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Optimal Secession Rules*

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Abstract

Should the constitution of a federation allow for peaceful secession? Constitutionally defined secession rules are optimal *ex post* if the federation breaks down. However, they may be suboptimal *ex ante* if the member countries receive a benefit from the perceived long-term stability of the federation and constitutionally defined secession rules increase the probability of a break-up. The optimal social contract trades off *ex ante* benefits and *ex post* losses, and it may avoid explicit secession rules. If transfers are costly, the trade-off is present even if *ex post* renegotiation is allowed. Finally, we show that under asymmetric information it is more difficult to keep the federation together and that a secession war may occur.

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Optimal Secession Rules

By Massimo Bordignon and Sandro Brusco

Non-Technical Summary.

Should the member countries of a federation be allowed to leave peacefully that federation? What is gained and what is lost when explicit secession rules are introduced in a federal constitution? And if explicit secession rules are to be introduced, how should they be structured?

Even if the federal constitution does not allow for explicit peaceful exit rules, member states may always attempt to secede *not* peacefully. Indeed, if a state perceives that remaining in a federation is against its interest, then it is only the threat of military action that may induce it to give up its claims to independence. Recent history is full of examples in which a secession was eventually obtained, often at huge costs in terms of lost lives and wasted economic resources. These examples suggest that *ex ante* (constitutional) rules for leaving the federation could play a positive economic role, by reducing the *ex post* cost of breaking up the federation. Yet, in most cases existing federations do not allow for such rules. Even the most recent example of a successfully formed federation, the European Monetary Union, does not consider the possibility that some of its members might in the future decide to regain their monetary sovereignty.

Why are secession rules so rarely part of a constitutional agreement? More in general, which economic and institutional factors affect the optimal secession rules? Since these rules are likely to be optimal *ex post*, in the event that the federation breaks down, the rationale for their absence at the constitutional level must lie in *ex ante* considerations. We argue that the absence of explicit secession rules can be seen as a *commitment device* to increase the stability of the federation. By *not* introducing these rules, the federation raises the exit cost for its members, thus reducing the probability of a break-up in the future. In turn, committing to a federation may be economically advantageous if the benefits a country receives from joining the federation depends on its (expected) duration. For instance, it seems hard to dispute that this factor was at work in the case of the EMU. Forming a monetary union, rather than, say, agreeing to irrevocable fixed exchange rates, may be more advantageous exactly because it is more costly to break a monetary union than simply unilaterally change an exchange rate. Thus, the expected benefits of fixed exchange rates, in terms of reduced uncertainty and increased price stability,

may be more easily obtained with a single currency.

This suggests to look at optimal secession rules as a way to trade off *ex ante* and *ex post* benefits. In this paper, we make a first attempt to address this trade-off formally. We do it so by assuming that at the time of joining the federation, the member countries can write a *complete social contract* (federal constitution) specifying transfers and secession rules in every possible future contingency. In this setting, we derive the optimal secession rules under scenarios of increasing complexity and realism. Under conditions of full information, it turns out that secession rules may or may not be introduced, depending on the relevance of the benefits *ex ante* to commit to the federation, which in turn depend on the exact features of the public good which is offered by the federation. However, if they are introduced, secession rules should usually take the form of an “unconditional” right to secede; because of the deadweight loss of taxation, no monetary compensation should be paid by the leaving countries. Furthermore, although the optimal secession rules – or rather the lack of them – may induce some welfare loss *ex post*, a secession war is never possible. The constitution would always prefer to let the countries leave peacefully if the alternative is a costly war.

Results may change if there is asymmetric information. In that case, it might be optimal not to introduce secession rules at all at the constitutional level, although this may lead to a costly secession war under some realization of the states of the world. Furthermore, when secession rules are introduced, they may also take the form of a “conditional” right to secede, with the leaving countries being forced to pay monetary compensations to the remaining countries. The reason for this reversal of results is that under asymmetric information the countries which benefit from the federation *ex post* may have an incentive to lie in order to avoid paying compensating transfers. As the federation breaks up more easily when the benefiting countries lie, it may be optimal to make it more costly to break the federation, so as to induce truthful revelation of types. As a result, however, severe welfare losses may occur under asymmetric information if the federation ends up breaking up.

1 Introduction

Should the member countries of a federation be allowed to leave peacefully that federation? What is gained and what is lost when explicit secession rules are introduced in a federal constitution? And if explicit secession rules are to be introduced, how should they be structured?

These questions are of particular interest when it is realized that even if the federal constitution does not allow for explicit peaceful exit rules, member states may always attempt to secede *not* peacefully. Indeed, if a state perceives that remaining in a federation is against its interest, then it is only the threat of military action that may induce it to give up its claims to independence. Recent history is full of examples in which a secession was eventually obtained, often at huge costs in terms of lost lives and wasted economic resources (Bosnia, Eritrea). In other cases, a secession was threatened in order to achieve economic advantages (Belgium, Lombardy). In other cases still, a secession was attempted and blocked by the use of military force and resulting economic destruction (Kurdistan). These examples suggest that *ex ante* (constitutional) rules for leaving the federation could play a positive economic role, by reducing the *ex post* cost of breaking up the federation. Yet, in most cases existing federations do not allow for such rules. Although some federal constitutions do pay lip service to the right of secession of the members, this right is usually expressed so vaguely or it is so severely constrained to seem hardly effective in practice¹.

¹For example, the 1971 constitution of the former Socialist Federal Republic of Yugoslavia (as the sister 1972 URSS constitution) explicitly acknowledged the right to secession of the member republics, without however being very specific on the way in which this right could be implemented. As history has shown, this lack of clarity may have been dearly paid by the country itself. On the contrary, the recent 1995 Ethiopian constitution recognizes the right to secede for the member nations and it spells out in detail the rules for secession. However, the rules are so strict (involving a positive vote to secession by the two-third majority of the Parliament, a national referendum and an agreed-upon division of assets) to make it difficult to believe they could be applied in practice. Interestingly, the constitutions of some of the new countries which have resulted from the dissolution of pre-existing federations (such as Croatia, Slovakia, and Georgia) explicitly forbid these countries to join federations where a right to secede is *not* acknowledged to the members. Finally,

Turning to a less dramatic case, the most recent example of a successfully formed federation, the European Monetary Union, does not consider the possibility that some of its members might in the future decide to regain their monetary sovereignty. Yet, many observers fear that a unique monetary policy, necessarily a compromise among the interests of still very different countries, may turn out to be unbearable for some of the members of the Union. Should this lead eventually to a breakup of the monetary union, it will certainly result in a serious disruption of economic and political relations in Europe. Again, explicit secession rules could ease the process, reducing the costs for both the remaining and the leaving countries of the Union.

Why are secession rules so rarely part of a constitutional agreement? More in general, which economic and institutional factors affect the optimal secession rules? Since these rules are likely to be optimal *ex post*, in the event that the federation breaks down, the rationale for their absence at the constitutional level must lie in *ex ante* considerations.

The absence of explicit secession rules can be seen as a commitment device to increase the stability of the federation. By *not* introducing these rules, the federation raises the exit cost for its members, thus reducing the probability of a break-up in the future. To put it differently, a constitutionally guaranteed secession clause modifies the *ex post* individual rationality constraint of member states. For a state to remain in a federation, it must be the case that the utility of staying is greater than the utility of leaving. The latter is reduced when a secession can only be attempted militarily rather than through constitutional means. Since the absence of explicit exit rules increases the cost of secession, it will make less likely a break-up of the federation.

Committing to a federation may be economically advantageous if the benefits a country receives from joining the federation depends on its (expected) duration. For instance, it seems hard to dispute it should also be noted that not explicitly acknowledging a constitutional right to secede is *not* equivalent to deny it; see for example the recent rule of the Canadian Constitutional Court on the admissibility of the Quebec separatists referendum. See Raina (1995), Bookman (1993) and Blaustein and Flanz (1998) for further institutional details.

that this factor was at work in the case of the EMU. Forming a monetary union, rather than, say, agreeing to irrevocable fixed exchange rates (an experiment already attempted in the European context, with dismal consequences), may be more advantageous exactly because it is more costly to break a monetary union than simply unilaterally change an exchange rate. Thus, the expected benefits of fixed exchange rates, in terms of reduced uncertainty and increased price stability, may be more easily obtained with a single currency. More generally, the benefits that a country may enjoy by joining a federation today (e.g. fiscal co-insurance, common defence policy, increased trade etc.) may be harder to obtain if it is commonly perceived that the federation will not be there tomorrow.

This suggests to look at optimal secession rules as a way to trade off *ex ante* and *ex post* benefits. By making secession more difficult a federation provides an *ex ante* economic advantage to its members, as to a large extent the success of the federation depends on the perception of its future duration. On the other hand, rules making secession more difficult increase the cost of a break-up should this occur, and may force the countries to stick together even when it is no longer efficient to do so. In this paper, we make a first attempt to address this trade-off formally. We do so by assuming that at the time of joining the federation, the member countries can write a *complete social contract* (federal constitution) specifying transfers and secession rules in every possible future contingency. This seems to be a natural benchmark for the analysis, one on which to build for future research. Furthermore, the complete contracts framework may not be too much out of the mark for those federal constitutions (such as, for example, the Maastricht Treaty) which do in fact consider very specific contingent rules for the member countries.

In this setting, we derive the optimal secession rules under scenarios of increasing complexity and realism. We start with the benchmark case of full information and no renegotiation. We first show that in this case there is indeed the trade-off we discussed above: to gain *ex-ante* benefits the optimal constitution may actually impose *ex post* losses on the member countries. However, we also show that under complete information, secession rules are usually a part of the optimal federal constitution. At

least in the *symmetric* case in which all countries receive *ex post* a negative utility from maintaining federation, the optimal constitution allows the countries to separate peacefully. Next, we study how secession rules are affected by *ex post* renegotiation. Renegotiation is crucial to our argument here, because if countries by renegotiating *ex post* could undo all that is written in the constitution *ex ante*, the trade-off we focus on in this paper would simply disappear. We show that this does not in general happen if transfers are costly. When some countries suffer and some gain from the federation *ex post*, by not allowing peaceful secession the constitution creates vested interests in maintaining the federation. If international transfers involve some efficiency loss, losers from the federation may not have enough resources to compensate the winners. Building on this result, we then derive the renegotiation-proof optimal constitution and compare it with that of the benchmark case.

Finally, we relax the assumption of complete information. We do it so by assuming that member countries have better information on their characteristics (i.e. preferences and tax bases) than the federal constituent has. This is an issue which has raised considerable interest in the recent fiscal federalism literature (i.e. Laffont, 1995, Lockwood, 1999, Cornes and Da Silva, 1999, Bordignon et al., 1996, Tabellini and Persson, 1996), especially with reference to the European Union. We show that, under asymmetric information, in order to keep incentives aligned the constituent will in general make it more difficult for the countries to leave the federation, not allowing them to secede peacefully even in those states of the world where maintaining the federation is suboptimal *ex ante* and not only *ex post*. Indeed, if conditions of asymmetric information are pervasive, no secession rules at all may well be the optimal second best solution. As a result, huge welfare losses, including a possible secession war, may characterize the federation *ex post* in some states of the world.

Our work can be seen as complementing two different lines of research in economics: the recent literature inquiring on the reasons for the break-up and the integration of countries (Bookman, 1993, Casella, 1992; Alesina and Spolore, 1997; Alesina, Perotti and Spolore, 1995; Bolton and Roland, 1997; Alesina, Spolore, and Wacziarg, 1998, Bolton, Roland and Spolore, 1996; Wei, 1992), and the

older literature inquiring on the normative reasons for introducing secession clauses in federal constitutions (Buchanan and Faith, 1987; Chen and Ordershook, 1994, Wood, 1981). The former literature highlights a number of economic and political reasons why countries should dissolve or integrate; however, it does not realize that some of the costs of doing so are endogenously (constitutionally) determined, and should therefore be explained and not simply assumed. The latter finds a number of reasons for introducing secession rules in federal constitutions; however, it does not ask why so few existing federal constitutions do in fact allow for secession clauses. Finally, although the issue of a “secession clause” has already been raised in connection with the EMU formation (e.g. Buchanan, 1990, Bernholz, 1992, Apolte, 1997), we are aware of no previous study which has attempted to study systematically the trade-off involved in such a clause.

The rest of the paper is organized as follows. In section 2 we spell out the model. In section 3 we derive the optimal federal constitution in the benchmark case of full information and no renegotiation. In section 4 we allow countries to renegotiate the Constitution *ex post* and study the optimal contract in this case. Section 5 characterizes the optimal constitution under asymmetric information. Concluding remarks are offered in section 6. The appendix collects the proofs.

2 The Model

We consider a simple economy with three countries² and two periods, and for simplicity we assume no discounting between periods. In period 0, the countries have to decide whether or not to form a federal union enabling them to produce a public good. This public good is excludable, meaning that if a country does not belong to the federation it will be unable to enjoy its benefits. At period 0 the countries ignore what their preferences about the public good will be in period 1. However, it is

²We focus on the three countries case, because it allows us to raise a number of issues which would not have arisen in the two countries case, while maintaining the analysis at a relatively simple level. As will be clear shortly, the extension to the n countries case is straightforward.

common knowledge that these preferences will be given by:

$$U_1^i(m^i, G) = \theta^i G(n) + m^i$$

where m^i is the amount of private consumption at time 1, $G(n)$ is the amount of the federal public good to which country i has access at time 1 when n countries (including i) belong to the federation in period 1, and θ^i is a random variable taking value $\bar{\theta}$ with probability p and $\underline{\theta}$ with probability $1 - p$, where $\bar{\theta} > 0 > \underline{\theta}$. Thus, the federal public good may turn out to be a "bad" for some countries in period 1. The random variables θ^1, θ^2 and θ^3 are independently distributed. $G(\cdot)$ is assumed to be an increasing function of n , capturing the idea that there are increasing returns to scale in the production of the federal public good. To make things as simple as possible, in what follows we assume that $G(n) = 1$ if $n = 3$, and $G(n) = 0$ otherwise, and we normalize the cost of producing the public good to 0. Thus, the federal public good can only be produced (in fixed quantity and at no cost) if all countries stay in the federation at period 1.

The consumption of the private good by country i is given by $m^i = w^i + \tau^i - T^i$ with w^i being the initial wealth of the country, and τ^i and T^i , respectively, the subsidy obtained and the tax paid at time 1. The triplet $\theta = (\theta^1, \theta^2, \theta^3)$ is the state of the world at period 1. The set of all possible states of the world is denoted with Θ . Finally, we normalize the level of wealth by setting $w^i = 0$ for each i .

For simplicity, we assume that at period 0 no production of the federal public good occurs. Nevertheless, if the countries decide to form the federation, they enjoy in period 0 a utility which is an increasing function of the probability that the federation will be maintained in period 1. This captures the idea, discussed in the introduction, that a federation provides greater utility to its members when it is expected to last. In period 0 countries are identical, and their utility is given by:

$$U_0^i = \gamma \Pr(n = 3)$$

where $\gamma \geq 0$ is a parameter. Notice that, since we allow for secession, n is a random variable. Its realization will depend on the particular rules chosen for secession at the constitutional stage and on

the realization of the state of the world $\theta = (\theta^1, \theta^2, \theta^3)$.

At the constitutional stage, the countries have to decide what rules to choose for secession, and what rules to choose for redistributing income among them. Throughout the paper, we will assume that at period 1 a country has always the option to secede violating the constitutional rules (the ‘independence war’ option). At the same time, after formally joining a federation, a country deciding to leave it unilaterally must pay a cost. Furthermore, we assume that if one country decides to secede against the constitutional rules, it imposes a cost on the other countries as well, due to the resulting economic weakening or dissolving of the same federation³. For simplicity, we will consider here only the case in which the costs of secession are symmetric among seceding and not seceding countries. Thus, we assume that if a country decides to secede in period 1, the federation is dissolved for sure and each country suffers a cost c , intended as the amount of resources destroyed in the ‘independence war’.

The constitution may grant a “right to secede” to the member countries. In that case, if a country decides to leave the federation unilaterally in period 1, the costs of the independence war are avoided, and the federation may be dissolved at lower costs for all countries. For simplicity, we will normalize these dissolving costs at 0. For the sake of generality, however, we also allow the constitution to grant a “conditional” right to secede to the member countries, by asking a leaving country to pay (or receive) a monetary compensation to (from) the remaining countries⁴.

³The interpretation to be given to these costs depends on the type of federation one has in mind. In the case of EMU, for instance, the costs of a unilateral secession for the seceding country would largely be in terms of the cost of building up again a credible national monetary institution. For the countries remaining in the EMU, on the other hand, the cost of a secession would largely be in terms of a loss of reputation by the European monetary institutions, likely resulting in a period of serious financial instability. In the case of a political federation, the costs of a secession for both seceding and not seceding countries could be in terms of a souring of international relationships, which may lead to a military conflict.

⁴It can be disputed, of course, if a federal constitution could be so specific to have such an explicit compensating clause written in it. As we saw above, with the exception of Ethiopia, most existing constitutions either do not allow for secession at all, or if they do, they usually grant an unconditional right to secede to members. In practice, however, most

The constitution can in principle specify different secession and transfer rules for different states of the world. We will denote by $d(\theta)$ the decision to maintain or dissolve the federation at period 1 when the state of the world is θ , with $d(\theta) = 1$ denoting the decision to maintain the federation and $d(\theta) = 0$ denoting the decision to dissolve.

Private consumption can be transferred among countries. However, we assume that, because of administrative and incentive costs, one unit of consumption can be transferred from one country to another only if a deadweight cost $\lambda \geq 0$ is paid. This means that in order to give $\tau \geq 0$ units of consumption to country i , the other countries have to pay a tax equal to $\tau(1 + \lambda)$. The consumption of country i in period 1 at state of the world θ is then equal to the difference between the transfer received and the tax paid: $m^i(\theta) = \tau^i(\theta) - T^i(\theta)$. Thus, a constitution specifies, for each state of the world θ , the decision $d(\theta)$ to be taken and the transfers and taxes for each country to be paid⁵. The sequence of events we consider is the following:

1. At period 0 the federation is either formed or not formed. In the first case, a constitution is drafted and approved unanimously by all countries involved; in the second case, the game ends.
2. At the beginning of period 1, the state of world θ is realized. The realization of θ^i may be observed by all countries (full information), or by country i only (asymmetric information);

If renegotiation is allowed, the countries may decide to rewrite the constitutional rules.

of the examples of pacific secession in the real world did involve some form of compensation to the remaining countries or regions. There are also examples (e.g. Belgium) where a full secession was not achieved precisely because the separating regions could not find an agreement on the division of national assets and liabilities (i.e. public debt). Furthermore, as we noted already, there are examples of very contingent federal constitution. In the case of the EMU, for example, the “stability pact” imposes specific rules of behavior on the countries remaining in the federation, involving fines for violating the rules. These can be seen as compensating transfers necessary to maintain the federation.

⁵In what follows transfers and taxes can be paid and received even if $d(\theta) = 0$. This captures the idea of a conditional right to secede to which we referred above.

3. Following the constitutional rules, a federal decision is taken about whether the federation should be maintained or dissolved and what transfers should be implemented.
4. Each country decides whether to accept the federal decision or to undertake an independence war.
5. According to the decisions taken above, the payoffs of the countries are realized and the game ends.

In our framework, a constitution is a social contract, and the exact content of this contract depends on the kind of variables we allow the contract to be written on. The benchmark case, which we discuss in the next section, is that of complete contracts under complete information and no renegotiation. After having characterized the benchmark case, we study how the results change when renegotiation is allowed and asymmetric information is introduced.

3 Complete Information and No Renegotiation

When dealing with the complete information problem, we can restrict our attention without loss of generality to constitutions such that the *ex post* individual rationality constraint is never violated, so that the ‘independence war’ is never declared. The expected utility of country i is given by:

$$E(U^i) = \gamma \Pr(d(\theta) = 1) + \sum_{\theta \in \Theta} p(\theta) (d(\theta) \theta^i + \tau^i(\theta) - T^i(\theta))$$

The expected social welfare is the sum of the expected utilities:

$$S = 3\gamma \Pr(d(\theta) = 1) + \sum_{\theta \in \Theta} p(\theta) \left(d(\theta) \left(\sum_{i=1}^3 \theta^i \right) + \sum_{i=1}^3 (\tau^i(\theta) - T^i(\theta)) \right) \quad (1)$$

and the budget constraint $\sum_{i=1}^3 ((1 + \lambda) \tau^i(\theta) - T^i(\theta)) = 0$ has to be satisfied for each θ . This can be written as:

$$\sum (\tau^i(\theta) - T^i(\theta)) = -\lambda \sum \tau^i(\theta). \quad (2)$$

Substituting for the above equation, we can then rewrite the social welfare function S as:

$$S = 3\gamma \Pr(d(\theta) = 1) + \sum_{\theta \in \Theta} p(\theta) \left(d(\theta) \left(\sum_{i=1}^3 \theta^i \right) - \lambda \left(\sum_{i=1}^3 \tau^i(\theta) \right) \right)$$

Since countries are *ex-ante* identical, it is natural to focus on *symmetric* constitutions. By this we mean that the decision to dissolve or maintain the federation is based only on the number of $\bar{\theta}$'s and $\underline{\theta}$'s, and that countries having the same level of θ^i receive (pay) the same transfer (tax). As θ is fully observable and verifiable, there are no incentive compatibility constraints to be considered. Furthermore, if it turns out to be optimal to form the federation, the *ex ante* participation constraints are trivially satisfied in the symmetric case. The only serious constraints are therefore the *ex post* participation constraints. This means that each country must receive at least $-c$ in each state of the world θ . We say that a constitution provides a *secession clause* if, for some state of the world θ , the federation is constitutionally dissolved, so that $d(\theta) = 0$.

Absent asymmetric information (and incentive compatibility constraints), we can study the optimal design of the constitution looking separately at each state of the world. As constitutions are symmetric, there are four states of the world to be considered, namely:

$$(\bar{\theta}, \bar{\theta}, \bar{\theta}) \quad (\bar{\theta}, \bar{\theta}, \underline{\theta}) \quad (\bar{\theta}, \underline{\theta}, \underline{\theta}) \quad (\underline{\theta}, \underline{\theta}, \underline{\theta})$$

To derive the optimal constitution, note first that if the benefits generated by the federation were independent of its expected duration (i.e. $\gamma = 0$ in (1)), then the optimal social contract would take a very simple form:

- If $\underline{\theta} \geq -c$ then dissolve the federation when $\sum_{i=1}^3 \theta^i < 0$ and maintain it if $\sum_{i=1}^3 \theta^i \geq 0$. Since transfers imply a deadweight loss it is optimal to set their level at zero for every state of the world. The condition $\underline{\theta} \geq -c$ ensures that the *ex post* individual rationality constraint is satisfied for every agent when transfers are zero.
- If $\underline{\theta} < -c$ then the federation is viable only if a transfer of at least $\tau^* = -(\underline{\theta} + c)$ is paid to countries of type $\underline{\theta}$. Therefore the deadweight loss of transfers has to be taken into account. Let

$\underline{\theta}$ be a state of the world, and let $j \in \{0, 1, 2, 3\}$ be the number of countries having $\theta^i = \underline{\theta}$. Then the federation is maintained if $(3 - j)\bar{\theta} + j\underline{\theta} - \lambda j\tau^* \geq 0$ and it is dissolved otherwise⁶.

When positive benefits from duration (i.e. $\gamma > 0$) are introduced, it may become *ex ante* optimal to prescribe that the federation be maintained in some states of the world in which this is not *ex post* optimal. In this case it is necessary to arrange transfers in such a way that the *ex post* participation constraints are satisfied. To see how these two effects interact in determining the optimal constitutional rules, consider first the case $\underline{\theta} \geq -c$. Since positive transfers involve a deadweight loss, the optimal choice is to set all transfers equal to zero. The choice between maintaining or dissolving the federation in period 1 thus involves a comparison between the *ex ante* benefits and the *ex post* potential losses (at zero transfers). Take for example the case $(\bar{\theta}, \underline{\theta}, \underline{\theta})$. From an *ex ante* perspective, the decision to maintain the federation in this state of the world implies an expected benefit equal to $3\gamma \Pr(\bar{\theta}, \underline{\theta}, \underline{\theta}) + \Pr(\bar{\theta}, \underline{\theta}, \underline{\theta})(\bar{\theta} + 2\underline{\theta})$, so that the federation should be maintained if $3\gamma + (\bar{\theta} + 2\underline{\theta}) \geq 0$, even if this is not *ex post* efficient (i.e. if $(\bar{\theta} + 2\underline{\theta}) < 0$). The same conclusion can be reached for all the other cases.

Next, suppose $\underline{\theta} < -c$; in this case a transfer $\tau^* = -(\underline{\theta} + c)$ must be paid to type $\underline{\theta}$ in order to keep it in the federation and the deadweight loss from the transfer must also enter in the optimal choice. For example, in the case $(\bar{\theta}, \underline{\theta}, \underline{\theta})$ the *ex ante* social utility equals $3\gamma + \bar{\theta} + 2\underline{\theta} - 2\lambda\tau^*$, *provided* that at this allocation the individual rationality constraint of type $\bar{\theta}$ is also satisfied; that is, provided that $\bar{\theta} - 2(1 + \lambda)\tau^* \geq -c$. Thus, the constitution prescribes that the federation should be maintained in case $(\bar{\theta}, \underline{\theta}, \underline{\theta})$ if *both* the conditions $3\gamma + \bar{\theta} + 2\underline{\theta} - 2\lambda\tau^* \geq 0$ and $\bar{\theta} - 2(1 + \lambda)\tau^* + c \geq 0$ are satisfied, and it should be dissolved otherwise. Notice now that the individual rationality constraint of type $\bar{\theta}$ in case $(\bar{\theta}, \underline{\theta}, \underline{\theta})$ can also be rewritten as $\bar{\theta} + 2\underline{\theta} - 2\lambda\tau^* + 3c \geq 0$. This implies that the two conditions can be written as:

$$\bar{\theta} + 2\underline{\theta} - 2\lambda\tau^* \geq -3c \qquad \bar{\theta} + 2\underline{\theta} - 2\lambda\tau^* \geq -3\gamma$$

⁶Notice that this condition implies that the *ex post* individual rationality constraint for type $\bar{\theta}$ is satisfied.

so that we can summarize the two inequalities by the condition:

$$\bar{\theta} + 2\underline{\theta} - 2\lambda\tau^* \geq -3 \min \{c, \gamma\} \quad (3)$$

In the case $\underline{\theta} < -c$, when the inequality in (3) is satisfied then it is both feasible and convenient to maintain the federation in period 1. We can then summarize the results of this section in the following proposition:

Proposition 1 *Assume that complete contracts are possible, there is full information, and that the member countries are able to commit not to renegotiate the constitution. Then the optimal social contract prescribes $d(\theta) = 1$ if:*

$$\sum_{i=1}^3 \left(\theta^i - \lambda \max \left\{ 0, -(\theta^i + c) \right\} \right) \geq -3 \min \{c, \gamma\} \quad (4)$$

Whenever the condition is satisfied, each country with $\theta^i = \underline{\theta}$ receives a subsidy $\tau^ = \max \{0, -(\underline{\theta} + c)\}$. If condition (4) is not satisfied then $d(\theta) = 0$ and transfer and taxes are zero.*

The proposition has a number of interesting implications. First, the optimal constitution usually involves a secession clause; for example, in the case $(\underline{\theta}, \underline{\theta}, \underline{\theta})$ and $\underline{\theta} < -c$, the optimal constitution certainly prescribes $d(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 0$. Second, the right to secede, when granted, is always unconditional. Transfers are socially costly and they are only used (at the lowest possible level) to convince disadvantaged countries to remain in the federation. The threat of using the secession war is credible in this case, since $\underline{\theta} < -c$ implies that the country is better off fighting rather than accepting the federation without compensating subsidies. On the other hand, when the federation is constitutionally dissolved there is no need to compensate countries with a high type, since in this case war is not a credible threat.

Third there may be a conflict between *ex ante* and *ex post* optimality. When there are benefits from the expected duration of the federation, the social contract may impose to the federation to go on even if it would be *ex post* optimal not to do so since $\sum \theta^i < 0$. We therefore face a classical time

inconsistency problem: member countries may be tempted to renegotiate the constitution and dissolve the federation *ex post*. We now investigate when this is possible and which effects the possibility of renegotiation may have on the optimal constitution.

4 Renegotiation

If the countries were able to renegotiate successfully whenever the constitution prescribes a course of action yielding an *ex post* aggregate loss, then the only feasible constitutions would be the ones prescribing *ex post* efficiency. In a sense, the constitution would be irrelevant. No *ex ante* agreement would be needed, since *ex post* efficient agreements would be reached anyway. If the constitution matters, it must be the case that there are situations in which renegotiation cannot modify what is defined in the constitution, although it would be *ex post* optimal to do so. In this section, we show that when $\lambda > 0$ (costly transfers) this is indeed the case in our model and then derive the optimal renegotiation proof constitution.

In our context, renegotiation means that the countries *unanimously* agree to a change of the constitution, modifying the transfers and the decision to dissolve or maintain the federation. We begin our analysis by checking whether the contract derived in the case of no renegotiation can survive. The first observation is that the decision to dissolve the federation is always renegotiation proof. From proposition 1, $d(\theta) = 0$ whenever $3 \min\{c, \gamma\} + \sum_{i=1}^3 (\theta_i - \lambda \tau^i(\theta)) < 0$. This implies $\sum_{i=1}^3 (\theta^i - \lambda \tau^i(\theta)) < 0$, so that separation is *ex post* optimal.

The renegotiation constraint may become binding only when the no-renegotiation contract prescribes that the federation should be maintained. When the state of the world is $(\bar{\theta}, \bar{\theta}, \bar{\theta})$ then the optimal contract prescribes no transfers and maintaining the federation. This is obviously renegotiation proof. On the other hand, if the state of the world is $(\underline{\theta}, \underline{\theta}, \underline{\theta})$ then the optimal contract prescribes no transfers and maintaining the federation if and only if $3\gamma + 3\underline{\theta} \geq 0$ and $\underline{\theta} \geq -c$ (or, more compactly, $\underline{\theta} \geq -\min\{c, \gamma\}$). This is clearly not renegotiation-proof, as the member countries can agree

to modify the constitution and allow for peaceful separation. In fact, it is clear that there is no way in which the countries can credibly commit to maintain the federation in the state of the world $(\underline{\theta}, \underline{\theta}, \underline{\theta})$ when renegotiation is possible. Notice that in ‘symmetric’ states of the world, the deadweight cost of transfer λ plays no role, since no transfer is possible. In ‘asymmetric’ states this is no longer true. We start establishing the following result.

Lemma 1 *The optimal social contract is renegotiation-proof at state θ when the federation is dissolved.*

If the federation is maintained at θ then the optimal contract is renegotiation proof if:

$$(3 - j)\bar{\theta} + j\underline{\theta} - j\tau^*\lambda \geq -\lambda \left((3 - j)\bar{\theta} - j\tau^*(1 + \lambda) \right) \quad (5)$$

where τ^* is the transfer scheme described in proposition (1) and j is the number of countries of type $\underline{\theta}$ at state of the world θ .

In order to interpret the lemma, observe that the expression on the left hand side of the inequality is simply the *ex post* social utility of maintaining the federation, given by the sum of the direct utilities minus the deadweight loss of the transfers necessary to keep the federation together. On the right hand side, we have the deadweight loss of the transfers which have to be paid in order to dissolve the federation⁷. This is the *ex post* social utility of dissolving the federation. Thus, the lemma establishes that the original social contract is renegotiation proof if the net social utility of maintaining the federation is larger than the net social utility of dissolving it.

Notice that, in presence of a conflict between *ex ante* and *ex post* optimality, the original social contract can be renegotiation proof only if $\lambda > 0$; if λ were equal to zero then (5) would certainly be violated whenever $\sum \theta^i < 0$. This provides the intuition for the lemma; by not allowing the federation to dissolve in some cases, the social contract creates a vested interest in countries of type $\bar{\theta}$ to maintain

⁷Recall that transfers have to be enough to compensate the $(3 - j)$ type $\bar{\theta}$ countries, each receiving a utility $\bar{\theta} - \frac{j}{3-j}\tau^*(1 + \lambda)$ if the federation is maintained.

the federation. If transfers involve a deadweight loss, countries of type $\underline{\theta}$ may not have enough resources to compensate countries of type $\bar{\theta}$ for dissolving the federation.

Suppose now that condition (5) is *not* satisfied at some θ at which it would be desirable to maintain the federation. Is there anything that can be done *ex ante* in order to avoid renegotiation *ex post*? In particular, is it possible to re-design the contract and specify transfers so as to make renegotiation impossible and maintain the federation?

To understand the question, remember that in order to agree to dissolve peacefully a federation, the countries enjoying a positive utility from the federation have to be compensated with transfers giving them at least equivalent utility. By setting different transfers *ex ante*, the social contract can modify the *status quo* utility levels. In turn, by modifying the *status quo*, the social contract can also modify the deadweight costs incurred to compensate the countries benefiting from the federation. In principle, it might therefore be possible that by setting transfers different from the optimal ones the constituent would make it impossible to renegotiate the social contract. This, however, turns out not to be the case.

Proposition 2 *No social contract can prevent renegotiation and dissolution of the federation at a state of the world θ at which condition (5) is not satisfied. The optimal social contract with renegotiation allows for dissolution of the federation in all the states in which either the optimal social contract without renegotiation prescribes dissolution or condition (5) is not satisfied.*

The proposition implies that it is impossible to modify the structure of the transfers so as to increase the stability of the federation when condition (5) is violated. The intuition is simple. The optimal social contract under no renegotiation minimizes the amount of transfers given the *ex post* participation constraints. Any (feasible) modification of the transfers therefore increases their aggregate level. Since transfers are socially costly, this implies reducing the social utility of maintaining the federation. However, it also implies increasing the cost of dissolving the federation, as different and higher transfers

change the status quo. The first effect make it more difficult to keep the federation going on; the second, makes it more difficult to dissolve it. But the first effect always dominates the second, so that it is never possible to make the federation more stable by moving away from the optimal transfers.

The implication is that the optimal social contract when renegotiation is possible closely resembles the optimal social contract when renegotiation is not allowed. Renegotiation reduces the set of states in which the federation can be maintained. Whenever maintaining the federation is impossible or not desirable, the optimal social contract prescribes dissolution⁸. While renegotiation does reduce the set of feasible outcomes, implying a reduction in expected social welfare, the presence of renegotiation does not induce a distortion in the transfers whenever the federation is maintained.

5 Asymmetric Information

Suppose now that there is asymmetric information about the realization of the state of the world θ . As usual, the stochastic structure of the model is common knowledge but only country i observes the actual realization of θ^i at the beginning of period 1. How does the optimal social contract change?

As anticipated in the introduction, this section is motivated by the recent focus in the fiscal federalism literature on problems of asymmetric information in federations, between the federal government and the local governments. For instance, asymmetric information problems are probably at the root of the serious budget problems in federal countries such as China and the former republics of USSR, where most tax revenue is collected and administered locally (Laffont, 1995). Should the European Commission budget increase in size, asymmetric information problems might become a serious prob-

⁸From the point of view of the implementation of the contract, dissolution has to be explicitly prescribed when $\underline{\theta} \geq -c$. In this case, if the social contract were not to prescribe explicitly the dissolution of the federation, countries of type $\underline{\theta}$ would have to bribe countries of type $\bar{\theta}$. Dissolution would occur anyway, but (socially costly) positive transfers would have to be paid. In the case $\underline{\theta} < -c$ it is not necessary to include explicitly a secession clause, since countries of type $\bar{\theta}$ will accept to renegotiate and dissolve the federation.

lem in the European Union as well, as the member countries are still in charge of collecting their own revenue and they are also the main source of national statistics (Bordignon et al., 1996; Cornes and Da Silva, 1999).

In our context, asymmetric information may become an issue only if the countries, by lying about their true θ^i , may affect the implementation of the constitutional rules to their advantage. To study this issue, we set up the problem as follows. The social contract at time 0 establishes tax and transfer schemes, as well as the secession rule, as a function of the *declared state of the world* by all countries. That is, the social contract chooses functions $d(\tilde{\theta})$, $\tau^i(\tilde{\theta})$, $T^i(\tilde{\theta})$, where $\tilde{\theta} = (\tilde{\theta}^1, \tilde{\theta}^2, \tilde{\theta}^3)$ is the announced state of the world. At the beginning of period 1 member countries learn their type and announce it simultaneously. Given the announcement $\tilde{\theta}$, the social decision $(d(\tilde{\theta}), \tau^i(\tilde{\theta}), T^i(\tilde{\theta}))$ is implemented. Each country i has still the option to refuse the decision, making everybody pay the cost c . If all countries accept, then the social decision is implemented.

The *ex post* participation constraints of all countries must therefore again be satisfied whenever the social decision is implemented in period 1. There is however an important difference with respect to the complete information case. As we saw above, under complete information it is never optimal to prescribe a decision such that the *ex post* individual rationality constraints are violated. This would only lead to each country paying a cost c , and it is obviously better to set $d(\theta) = \tau^i(\theta) = T^i(\theta) = 0$ and avoid paying that cost. Under incomplete information things may be different. In principle, it may now become convenient to trigger an ‘independence war’ under some circumstances if this helps to keep incentives aligned. By the same token, it might also become convenient to let the federation peacefully dissolve at a cost, by imposing a monetary compensation for the leaving countries.

Let $\chi^i(\theta)$ be the decision by country i to trigger the independence war at state of the world θ , with $\chi^i(\theta) = 1$ denoting acceptance of the social decision and $\chi^i(\theta) = 0$ denoting the decision to fight. Let $\chi(\theta) = \chi^1(\theta) \chi^2(\theta) \chi^3(\theta)$, so that $\chi(\theta) = 1$ if the war is not triggered and $\chi(\theta) = 0$ otherwise.

Feasible social rules have to take into account the incentive compatibility constraints for the two

types of countries. Define:

$$U^i(\theta^i, \theta^{-i}) = \left(d(\theta^i, \theta^{-i}) \bar{\theta} + \tau^i(\theta^i, \theta^{-i}) - T^i(\theta^i, \theta^{-i}) \right) \chi(\theta^i, \theta^{-i}) - \left(1 - \chi(\theta^i, \theta^{-i}) \right) c$$

as the utility of a country of type θ^i announcing the truth, when other countries announce θ^{-i} .

Furthermore, define:

$$\overline{U}_{\underline{\theta}}(\theta^{-i}) = \max \left\{ \left(d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) \right) \chi^{-i}(\underline{\theta}, \theta^{-i}) - \left(1 - \chi^{-i}(\underline{\theta}, \theta^{-i}) \right) c, -c \right\}$$

as the utility of a country of type $\bar{\theta}$ announcing $\underline{\theta}$. The first term in the ‘max’ operator is the utility of the country if it accepts the decision (notice that $\chi^{-i}(\underline{\theta}, \theta^{-i})$ denotes the decision to stay or not in the federation by countries other than i when i declares $\underline{\theta}$), while the second term denotes the utility if i rejects the social decision. The term $\underline{U}_{\bar{\theta}}(\theta^{-i})$ can be defined similarly.

The *ex ante* maximization problem becomes:

$$\begin{aligned} & \max_{d(\theta), \tau^i(\theta), T^i(\theta)} 3\gamma \sum_{\theta \in \Theta} \Pr(\theta) d(\theta) \chi(\theta) + \\ & \sum_{\theta \in \Theta} \Pr(\theta) \left(\left(d(\theta) \left(\sum_{i=1}^3 \theta^i \right) + \tau^i(\theta) - T^i(\theta) \right) \chi(\theta) - (1 - \chi(\theta)) 3c \right) \end{aligned}$$

s.t.

$$\sum_{i=1}^3 \left((1 + \lambda) \tau^i(\theta) - T^i(\theta) \right) \leq 0 \quad \text{each } \theta \quad (\text{BC})$$

$$\begin{aligned} \chi^i(\theta) &= 0 & \text{if } d(\theta) \theta^i + \tau^i(\theta) - T^i(\theta) < -c \\ \chi^i(\theta) &\in [0, 1] & \text{if } d(\theta) \theta^i + \tau^i(\theta) - T^i(\theta) = -c & \text{each } i, \theta \in \Theta \quad (\text{EPIR}) \\ \chi^i(\theta) &= 1 & \text{otherwise} \end{aligned}$$

$$\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) U^i(\bar{\theta}, \theta^{-i}) \geq \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \overline{U}_{\underline{\theta}}(\theta^{-i}) \quad (\overline{\text{IC}})$$

$$\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) U^i(\underline{\theta}, \theta^{-i}) \geq \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \underline{U}_{\bar{\theta}}(\theta^{-i}) \quad (\underline{\text{IC}})$$

Constraint BC is the budget constraint which has to be satisfied for every θ . EPIR is the *ex post* individual rationality constraint. It requires that a country should start a war whenever the utility enjoyed by accepting the social decision is less than $-c$. $\overline{\text{IC}}$ and $\underline{\text{IC}}$ are the incentive compatibility constraints for the high and low type, respectively⁹.

Clearly, the only difference with the optimization problem considered in the previous section is given by the two IC constraints. How does their presence affect the solution? One obvious observation is that whenever the solution described in proposition 1 satisfies the IC constraints then this will be the solution for the case of asymmetric information too. Hence, to verify if asymmetric information matters, we have first to check if at the complete information solution the IC constraints are binding; if they are not then the solution is unaffected by asymmetric information. This leads to the following proposition.

Proposition 3 *Suppose that the optimal social contract under complete information requires zero transfers in every state of the world. Then the contract remains optimal under asymmetric information.*

The proof is immediate and it is omitted. Intuitively, if no transfer is paid then the announcement has the only effect of determining whether the federation should be maintained or not. Since an announcement of $\underline{\theta}$ increases the probability that the federation is dissolved, it is clear that types $\bar{\theta}$ will tell the truth. A similar reasoning holds for types $\underline{\theta}$. Thus, with no transfers the original contract is incentive compatible and asymmetric information has no bite. An immediate corollary of the proposition is the following.

Corollary 1 *If $\underline{\theta} \geq -c$ then the optimal social contract under asymmetric information is the same as under complete information. The same occurs when the optimal social contract under complete*

⁹Note that given the assumption of symmetric constitutions and *ex ante* identical countries with independent shocks, the incentive compatibility constraints are given by just two inequalities, one for type $\underline{\theta}$ and one for type $\bar{\theta}$.

information prescribes that the federation is maintained only if $\theta = (\bar{\theta}, \bar{\theta}, \bar{\theta})$.

Proposition (3) thus implies that asymmetric information can be problematic only if positive transfers are involved, that is, in the case $\underline{\theta} < -c$. In what follows we focus on the case in which the optimal ‘complete information’ social contract is not incentive compatible. In the other case, it is obvious that the ‘complete information’ social contract is still optimal under incomplete information.

We begin by establishing the following proposition.

Proposition 4 *Suppose $\underline{\theta} < -c$ and the incentive compatibility constraint for type $\bar{\theta}$ is not satisfied at the optimal complete information social contract. Then whenever the federation is maintained, the optimal contract under asymmetric information has the same transfers and taxes as in the complete information case.*

The formal proof of the proposition is involved (see the appendix), but the intuition is fairly straightforward. Under asymmetric information, it turns out that the only incentive compatible constraint which matters is the one relative to type $\bar{\theta}$; type $\underline{\theta}$ would never have an incentive to lie, pretending to be of type $\bar{\theta}$ instead, because this leads to paying taxes rather than receiving subsidies in some states of the world, or to maintaining the federation more frequently. So suppose that the incentive compatibility constraint for type $\bar{\theta}$ is not satisfied at the optimal complete information social contract. Consider a state of the world at which it is *ex ante* optimal to maintain the federation. Is there any distortion of the transfers which would make the social contract incentive compatible in this case? The answer is no. Reducing the transfers to type $\underline{\theta}$ below τ^* is unfeasible, because they are already at the lowest possible level. Raising them is not incentive incompatible, as it increases the benefit of lying for type $\bar{\theta}$. Introducing positive transfers for type $\bar{\theta}$ is either unfeasible or would violate symmetry.

Given that is either unfeasible or sub-optimal to modify the transfers when the federation is maintained, the only possibility which is left to the constituent is to change either the transfers or

the secession rules *when the federation breaks down*. Assume that the countries have full commitment power so that renegotiation *ex post* is not possible. By this we mean that whenever the social contract prescribes $d(\theta) = 1$ the only way to break the federation is by unilateral secession, so that every country receives a utility equal to $-c$. Then there are three basic different strategies which can be used to make the social contract incentive compatible. First, it could simply set the transfers equal to zero in any (declared) state of the world. In this case the federation is maintained only when the state of world $(\bar{\theta}, \bar{\theta}, \bar{\theta})$ realizes, and optimality would require $d(\bar{\theta}, \bar{\theta}, \bar{\theta}) = 1$ and $d(\theta) = 0$ for all the other θ 's, so avoiding the “independence war” costs. This solution is not very satisfactory if γ is large, and indeed with this solution it may be impossible to support the federation even in cases in which it would be *ex post*, and not only *ex ante*, efficient to do so.

Second, under the assumption of full commitment, the constituent might attempt to *punish* type $\bar{\theta}$ for lying. It could do it so by imposing $d(\theta) = 1$ even for some states of the world θ at which it is *ex ante* inefficient to maintain the federation. In fact, as the federation is more likely to dissolve when type $\bar{\theta}$ lies, this action would increase the cost of lying for this type, by making it paying a cost $-c$ rather than 0 should these states occur. This solution may eliminate the incentive compatibility problem, at the cost of having the countries paying the independence war costs in some states of the world.

Finally, the social contract may attempt to *reward* type $\bar{\theta}$ for telling the truth, by imposing to countries of type $\underline{\theta}$ to pay a transfer to countries of type $\bar{\theta}$ whenever the federation is dissolved. That is, the constituent may grant a “conditional” right to secede to the countries, allowing them to secede only if a compensation is paid to the other countries. Of course, this compensation must be lower than c (otherwise, type $\underline{\theta}$ countries would prefer to secede unilaterally) and must also not be so large to violate the incentive compatibility constraint for type $\underline{\theta}$. Again, this strategy might solve the incentive compatibility problem, at the cost of having welfare reducing transfers to be paid in situations in which the federation breaks down.

As these different strategies have different costs and benefits depending on the values of the parameters θ, γ, c and λ , intuition would suggest that each of these different strategies may be optimal. We will later discuss some examples.

One may ask if in principle the federation could be maintained in a larger set of cases as a result of asymmetric information. The question is not trivial (as it would have been if we had assumed only two countries; see footnote 2) because, in principle, one of the strategies to solve the incentive compatibility problem is to make it more difficult for the countries to leave the federation. As transfers are incentive compatible if this strategy is successful, this means that in some of the “mixed cases” where the complete information contract would have had the federation dissolved, it could now in principle be maintained. However, as the next proposition proves, this can never happen at the optimal contract under asymmetric information.

Proposition 5 *The set of states of the world in which the federation is maintained when there is incomplete information is included in the set of states of the world in which the federation is maintained when there is complete information.*

Intuitively, in order to solve the revelation problem, the strategy of maintaining the federation in some of the states of the world where it would have been dissolved under complete information is welfare dominated by the strategy of making it more costly to dissolve the federation when this dissolution actually occurs. Thus, the number of states of the world where the federation is maintained is always equal or greater under complete information.

We now present two examples characterizing optimal constitutions under incomplete information.

Example 1. Suppose $\underline{\theta} < -c$ and the inequality:

$$3\gamma + \underline{\theta} + 2\bar{\theta} - \lambda\tau^* > 0 > 3\gamma + 2\underline{\theta} + \bar{\theta} - 2\lambda\tau^*$$

is satisfied. The optimal contract under full information requires $d(\bar{\theta}, \bar{\theta}, \bar{\theta}) = d(\bar{\theta}, \bar{\theta}, \underline{\theta}) = 1$ and

$d(\bar{\theta}, \underline{\theta}, \underline{\theta}) = d(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 0$. The incentive compatibility constraint for type $\bar{\theta}$ is:

$$p^2 \bar{\theta} + 2p(1-p) \left(\bar{\theta} - \frac{(1+\lambda)\tau^*}{2} \right) \geq p^2 (\bar{\theta} + \tau^*).$$

Therefore, the optimal contract under complete information is not incentive compatible if:

$$2(1-p)\bar{\theta} - \tau^*(1 + \lambda(1-p)) < 0. \quad (6)$$

Suppose first that the constituent wishes nevertheless to maintain the federation in the same states of the world as under complete information. To do so, it can either reward type $\bar{\theta}$ for telling the truth or it might punish it for lying. Consider the first option. In state $(\underline{\theta}, \underline{\theta}, \underline{\theta})$ the federation dissolves for sure and no transfer can be imposed because of symmetry and budget balance. Thus, the only possibility is to set $d(\bar{\theta}, \underline{\theta}, \underline{\theta}) = 0$ and impose countries of type $\underline{\theta}$ to pay a compensating transfer r to countries of type $\bar{\theta}$ for dissolving the federation in this case. Let us call this the ‘conditional secession’ policy. The policy is feasible if the incentive compatibility constraints of the high and low types are satisfied, that is:

$$p^2 \bar{\theta} + 2p(1-p) \left(\bar{\theta} - \frac{(1+\lambda)\tau^*}{2} \right) + (1-p)^2 r \geq p^2 (\bar{\theta} + \tau^*) + 2p(1-p) \left(\frac{-r(1+\lambda)}{2} \right) \quad (7)$$

$$2p(1-p) \left(\frac{-r(1+\lambda)}{2} \right) + p^2(-c) \geq (1-p)^2 r + 2p(1-p)(-c) + p^2(-c) \quad (8)$$

Inequality 8 can be rewritten as:

$$\left(\frac{-r(1+\lambda)}{2} \right) - \left(\frac{1-p}{p} \right) \frac{r}{2} \geq -c$$

Thus, policy 1 is feasible¹⁰ if there is an r which satisfies inequalities 7 and 8. This is possible if:

$$2(1-p)(\bar{\theta} + c) - \tau^*(1 + \lambda(1-p)) \geq 0 \quad (9)$$

¹⁰The individual rationality condition of the low type has also to be satisfied. However, this condition is given by $-\frac{r(1+\lambda)}{2} \geq -c$, and it is satisfied whenever 8 is satisfied.

which can in principle be satisfied even if (6) is not.

Another possibility is to *punish* type $\bar{\theta}$ for lying, by imposing that in the cases in which the federation breaks down a secession war is started. This can be obtained by setting either $d(\bar{\theta}, \underline{\theta}, \underline{\theta}) = 1$ or $d(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 0$ (or both). Furthermore, there may in principle be a “mixed policy” where a conditional right to secede is granted in state of the world $(\bar{\theta}, \underline{\theta}, \underline{\theta})$ and no secession rule at all in $(\underline{\theta}, \underline{\theta}, \underline{\theta})$. Each of these policies could, under some conditions, solve the incentive compatible problem. It turns out however that all these policies are welfare dominated by the ‘conditional secession’ policy¹¹. The intuition is simple. By construction, the ‘conditional secession’ policy always gives more utility to both types than any of the alternative policies, because it avoids the waste of a secession war. Thus, the constituent could wish to use an alternative policy only if under this alternative policy it were easier to support the federation. But this turns out never to be the case; it can be shown that under any of the alternative policies described above the conditions to support the federation in states of the world $(\bar{\theta}, \bar{\theta}, \bar{\theta})$ and $(\bar{\theta}, \bar{\theta}, \underline{\theta})$ are always at least as restrictive as in inequality (9).

Thus, if it wishes to support the federation in the states of the world $(\bar{\theta}, \bar{\theta}, \bar{\theta})$ and $(\bar{\theta}, \bar{\theta}, \underline{\theta})$, the constituent cannot do better than providing a conditional right to secede to countries of type $\underline{\theta}$ in state of the world $(\bar{\theta}, \underline{\theta}, \underline{\theta})$. However, the policy comes at a cost, as now the additional transfer r has to be paid.

Alternatively, the constituent could give up maintaining the federation in state of the world $(\bar{\theta}, \underline{\theta}, \underline{\theta})$, setting all transfers equal to zero. In that case, as the federation will certainly break up in all realizations except than in case $(\bar{\theta}, \bar{\theta}, \bar{\theta})$, the best choice for the constituent is to set $d(\bar{\theta}, \bar{\theta}, \bar{\theta}) = 1$ and $d(\bar{\theta}, \bar{\theta}, \underline{\theta}) = d(\bar{\theta}, \underline{\theta}, \underline{\theta}) = d(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 0$. Call this policy 2. Which of the two policies is better depends on the *ex ante* utility of the constituent under the two policies. Intuitively, a policy of conditional

¹¹This can be proved by substituting for all the alternative policies in the incentive compatible constraint of the high type and by noting that none of these policies affect the incentive compatible constraint of the low type. Deriving the feasibility conditions and comparing them with equation 9 gives the result.

secession may dominate giving up the federation in all cases except $(\bar{\theta}, \bar{\theta}, \bar{\theta})$, provided that the extra utility gained by maintaining the federation in case $(\bar{\theta}, \bar{\theta}, \underline{\theta})$ is large enough.

Example 2. Suppose $\underline{\theta} < -c$ and $3\gamma + 2\underline{\theta} + \bar{\theta} - 2\lambda\tau^* > 0$. In this case, the optimal policy under complete information is to maintain the federation in all cases except $(\underline{\theta}, \underline{\theta}, \underline{\theta})$. Thus, under complete information, the optimal secession rules are $d(\bar{\theta}, \bar{\theta}, \bar{\theta}) = d(\bar{\theta}, \bar{\theta}, \underline{\theta}) = d(\bar{\theta}, \underline{\theta}, \underline{\theta}) = 1$ and $d(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 0$. Suppose again the relevant incentive compatible condition for type $\bar{\theta}$ is violated at this contract. In this case, if the constituent wishes to maintain the federation in the same cases as under complete information, it has no other choice than imposing $d(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 1$ and let a secession war burst if this case occurs. Assuming that this is enough to make the incentive compatibility constraint of the high type satisfied, the constituent can then support the federation in the same cases as under complete information, at the cost of risking a secession war. However, it is clear that if γ is large enough it will find it optimal to do so.

Summing up, there are two basic conclusions to be drawn from this section. First, asymmetric information reduces expected welfare and makes it more difficult to keep together the federation. Second, in order to cope with asymmetric information, the social contract may limit the introduction of secession rules, not allowing the countries to leave the federation at zero cost even when it would like them to do so; that is, when dissolving the federation is optimal *ex ante* and not only *ex post*. This policy may be needed to satisfy the incentive compatibility constraints. The implication is that under asymmetric information there may be states of the world where the countries suffer heavy welfare losses *ex post*; indeed, as we have shown above, under asymmetric information countries may end up with the payoffs of the “secession war”, whereas this was never possible under full information.

The results could be different if we had allowed the countries to renegotiate the contract *ex post*. Paying the cost of a secession to break the federation, when the same could be dissolved at zero cost for everybody may not appear a very credible outcome. On the other hand, the possibility of renegotiation would modify the incentive compatibility constraints. Renegotiation *ex post* should be

correctly modeled as a bargaining problem under asymmetric information, but unfortunately in this case the results are sensitive to the assumptions made on the structure of the negotiation process. We prefer to leave the matter here and simply note that whatever the framework chosen to model this kind of problem, bargaining under asymmetric information in general does not lead to Pareto efficient outcomes¹². Thus, we believe that the possibility of a secession war under asymmetric information is robust to the introduction of renegotiation under asymmetric information.

6 Concluding Remarks.

We began this work by asking a few simple questions: should secession rules be introduced in a federal constitution? And if so, how should they be structured? The paper offers the following answers. The basic trade-off in choosing optimal secession rules is between the *ex post* benefits of reducing the cost of dissolving the federation and the *ex ante* benefits of credibly committing to the federation. The specific features of the rules depend on the economic and institutional framework in which the federation operates. Assuming that the member countries can write a complete contract at the time of joining in a federation, we get a very neat characterization of the optimal secession rules. Under conditions of full information, secession rules may or may not be introduced, depending on the relevance of the benefits *ex ante* to commit to the federation, which in turn depend on the exact features of the public good which is offered by the federation. However, if they are introduced, secession rules should usually take the form of an “unconditional” right to secede; because of the deadweight loss of taxation, no monetary compensation should be paid by the leaving countries. Furthermore, although the optimal secession rules – or rather the lack of them – may induce some welfare loss *ex post*, a secession war is never possible. The constitution would always prefer to let the countries leave peacefully if the alternative is a costly war.

¹²Notice that renegotiation may create problems even if the social contracts prescribes no transfers, since there may be opportunities to bribe someone else in lying in order to break the federation.

Results may change if there is asymmetric information. In that case, it might be optimal not to introduce secession rules at all at the constitutional level, although this may lead to a costly secession war under some realization of the states of the world. Furthermore, when secession rules are introduced, they may also take the form of a “conditional” right to secede, with the leaving countries being forced to pay monetary compensations to the remaining countries. The reason for this reversal of results is that under asymmetric information the countries which benefit from the federation *ex post* may have an incentive to lie in order to avoid paying compensating transfers. As the federation breaks up more easily when the benefiting countries lie, it may be optimal to make it more costly to break the federation, so as to induce truthful revelation of types. As a result, however, severe welfare losses may occur under asymmetric information if the federation ends up breaking up.

Our results are roughly consistent with the empirical evidence on existing federations. Few constitutions allow for peaceful secessions, and when they do, they usually provide an unconditional right to secede. Our results may also be used to question the optimality of the current constitutional arrangements in the European Monetary Union, which do not consider any secession rule. We think however that the issue deserves more research. On the one hand, as the analysis was meant to cast some light on a so far neglected issue, the model has been willingly kept at very simple level. Several extensions (such as for instance to allow for asymmetric and risk averse countries) would be worth making in order to cast further light on the characteristics of existing federations. On the other hand, our results crucially depend on the possibility of using complete contracts at the constitutional level. The ‘complete contracts’ paradigm is a useful benchmark, and as we have already argued, it might not be too bad an assumption for some existing federations. However, in many other cases, constitutions are probably better seen as incomplete contracts. That is, because of the impossibility of predicting and describing *ex ante* all future contingencies, constitutions can only specify *procedures* to make decisions which are independent of contingencies (see Dixit, 1996, Tabellini and Persson, 1999; Aghion and Bolton, 1998). In our context, one should therefore ask which optimal procedures should be chosen

at the constitutional level to allow for peaceful secession, taking into account the trade-off between *ex ante* and *ex post* optimality which is implicit in the secession rules. We think that extending our analysis to these issues would be a very interesting avenue for further research.

Appendix

Proof of Proposition 1. If we ignore the *ex post* individual rationality conditions, optimality requires that the federation be maintained in all states of the world such that:

$$3\gamma + \sum_{i=1}^3 \theta^i \geq 0 \quad (10)$$

If $\underline{\theta} \geq -c$, the *ex post* participation constraints are satisfied when no transfer occurs. Therefore in that case it is both feasible and desirable to maintain the federation. Notice that if $\underline{\theta} \geq -c$ then condition (4) is equivalent to condition (10). If $\underline{\theta} < -c$ then compensating transfers are needed. Since transfer are socially costly, optimality requires that they be equal to the lowest possible amount. Therefore, an agent of type $\underline{\theta}$ receives a transfer $\tau^* = -(\underline{\theta} + c)$. The associated cost is $\lambda\tau^*$ for each agent of type $\underline{\theta}$ so that, once the individual rationality constraint of type $\underline{\theta}$ has been taken into account, the condition for social optimality becomes:

$$\sum_{i=1}^3 \left(\theta^i - \lambda \max \{0, -(\underline{\theta} + c)\} \right) \geq -3\gamma \quad (11)$$

We have to make sure that the individual rationality constraint for types $\bar{\theta}$ is satisfied. Let j be the number of types $\underline{\theta}$ at state of the world $\theta = (\theta^1, \theta^2, \theta^3)$. If $j = 3$ then it is not feasible to keep the federation together, and it can be seen that in this case condition (4) is violated. Suppose $j < 3$. The *ex post* individual rationality constraint for type $\bar{\theta}$ is now:

$$\bar{\theta} - \frac{j}{3-j} \tau^* (1 + \lambda) \geq -c \quad (12)$$

since a total subsidy $j\tau^*$ has to be paid to types $\underline{\theta}$, resulting in a *per capita* payment of $\frac{j}{3-j}\tau^*(1+\lambda)$ for each type $\bar{\theta}$. Using $\tau^* = -(\underline{\theta} + c)$, inequality (12) can be written as:

$$(3-j)\bar{\theta} + j\underline{\theta} + \lambda j(\underline{\theta} + c) \geq -(3-j)c - jc$$

which can also be written as:

$$\sum_{i=1}^3 \left(\theta^i - \lambda \max \left\{ 0, -(\theta^i + c) \right\} \right) \geq -3c \quad (13)$$

Therefore, maintaining the federation is both desirable and feasible when inequalities (11) and (13) are both satisfied. This is equivalent to condition (4).

Proof of Lemma 1. We have already shown that the decision to dissolve is renegotiation proof. Suppose that the constitution prescribes that the federation should be maintained. In this case, each country with $\theta^i = \underline{\theta}$ is paid a transfer $\tau^* = \max \{0, -(\underline{\theta} + \bar{c})\}$. The total tax to be paid is $j\tau^*(1+\lambda)$ and each country $\bar{\theta}$ pays $\frac{j\tau^*(1+\lambda)}{3-j}$. A country of type $\underline{\theta}$ always receives a negative utility (i.e. $-c$) when the federation is maintained. If it also turns out that $\bar{\theta} - \frac{j\tau^*(1+\lambda)}{3-j} \leq 0$ then the countries will renegotiate and agree to dissolve the federation at zero cost. It is immediate to see that in this case condition (5) is violated.

Suppose then that $\bar{\theta} - \frac{j\tau^*(1+\lambda)}{3-j} > 0$. In this case the federation would be dissolved only if type $\underline{\theta}$ countries were able to compensate the type $\bar{\theta}$ countries. For this to be the case, it must be possible to find a transfer R such that:

$$R \geq \bar{\theta} - \frac{j\tau^*(1+\lambda)}{3-j} \quad -\frac{(3-j)}{j}R(1+\lambda) \geq \underline{\theta} + \tau^*$$

The first inequality states that the transfer received by a country with type $\bar{\theta}$ must be enough to make it accept the dissolution of the federation. The total tax to be paid is $(3-j)R(1+\lambda)$, and it is divided among the j countries with type $\underline{\theta}$, so that the second inequality implies that countries with type $\underline{\theta}$ are willing to pay the tax in order to get the federation dissolved. The transfer R exists, so

that renegotiation is possible, if:

$$0 \geq (1 + \lambda) \left((3 - j) \bar{\theta} - j \tau^* (1 + \lambda) \right) + j (\underline{\theta} + \tau^*)$$

This implies that renegotiation can be prevented only if 5) holds.

Proof of proposition 2. The proposition is obtained establishing the following lemmas.

Lemma 2 *Assume that condition (5) is not satisfied at state of the world θ . Then any social contract that maintains the federation at state θ and gives a positive transfer to countries of type $\bar{\theta}$ is not renegotiation proof.*

Proof. A subsidy to countries of type $\bar{\theta}$ can only be paid if $\underline{\theta} > -\bar{c}$, otherwise the participation constraint for types $\underline{\theta}$ would be violated. In that case we have $\tau^* = 0$ and since (5) is violated we have:

$$(3 - j) \bar{\theta} + j \underline{\theta} < -\lambda (3 - j) \bar{\theta}. \quad (14)$$

Suppose that the social contract prescribes a positive transfer τ to countries with type $\bar{\theta}$. In order to renegotiate the contract and dissolve the federation it has to be possible to compensate countries of type $\bar{\theta}$. Therefore, renegotiation occurs if we can find R such that:

$$R \geq \bar{\theta} + \tau \quad -\frac{3-j}{j} R (1 + \lambda) \geq \underline{\theta} - \frac{3-j}{j} \tau (1 + \lambda)$$

Combining the two inequalities, we see that renegotiation is possible if:

$$-\lambda (3 - j) \bar{\theta} \geq (3 - j) \bar{\theta} + j \underline{\theta}.$$

which is exactly condition (14).

Lemma 3 *Assume that condition (5) is not satisfied at state of the world θ . Then there is no renegotiation-proof social contract such that the federation is maintained at state θ in period 1.*

Proof. We only need to worry about transfers to countries of type $\underline{\theta}$. Since (5) is violated we have:

$$(3-j)\bar{\theta} + j\underline{\theta} < -\lambda(3-j)\bar{\theta} + j\tau^*\lambda(2+\lambda) \quad (15)$$

Assume that a transfer $\tau > \tau^*$ is paid to countries of type $\underline{\theta}$. Renegotiation occurs if the utility of each country is negative. Furthermore, utility cannot be positive for both types, since this would imply that condition (5) is satisfied. We have therefore to consider only cases in which either the utility of type $\underline{\theta}$ or the utility of type $\bar{\theta}$ is strictly positive. Let us look at the two cases.

Case 1: $\underline{\theta} + \tau > 0$, $\bar{\theta} - \frac{j}{3-j}\tau(1+\lambda) < 0$. In this case types $\bar{\theta}$ have to compensate types $\underline{\theta}$ in order to dissolve the federation. Renegotiation is possible if there exists R satisfying:

$$R \geq \underline{\theta} + \tau \quad -\frac{j}{3-j}R(1+\lambda) \geq \bar{\theta} - \frac{j}{3-j}\tau(1+\lambda)$$

which yields the condition:

$$(3-j)\bar{\theta} + j\underline{\theta} \leq -\lambda j\underline{\theta} \quad (16)$$

From (16) and (15), we conclude that renegotiation is always possible if:

$$-\lambda j\underline{\theta} > j\tau^*\lambda - \lambda(3-j)\bar{\theta} + j\tau^*\lambda(1+\lambda) \quad (17)$$

If $\tau^* = 0$ it is immediate to see that (17) is satisfied. If $\tau^* = -(\underline{\theta} + c)$ then write the condition as:

$$(3-j)\bar{\theta} + j\underline{\theta} - j\lambda\tau^* > -2jc \quad (18)$$

Suppose (18) does not hold, that is

$$(3-j)\bar{\theta} + j\underline{\theta} - j\lambda\tau^* \leq -2jc \quad (19)$$

The individual rationality constraint for types $\bar{\theta}$ implies:

$$-(3-j)c \leq (3-j)\bar{\theta} - j\tau(1+\lambda)$$

Using now the inequality $j(\underline{\theta} + \tau) > 0$ and adding up both sides we obtain:

$$-(3-j)c \leq (3-j)\bar{\theta} + j\underline{\theta} - j\tau\lambda \quad (20)$$

adding (19) and (20) on both sides we obtain:

$$j\lambda(\tau - \tau^*) \leq 3c(1 - j) \implies \tau < \tau^*$$

This is impossible, since τ^* is the lowest transfer that can be given to types $\underline{\theta}$.

Case 2: $\underline{\theta} + \tau < 0$, $\bar{\theta} - \frac{j}{3-j}\tau(1 + \lambda) > 0$. In this case renegotiation is possible if:

$$j\tau\lambda(2 + \lambda) - \lambda(3 - j)\bar{\theta} \geq (3 - j)\bar{\theta} + j\underline{\theta}$$

From (15) we have that renegotiation is always possible if:

$$-\lambda(3 - j)\bar{\theta} + j\tau^*\lambda(2 + \lambda) \leq j\tau\lambda(2 + \lambda) - \lambda(3 - j)\bar{\theta}$$

which, after simplifications turns out to be equivalent to:

$$\tau \geq \tau^*$$

which is always satisfied.

Proof of proposition 4. We first establish the following lemmas.

Lemma 4 *Suppose $\underline{\theta} < -c$. Then for every feasible social contract it must be the case that for each state of the world θ such that $d(\theta)\chi(\theta) > 0$ we have $\tau^i(\theta) = 0$ if $\theta^i = \bar{\theta}$.*

Proof. If $d(\theta)\chi(\theta) > 0$ then *ex post* rationality has to be satisfied. Since we are analyzing the case $\underline{\theta} < -c$, type $\underline{\theta}$ must receive a strictly positive transfer. Therefore, in every symmetric constitution type $\bar{\theta}$ must pay a tax whenever the federation is maintained and at least one type $\underline{\theta}$ is present. If no type $\underline{\theta}$ is present then zero transfers are implied by symmetry.

Lemma 5 *The probability of dissolving the federation is higher when a type $\underline{\theta}$ is announced, that is:*

$$\sum_{\theta^{-i} \in \Theta^{-i}} p(\bar{\theta}, \theta^{-i}) d(\bar{\theta}, \theta^{-i}) \chi^{-i}(\bar{\theta}, \theta^{-i}) \geq \sum_{\theta^{-i} \in \Theta^{-i}} p(\underline{\theta}, \theta^{-i}) d(\underline{\theta}, \theta^{-i}) \chi^{-i}(\underline{\theta}, \theta^{-i}).$$

Proof. The incentive compatibility constraint for type $\bar{\theta}$ can be written as:

$$\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\bar{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) + c) \chi^{-i}(\bar{\theta}, \theta^{-i}) - c \right) \geq$$

$$\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c) \chi^{-i}(\underline{\theta}, \theta^{-i}) \bar{\chi}^i(\theta^{-i}) - c \right)$$

where:

$$\begin{aligned} \bar{\chi}^i(\theta^{-i}) &= 0 & \text{if } d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) < c \\ \bar{\chi}^i(\theta^{-i}) &\in [0, 1] & \text{if } d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) = c \\ \bar{\chi}^i(\theta^{-i}) &= 1 & \text{if } d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) > c \end{aligned}$$

The incentive compatibility constraint for type $\underline{\theta}$ is:

$$\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\underline{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c) \chi^{-i}(\underline{\theta}, \theta^{-i}) \geq \right.$$

$$\left. \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\bar{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) + c) \chi^{-i}(\bar{\theta}, \theta^{-i}) \underline{\chi}^i(\theta^{-i}) \right) \right)$$

where:

$$\begin{aligned} \underline{\chi}^i(\theta^{-i}) &= 0 & \text{if } d(\bar{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) < c \\ \underline{\chi}^i(\theta^{-i}) &\in [0, 1] & \text{if } d(\bar{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) = c \\ \underline{\chi}^i(\theta^{-i}) &= 1 & \text{if } d(\bar{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) > c \end{aligned}$$

Summing up on both sides the two incentive compatibility constraints and simplifying we obtain:

$$\begin{aligned} &\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\bar{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) + c) \chi^{-i}(\bar{\theta}, \theta^{-i}) + \right. \\ &\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\underline{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c) \chi^{-i}(\underline{\theta}, \theta^{-i}) \geq \right. \\ &\sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c) \chi^{-i}(\underline{\theta}, \theta^{-i}) \bar{\chi}^i(\theta^{-i}) \right. \\ &\left. \left. \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) \left((d(\bar{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) + c) \chi^{-i}(\bar{\theta}, \theta^{-i}) \underline{\chi}^i(\theta^{-i}) \right) \right) \right) \end{aligned}$$

Notice now that, by definition of $\bar{\chi}^i(\theta^{-i})$ and $\underline{\chi}^i(\theta^{-i})$ we have

$$(d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c) \bar{\chi}^i(\theta^{-i}) \geq d(\underline{\theta}, \theta^{-i}) \bar{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c$$

$$\left(d\left(\bar{\theta}, \theta^{-i}\right) \underline{\theta} + \tau^i\left(\bar{\theta}, \theta^{-i}\right) - T^i\left(\bar{\theta}, \theta^{-i}\right) + c\right) \chi^i\left(\theta^{-i}\right) \geq d\left(\bar{\theta}, \theta^{-i}\right) \underline{\theta} + \tau^i\left(\bar{\theta}, \theta^{-i}\right) - T^i\left(\bar{\theta}, \theta^{-i}\right) + c$$

Therefore the following inequality must hold:

$$\begin{aligned} & \sum_{\theta^{-i} \in \Theta^{-i}} p\left(\theta^{-i}\right) \left(d\left(\bar{\theta}, \theta^{-i}\right) \bar{\theta} + \tau^i\left(\bar{\theta}, \theta^{-i}\right) - T^i\left(\bar{\theta}, \theta^{-i}\right) + c\right) \chi^{-i}\left(\bar{\theta}, \theta^{-i}\right) + \\ & \sum_{\theta^{-i} \in \Theta^{-i}} p\left(\theta^{-i}\right) \left(d\left(\underline{\theta}, \theta^{-i}\right) \underline{\theta} + \tau^i\left(\underline{\theta}, \theta^{-i}\right) - T^i\left(\underline{\theta}, \theta^{-i}\right) + c\right) \chi^{-i}\left(\underline{\theta}, \theta^{-i}\right) \geq \\ & \sum_{\theta^{-i} \in \Theta^{-i}} p\left(\theta^{-i}\right) \left(d\left(\underline{\theta}, \theta^{-i}\right) \bar{\theta} + \tau^i\left(\underline{\theta}, \theta^{-i}\right) - T^i\left(\underline{\theta}, \theta^{-i}\right) + c\right) \chi^{-i}\left(\underline{\theta}, \theta^{-i}\right) \\ & \sum_{\theta^{-i} \in \Theta^{-i}} p\left(\theta^{-i}\right) \left(d\left(\bar{\theta}, \theta^{-i}\right) \underline{\theta} + \tau^i\left(\bar{\theta}, \theta^{-i}\right) - T^i\left(\bar{\theta}, \theta^{-i}\right) + c\right) \chi^{-i}\left(\bar{\theta}, \theta^{-i}\right) \end{aligned}$$

After simplifications we obtain:

$$\sum_{\theta^{-i} \in \Theta^{-i}} p\left(\theta^{-i}\right) \chi^{-i}\left(\bar{\theta}, \theta^{-i}\right) d\left(\bar{\theta}, \theta^{-i}\right) \geq \sum_{\theta^{-i} \in \Theta^{-i}} p\left(\theta^{-i}\right) \chi^{-i}\left(\underline{\theta}, \theta^{-i}\right) d\left(\underline{\theta}, \theta^{-i}\right)$$

concluding the proof.

Lemma 5 is used to prove the following.

Lemma 6 *It is never the case that a country of type $\underline{\theta}$ receives at some state of the world such that $d\left(\underline{\theta}, \theta^{-i}\right) \chi\left(\left(\underline{\theta}, \theta^{-i}\right)\right) > 0$ a subsidy $\tau^i\left(\underline{\theta}, \theta^{-i}\right) > -(\underline{\theta} + c)$.*

Proof. Because of the deadweight cost λ , transfers enter negatively into the objective function. It cannot therefore be the case that, at an optimal point, no constraint is binding. In particular, either $\overline{\text{IC}}$ or $\underline{\text{IC}}$ must be binding. Clearly, a reduction in $\tau^i\left(\underline{\theta}, \theta^{-i}\right)$ does not violate $\overline{\text{IC}}$. Therefore, $\underline{\text{IC}}$ must hold with equality.

Suppose first that under the optimal contract the ‘independence war’ is declared with positive probability when country i announces $\underline{\theta}$, that is there exists a state $\left(\underline{\theta}, \widehat{\theta}^{-i}\right)$ such that $\chi^{-i}\left(\underline{\theta}, \widehat{\theta}^{-i}\right) < 1$. This social contract cannot maximize expected utility. We can find a feasible strict improvement over the contract by increasing $\chi^{-i}\left(\underline{\theta}, \widehat{\theta}^{-i}\right)$ and at the same time reducing both $\tau^i\left(\underline{\theta}, \theta^{-i}\right)$ and taxes in

a way that balance the budget. This can be done making sure that the two incentive compatibility constraints are satisfied, as well as all other constraints. Since transfers are reduced and the secession cost is paid with lower probability, the expected social utility increases.

Suppose now that independence war is never declared, that is $\chi^{-i}(\underline{\theta}, \theta^{-i}) = 1$ always. Since $\underline{\text{IC}}$ holds with equality we have:

$$\begin{aligned} \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) (d(\underline{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) - T^i(\underline{\theta}, \theta^{-i}) + c) = \\ \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) (d(\bar{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\bar{\theta}, \theta^{-i}) - T^i(\bar{\theta}, \theta^{-i}) + c) \chi^i(\theta^{-i}) \end{aligned}$$

If $\tau^i(\bar{\theta}, \theta^{-i}) > 0$ for some θ^{-i} then the $\overline{\text{IC}}$ constraint must hold with equality. In this case it is possible to reduce simultaneously $\tau^i(\underline{\theta}, \theta^{-i})$ and $\tau^i(\bar{\theta}, \theta^{-i})$ and keep both constraints satisfied with equality, while improving social welfare. Thus, the proposed policy is not optimal.

If $\tau^i(\bar{\theta}, \theta^{-i}) = 0$ then we also have $T^i(\underline{\theta}, \theta^{-i}) = 0$ always. This must be the case when $d(\theta) = 1$. If $d(\theta) = 0$ then positive taxes may only be needed to finance transfers to the high type or to keep incentives aligned. The first motive cannot hold, since $\tau^i(\bar{\theta}, \theta^{-i}) = 0$. As for the second motive, reducing $T^i(\underline{\theta}, \theta^{-i})$ does not violate the $\underline{\text{IC}}$. Considering now $\overline{\text{IC}}$, if the constraint is not binding then there is no problem. If it's binding then taxes are thrown away, since $\tau^i(\bar{\theta}, \theta^{-i}) = 0$. This is dominated by a policy in which taxes are reduced and tax revenue is (at least partially) distributed to the high types. This can be done keeping the two incentive constraints satisfied. Then the equality becomes:

$$\begin{aligned} \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) (d(\underline{\theta}, \theta^{-i}) \underline{\theta} + \tau^i(\underline{\theta}, \theta^{-i}) + c) = \\ \sum_{\theta^{-i} \in \Theta^{-i}} p(\theta^{-i}) (d(\bar{\theta}, \theta^{-i}) \underline{\theta} - T^i(\bar{\theta}, \theta^{-i}) + c) \chi^i(\theta^{-i}) \end{aligned}$$

The equality cannot hold, since by announcing $\underline{\theta}$ the country does strictly better. By lemma 5 the probability of dissolving the federation is higher, and the payments are lower. This ends the proof of the lemma.

The two lemmas imply that we can restrict our attention to social contracts such that $\tau^i(\theta) = \tau^*$ whenever $d(\theta) \chi(\theta) > 0$. It is clear that at each state of the world taxes are set at the level that balance the budget, that is whenever the federation is maintained taxes and subsidies are exactly as in the complete information situation. The reason is that taxes enter negatively into the objective function and can only create problems for the IC constraint of type $\bar{\theta}$.

Proof of proposition 5. If $c < \gamma$ then the optimal social contract under complete information already includes all possible social states in which it is feasible to maintain the federation. Therefore, in this case the set of states under which it turns out $d(\theta) \chi(\theta) > 0$ in the optimal incomplete information social contract is necessarily (weakly) included in the set of states of the world for which the federation is maintained under the complete information contract.

Suppose now $c \geq \gamma$. Observe that there are only three possible policies under complete information:

- 1) Maintain the federation when the state is $(\bar{\theta}, \bar{\theta}, \bar{\theta})$
- 2) Maintain the federation when the state is in the set $\{(\bar{\theta}, \bar{\theta}, \bar{\theta}), (\bar{\theta}, \bar{\theta}, \underline{\theta})\}$.
- 3) Maintain the federation when the state is in the set $\{(\bar{\theta}, \bar{\theta}, \bar{\theta}), (\bar{\theta}, \bar{\theta}, \underline{\theta}), (\bar{\theta}, \underline{\theta}, \underline{\theta})\}$.

In the first case no incentive problem arises, since there are no transfers. The optimal contract under incomplete information is therefore the same as under complete information. In the last case, the only state of the world in which the federation is not maintained is $(\underline{\theta}, \underline{\theta}, \underline{\theta})$. It can never be the case that $d(\underline{\theta}, \underline{\theta}, \underline{\theta}) \chi(\underline{\theta}, \underline{\theta}, \underline{\theta}) > 0$ under the incomplete information contract, since EPIR for type $\underline{\theta}$ is violated. Thus, it again turns out that the set of states under which it $d(\theta) \chi(\theta) > 0$ in the optimal incomplete information social contract is (weakly) included in the set of states of the world for which the federation is maintained under the complete information contract.

We are left with the second case. We start observing that the optimal contract must be such that $d(\underline{\theta}, \underline{\theta}, \underline{\theta}) \chi(\underline{\theta}, \underline{\theta}, \underline{\theta}) = 0$ (same argument as above) and $d(\bar{\theta}, \bar{\theta}, \bar{\theta}) \chi(\bar{\theta}, \bar{\theta}, \bar{\theta}) = 1$ (since adding this state can only improve the IC constraints for both types). Therefore we are left with only two cases such that the set in which the federation is maintained is not included in $\{(\bar{\theta}, \bar{\theta}, \bar{\theta}), (\bar{\theta}, \bar{\theta}, \underline{\theta})\}$:

1. $\{(\bar{\theta}, \bar{\theta}, \bar{\theta}), (\bar{\theta}, \underline{\theta}, \underline{\theta})\}$. This cannot be optimal because it is dominated by the policy of maintaining the federation only when the state is $(\bar{\theta}, \bar{\theta}, \bar{\theta})$. Notice that this policy is incentive compatible and remember that maintaining the federation at $(\bar{\theta}, \underline{\theta}, \underline{\theta})$ has negative social utility.
2. $\{(\bar{\theta}, \bar{\theta}, \bar{\theta}), (\bar{\theta}, \bar{\theta}, \underline{\theta}), (\bar{\theta}, \underline{\theta}, \underline{\theta})\}$. We show that this policy is also dominated by the policy of maintaining the federation only when the state is $(\bar{\theta}, \bar{\theta}, \bar{\theta})$. First observe that under the optimal complete information policy it must be the case that the incentive compatibility constraint for the high type is violated, otherwise the optimal policy under incomplete information would be identical to the one under complete information. Therefore:

$$p^2 \bar{\theta} + 2p(1-p) \left(\bar{\theta} - \frac{1}{2} \tau^* (1 + \lambda) \right) < p^2 (\bar{\theta} + \tau^*)$$

This inequality implies:

$$2(1-p) \left(\bar{\theta} - \frac{1}{2} \tau^* (1 + \lambda) \right) < p (\bar{\theta} + \tau^*) \quad (21)$$

The policy of maintaining the federation at state $(\bar{\theta}, \underline{\theta}, \underline{\theta})$ can be optimal only if it contributes to lessen the incentive compatibility problem for the high type, that is if:

$$(1-p) \left(\bar{\theta} - 2\tau^* (1 + \lambda) \right) > 2p (\bar{\theta} + \tau^*)$$

or:

$$(1-p) \left(\bar{\theta} - 2\tau^* (1 + \lambda) \right) > 2p (\bar{\theta} + \tau^*) \quad (22)$$

But now observe that:

$$2(1-p) \left(\bar{\theta} - \frac{1}{2} \tau^* (1 + \lambda) \right) > (1-p) \left(\bar{\theta} - 2\tau^* (1 + \lambda) \right)$$

so that inequalities 21 and 22 are incompatible.

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