utility of federalism, viewed from the time of constitution-setting, when \( c \) is known but \( y_1 \) and \( y_2 \) are not, is simply the expected value of these \( EU_1^F(c, x, y) \)'s over all possible income pairs with \( x > y \), with the weight \( f(x, y) + f(y, x) \) on each such pair.

The problem is that the curve in Fig. 6 is not concave on \((0, Y)\), even if it is concave over \((0, x - y)\). The function is quasi-concave, but the sum of quasi-concave functions is not necessarily quasi-concave. Therefore, Proposition 1 cannot easily be generalized to this case.

However, the results when transfers are possible can be generalized. It turns out that when ex post transfers are possible, ex ante expected utility under federalism must be increasing in \( c \) at \( c = 0 \), provided the above condition that \( \pi(x, y) > 0.5 \) for all \( x > y \) holds. Moreover, if the generalization of condition \((IR-T)\) holds, then expected utility under federalism is a concave function of \( c \), and Propositions 2 and 3 continue to hold.

The generalization of \((IR-T)\) is that this condition hold for all possible income pairs \((x, y)\) with \( x > y \):

\[
f(x, y)y^\beta < f(y, x)x^\beta \quad \text{for all } x > y \quad (IR-T')
\]
In this generalization, the transfer which is made ex post, and which cuts off all migration now depends on the levels of income as well, namely

\[ T^*(x, y, c) = \min\left(0, \frac{x - y - c}{2}\right) \]

Lemma 2, in Appendix A shows that the modified condition \((IR - T^*)\) again ensures \(EU_1^T\) is increasing in \(c\) at \(c = 0\), concave in \(c\), and decreasing in \(c\) when \(c\) is sufficiently large.

Returning to the case of perfectly negatively correlated incomes (with only two possible realizations), allowing differences in migration costs among people will
not change the results of Section 2 (when transfers are not possible between regions).

Arrange the people in order of their migration costs, so that type-0 people have the lowest costs, and type-1 people the highest. Then there will be some threshold type, so that all people in the poor region whose type is less than the threshold will choose to migrate.

To facilitate comparison with Section 2, it is convenient to have some measure \( c \) of overall migration costs, so that an increase in \( c \) now corresponds to an increase in all people’s migration costs. Let \( C(t; c) \) be the migration cost of a type-\( t \) person, where the convention just defined means \( C(t; c) \) is increasing in \( t \). Assume that everyone’s migration costs approach 0 as \( c \) approaches 0, and migration costs (for everyone with \( t > 0 \)) grow large as \( c \) grows large. Then a “cut-off” type \( n(c) \) can be defined, such that everyone of type \( t < n(c) \) will choose to leave the poor region, when the value of the migration cost parameter is \( c \).

In Appendix A (Lemma 3), it is shown that all the results of Section 2 continue to hold with these differences in migration costs, provided that \( n^* < 0.5 \), when each region’s preferences are decided by majority rule. That is, expected utility of the median voter in region 1 is quasi-concave in \( c \) if and only if the risk aversion parameter \( \beta \) exceeds 2, and federalism will be chosen only if \( \beta > 2 \) and conditions (\( IR \)) and (\( PO \)) hold.

The results of Section 3 no longer hold. After the uncertainty has been resolved, all residents of the rich region will receive the same income, assuming that no “reverse migration” has been induced. So all residents of the rich region will agree with each other on the best ex post transfer. However, there is no longer complete commonality of interest between residents of the rich and poor regions concerning transfers. If migration occurs, income in the rich region and income in the poor region differ by the migration cost. But this migration cost is not a constant; it varies with the transfer chosen. If transfers are not so high as to cut off migration completely, then an increase in the transfer must make better off the residents of the poor region. However, now

\[
i_R = i_p + C(n(c, T); c)
\]

where \( n(c, T) \) is the marginal migrant’s type. Increases in \( T \) lower \( n(c, T) \), and thus \( C(n(c, T); c) \), so that the increase in \( i_p \) no longer necessarily implies that \( i_R \) must increase as well. In general, it will not be the case that the optimal ex post transfer (from the perspective of residents of the rich region) is the one which eliminates all migration.\(^{13}\)

Nonetheless, the possibility of ex post transfers must make it more likely that federalism will be chosen. Suppose residents of the rich region choose to make

\(^{13}\)Mansoorian and Myers (1993) discuss the implications of this sort of heterogeneity on the efficiency of voluntary transfers, in a model where the level of migration affects aggregate income.
some transfer $T > 0$. These residents all have the same preferences, after the
uncertainty has been resolved. The fact that they chose a positive transfer, rather
than $T = 0$ shows they must get higher utility than when transfers were not
possible. Positive transfers must also raise the ex post utility of any resident of the
poor region. Hence the possibility of ex post transfers raises the expected utility
from federation of any resident of region 1 (or region 2, for that matter).

6. Limitations

The model presented here ignores many features which could be regarded as
quite relevant to the formation (or dissolution) of federations. First, it has been
assumed that the only form of insurance is economic integration. To the extent that
the productivity shocks are verifiable, regional governments should be able to
purchase actuarially fair insurance – although enforcement of a contract made
between a sovereign state and some foreign firm may be difficult. Governments
can, and do, obtain other forms of insurance which do not involve migration or
equalization: monetary integration, for example, or customs unions.

Quite apart from government efforts to insure fluctuations, individuals within
each region can find their own insurance. Portfolio investment in foreign assets is
an obvious example.

However, it does appear that considerable risk remains uninsured through these
channels. Asdrubali et al. (1996) report that 40% of shocks to state GDP in the
United States for the period 1963–1990 were smoothed by capital markets, and
24% by credit markets. The American federal government smoothed 14%, leaving
22% unsmoothed.

Next, in the model presented here, regional output is independent of the region’s
population. This assumption neglects one of the main benefits of labour mobility:
the reallocation of workers to regions where they are most productive. It has long
been recognized that free migration may be inefficient in the presence of
distortionary taxes.\footnote{Flatters et al. (1994) derived this result for economies with a pure public good. Wildasin (1986)
provides a generalization.} The migration costs of the model presented here can be
interpreted as the costs induced by fiscally-induced migration. But, even with these
fiscal externalities, free migration may increase world output. By neglecting the
benefits here, I bias the case against federalism. The question addressed here is
whether insurance alone can justify a federal constitution.

The European experience may provide some support from the framework
adopted here. The widespread migration of “temporary” workers into western
Europe in the 1970’s indicates that labour mobility may not depend on the formal
arrangements among jurisdictions. That is, workers may move so as to equalize
marginal productivity, and maximize world output whether the constitution is
unitary, federal, or separate. The constitutional decision then becomes whether to share the rents with the migrant workers.

The model presented here is static. In reality, regional incomes vary over time – as do the perceptions of the likely distributions of income in the future. Regions may not wish to honour their commitments (either to share rents with immigrants, or to provide transfers) when they are relatively prosperous. For instance, the decentralization of Belgium may be due to changes over time in the relative prosperity of Flanders and Wallonia.

Mention of the Belgian experience suggests another salient feature left out of this model – and many others – non-economic factors. There are no ethnic or linguistic differences explicitly modelled here. Now to some degree, these differences may underlie migration costs. But quite apart from the effect such differences have on migration costs, they obviously play a direct role in many people’s views about constitutional structure. Slovakia may have decided to break with the Czechs in spite of economic factors, rather than because of them. Similarly, few proponents of Quebec independence argue on economic grounds alone. Rather, they argue that the economic costs are so small as to be outweighed by the non-economic benefits.

Nonetheless, these examples are consistent with some insurance role for federalism. It may be that increasing world economic integration means much better insurance opportunities are available than before. If separate regions can find almost as good insurance elsewhere as the federation provided, then the costs of secession from the federation are small. If there are non-economic benefits perceived, better world integration leads to the break-up of smaller federations.

Acknowledgements

I have benefitted greatly in the preparation and revision of this paper from comments from Gordon Myers, from participants in the public finance workshop at the University of Toronto, from two anonymous referees for this journal, and from the co-editor, Roger Gordon.

Appendix A

Proof of Lemma 1. From the definitions of \(EU_1^F\), \(i_k\) and \(i_p\),

\[
\frac{\partial EU_1^F}{\partial c} = \frac{\partial m}{\partial c} \left[ -\pi U'(i_k) \frac{\rho}{(1+n)^2} + (1-\pi)U'(i_p) \frac{1}{(1-n)^2} \right]
\]

(A.1)

Differentiating yet again with respect to \(c\),
From the assumption of constant relative risk aversion, and the definitions of \( i_r = \rho / (1 + n) \), \( i_p = \rho / (1 - n) \), therefore

\[
\frac{\partial^2 EU^V}{\partial c^2} = \left[ \frac{\partial EU^V}{\partial c} \right] \frac{n''(c)}{n'(c)} + [n'(c)]^2 \left[ \pi U''(i_R) \frac{\rho^2}{(1 + n)^2} + (1 - \pi) U''(i_p) \frac{1}{(1 - n)^3} \right]
+ 2[n'(c)]^3 \left[ \pi U''(i_R) \frac{\rho}{(1 + n)^3} + (1 - \pi) U''(i_p) \frac{1}{(1 - n)^3} \right]
\]  

(A.2)

so that \( \frac{\partial^2 EU^V}{\partial c^2} \) has the same sign as \( 2 - \beta \) when \( \frac{\partial EU^V}{\partial c} = 0 \), proving the lemma.

**Proof of Proposition 2.** Differentiating Eq. (7),

\[
\frac{\partial EU^V}{\partial c} = \frac{1}{2} \left( \pi U' \left[ \frac{1}{2} (1 + c + \rho) \right] - (1 - \pi) U' \left[ \frac{1}{2} (1 - c + \rho) \right] \right)
\]  

(A.4)

Differentiating yet again

\[
\frac{\partial^2 EU^V}{\partial c^2} = \frac{1}{4} \left( \pi U'' \left[ \frac{1}{2} (1 + c + \rho) \right] + (1 - \pi) U'' \left[ \frac{1}{2} (1 - c + \rho) \right] \right)
\]  

(A.5)

which must be negative, so that \( EU^V \) is a concave function of \( c \).

Eq. (A.4) shows that \( EU^V \) is increasing in \( c \) if and only if

\[
\frac{\pi}{1 - \pi} > \frac{U'(i_p)}{U'(i_R)}
\]

At \( c = \rho - 1 \), \( i_p = 1 \) and \( i_R = \rho \), so that \( EU^V \) decreasing in \( c \) at \( c = \rho - 1 \) is equivalent to condition \( (IR-T) \), proving the first part of the theorem. At \( c = 0 \), \( i_R = i_p \), so that the assumption \( \pi > 0.5 \) ensures that \( EU^V \) must be increasing in \( c \), meaning \( EU^V(c) > EU^V_0 \) for small enough \( c \), proving the second part.

The concavity of \( EU^V(c) \) proves the third part.
Proof of Proposition 3. Let $G(T)$ denote the expected utility of a person born in region 1, with ex ante transfers of $T$, when no migration occurs,

$$G(T) = \pi U(\rho - T) + (1 - \pi)U(1 + T)$$

The key to the proposition is to notice that if $T = T^*(c)$ for some $c$ in $[0, \rho - 1]$, then

$$G(T) = -\frac{1}{2} \frac{\partial EU_1^T}{\partial c}$$

Further, note that $T = T^*(0)$ fully equalizes incomes between rich and poor regions, so that any increase in $T$ above $T^*(0)$ must lower $G(T)$, given that $\pi > 0.5$. Also, $T^*(\rho - 1) = 0$, so that the optimal ex ante transfer $T$, from the point of view of region 1, must equal $T^*(c)$ for some $0 \leq c \leq \rho - 1$.

If condition $(IR - T)$ does not hold, then $EU_1^T$ is an increasing function of $c$. Thus $G(T)$ decreases with $T$, for any $T > T^*(c)$, and region 1 can do no better with ex ante transfers than with ex post transfers. And federalism cannot be individually rational with ex post transfers in this case, as Proposition 2 demonstrated.

If condition $(IR - T)$ does hold, then $EU_1^T$ reaches a maximum, as a function of $c$, at some $c^*$, with $0 < c^* < \rho - 1$. Denote the expected utility attained by residents of region 1 under federalism, when $c = c^*$, and transfers of $T^*(c^*)$ are made, as $U^*$. When condition $(IR - T)$ holds, $U^* = \max(EU_1^T, EU_1^I)$.

If $c > c^*$, a transfer of $T^*(c^*)$ would cut off all migration. And therefore it would give residents of region 1 expected utility of $U^*$. So for $c > c^*$, a transfer of $T^*(c^*)$ makes federalism both Pareto optimal and individually rational, if the regions can commit to the transfer policy.

What if $c < c^*$? A transfer of $T^*(c^*)$ would not cut off all migration, and the analysis of the previous section shows residents of region 1 would do better to specify $T = T^*(c)$, and cut off all migration. But any further increases above $T^*(c)$ would reduce expected utility, since $EU_1^T$ is decreasing in $c$ for $c < c^*$, and higher transfers just give the region the utility it would have attained had the migration cost been lower than $c$ and had transfers been decided ex post.

Hence, writing $EU_1^A$ and $EU_1^T$ as functions of $c$, it has been shown that

$$EU_1^A(c) = \max_{b \leq c} EU_1^T(b)$$

which proves the proposition.

Lemma 2. Suppose the distribution of incomes is arbitrary (but that everyone has the same migration cost $c$). For any pair of incomes $(x, y)$, with $x > y$, suppose that it is more likely region 1 has the higher income than region 2 — that is $f(x, y) > f(y, x)$ where $f(y_1, y_2)$ is the probability density function for the income pair $(y_1, y_2)$. 


Let \( EU^T_1(c) \) be the expected utility from federalism to region 1 if the migration cost is \( c \), and transfers are made ex post, with the expectation now made over all possible income pairs.

Then \( EU^T_1(c) \) will increase with \( c \) at \( c = 0 \). It will be concave, and will be decreasing in \( c \) for large enough \( c \), if the following generalization of condition \((IR-T)\) holds for all income pairs:

\[
f(x,y)y^\beta < f(y,x)x^\beta \quad \text{for all } x > y \quad (IR - T')
\]

**Proof.** Let \( Y \) be the maximum possible value for income in either region.

The transfer which will be made ex post will be the smallest transfer which cuts off all migration, \((x+y-c)/2\), unless \( x \leq y+c \) in which case no transfer is made. Income in the poor region is \((x+y-c)/2\) if \( x-y > c \) and \( y \) otherwise, and the income in the rich region is \((x+y+c)/2\) if \( x-y > c \) and \( x \) otherwise. Thus expected utility under federalism in region 1 is

\[
EU^T_1(c) = \int_0^y \int_{y+c}^y u \left( \frac{x+y+c}{2} \right) f(x,y) \, dx \, dy + \int_0^y \int_{y+c}^y u(\hat{x})f(x,y) \, dx \, dy + \int_0^y \int_0^{y+c} u(\hat{y})f(y,x) \, dx \, dy
\]

Therefore,

\[
\frac{\partial EU^T_1}{\partial c} = \frac{1}{2} \int_0^y \int_{y+c}^y u' \left( \frac{x+y+c}{2} \right) f(x,y) \, dx \, dy - \frac{1}{2} \int_0^y \int_{y+c}^y u' \left( \frac{x+y-c}{2} \right) f(y,x) \, dx \, dy
\]

and the second derivative is
Lemma 3. If people differ in migration cost, and \( C(t; c) \) is the migration cost of a type-\( t \) person, with

\[
C(t; 0) = 0 \quad \text{all } t > 0
\]

\[
C_s(t; c) > 0
\]

\[
C_c(t; c) > 0 \quad \text{for } c > 0
\]

\[
\forall t > 0 \quad \exists S(t) \text{ such that } c > S(t) \rightarrow C(t; c) > \rho - 1
\]

then Proposition 1 continues to hold if regions’ decisions are made by majority rule.

Proof. Let \( EU^1(t; c) \) be the expected utility of a resident of region 1 of type \( t \) under federalism, when the migration cost parameter equals \( c \). When \( c = 0 \), then \( C(t; c) = 0 \) for everyone, so that federalism is equivalent to a unitary state, so that

\[
EU^1(t; 0) = EU^U(t) \quad \forall t
\]

The assumption above on the existence of the finite \( S(t) \) for any \( t > 0 \) implies that as \( c \) approaches infinity, then \( C(t; c) > \rho - 1 \) for an arbitrarily large proportion of
people. Thus as \( c \) approaches infinity, then \( n(c) \) approaches 0, so that \( i_R \) approaches \( \rho \) and \( i_p \) approaches 1, which means that

\[
EU_1^F(t; c) \to EU_1^S \quad \text{as} \quad c \to \infty \quad \forall t > 0
\]

The utility of a type-\( t \) person under federalism is

\[
\pi U(i_R) + (1 - \pi)U(i_p)
\]

if \( t > n(c) \), and

\[
\pi U(i_R) + (1 - \pi)U(i_R - C(t; c))
\]

if \( t < n(c) \), where

\[
i_p = \frac{1}{1 - n(c)}
\]

\[
i_R = \frac{\rho}{1 + n(c)}
\]

and \( n(c) \) is the solution to the equation

\[
\frac{\rho}{1 + n(c)} = C(n(c); c) = \frac{1}{1 - n(c)}
\]

Differentiation of this definition implies

\[
n'(c) = -C_i(n(c); c) \frac{[n(c)]^2 - 1}{C_t^2 + 2n(c)C(n(c); c) - 1 - \rho} < 0
\]

Since people of type \( t > n(c) \) choose not to migrate, then \( EU_1^F \) is independent of \( t \) for \( t > n(c) \). If \( n^* < 0.5 \), then \( n(c) < 0.5 \) for all \( c \geq 0 \), since \( n(0) = n^* \), and \( n'(c) < 0 \). Therefore, a majority of the people of region 1 will find federalism individually rational if and only if \( EU_1^F(0.5; c) > EU_1^S \), and a majority of people of region 1 will prefer federalism to a unitary state if and only if \( EU_1^F(0.5; c) > EU_1^U \).

Now for a person of type \( t > n^* \),

\[
EU_1^F(t; c) = \pi U(i_R) + (1 - \pi)U(i_p)
\]

so that

\[
\frac{\partial EU_1^F}{\partial c} = n'(c) \left[ -\pi U'(i_R) \frac{\rho}{[1 + n(c)]^2} + (1 - \pi)U'(i_p) \frac{1}{[1 - n(c)]^2} \right]
\]

which means that Lemma 1 still holds.

At \( c = 0 \), \( i_R = i_p = \bar{y} \), and \( n(c) = n^* \), so that

\[
\left[ \frac{\partial EU_1^F(t; c)}{\partial c} \right]_{c=0} = n'(c)U'(\bar{y})\bar{y} \left[ \frac{\pi}{1 + n^*} - \frac{1 - \pi}{1 - n^*} \right]
\]
for any person with \( t > n^* \), so that condition (PO) is necessary and sufficient for \( EU^F_i \) to increase with \( c \) at \( c = 0 \), just as in the case of identical migration costs.

But as \( c \) approaches infinity, \( n(c) \) approaches 0, so that \( \partial EU^F_i / \partial c \) approaches

\[
n'(c)[-\pi U'(\rho) + (1 - \pi)U'(1)]
\]

for \( t > 0 \), so that condition (IR) is necessary and sufficient for \( EU^F_i \) to decrease with \( c \), just as in the case of identical migration costs.

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