The Survival and Demise of the State: A Dynamic Theory of Secession

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Abstract

This paper analizes the repeated interaction between groups in a country as a repeated Stackelberg game, where conflict and secession can occur on the equilibrium path owing to commitment problems. If a group out of power is small enough and its contribution to total surplus not too large, then the group in power can always maintain peace with an acceptable offer of surplus sharing for every period. When there is a mismatch between the relative size and the relative surplus contribution of the minority group, conflict can occur. While in the static model secession can occur only as a peaceful outcome, in the infinite horizon game with high discount factor secession may result following costly conflict. We discuss our full characterization of equilibrium outcomes in the light of the available empirical evidence.

Keywords: Secessions, Conflict, Repeated Stackelberg Game.
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1 Introduction

Historically, secessions from empires or states, or collapses, have been due to war or rebellion, and the types of secession incentives (or their lack) have varied widely. Some secessions take place in peace. For instance, the Roman Empire voluntarily and peacefully split into two similarly large and similarly rich halves marked by some salient differences in social and religious norms. Or to take a contemporary case after the collapse of the Soviet bloc, Czechoslovakia was split peacefully into two similarly large and rich halves, marked by ethnic differences.

Other secessions have been considerable less harmonious: The collapses of the Soviet empire and Yugoslavia were accompanied by a series of bloody conflicts, with disagreements over whether to split or stay together. In both cases the sizes of the composing regions varied greatly, and while the richest and most productive regions were eager to secede (i.e. Russia, the Baltic states, resp. Slovenia and Croatia) other regions opposed secession.

The academic literature on secessions is mostly based on static models, but the survival or demise of a state is an inherently dynamic phenomenon; the relative size of the groups, inequalities in affluence, and heterogeneity in preferences and social norms affect the inter-temporal trade-offs of the various groups which are involved in strategic interaction.[3]

To address this gap in the literature we propose a full-blown dynamic model of stability and break-down of states. We consider a country with two groups, that can differ in size, economic productivity and preferences in the type of public good to be supplied. The types of public goods we have in mind are culture, language, legislation, and other identity related collective decisions. Setting up or maintaining a State carries a cost. As long as a non-homogeneous State remains united (which we call the "union" case), the group in power selects the public goods and determines how the surplus is shared. With secession we have two separate States, each producing its own public good and paying the constant cost for running the State. The overall trade-off is between the economies of scale of larger states (as the fixed administrative costs are shouldered by a larger population) and the cost of prefer-

[3] Relative size appears to play a major role, as we shall see. Small minorities are usually not intensely interested in ending the union with the rest of the country (e.g. think of German-speaking Südtirol in Italy, Martinique and Guadeloupe in France, Galicia in Spain or the Sami people in Northern Scandinavia).

ence heterogeneity (the opposition group cannot select its favored public good). We select these features of the model for comparability with the literature. However, we depart from the standard models by assuming that the group in power makes a proposal (union, peaceful secession, or conflict), which the group in opposition can either accept or reject, in the third case of costly conflict. The game continues with the winning group in power, hence choosing between seceding or becoming the new ruling group in the union. In the latter case, the threat of conflict may induce the group in power to compensate the opposition with larger transfers. The proposal depends on the value attached to the continuation of the game. The game is infinitely repeated, with secession being an absorbing state (after secession no more strategic decisions are made).

We are able to characterize the Subgame Perfect Equilibrium [SPE] of this game for all parameter values. Depending on the latter the equilibria will consist of union, peaceful secession, conflict followed by secession, or indefinite conflict. To get a sense of these equilibria, we can consider the population share and the surplus share of the opposition group and see how the equilibria vary as players attach greater weight to the future, with the time discount factor ranging from zero to unity. When no importance is ascribed to the future we have a static game. In this case union is the equilibrium for almost all pairs of population and surplus share, the exception being when the population share of the opposition is sufficiently large and its share of the surplus is also large. In this case the equilibrium is peaceful secession. Naturally, as the benefit from producing the preferred public good increases, the set of parameter values yielding an equilibrium of peaceful secession becomes larger and if the opposition population share is very large we can have conflict triggered by the opposition.

As the value attached to the future becomes greater, a shrinking set of parameter values yield union as a SPE. At the limit, when the discount factor goes to unity, we have union only when the opposition's share of both population and surplus is sufficiently small. The parameter values for which peaceful secession is a SPE continue to have similar qualitative properties: sufficiently large shares of population and surplus and similar productivity, i.e. similar surplus per capita. In contrast, the set of parameter values for which the SPE is conflict followed by secession becomes larger and larger as the time discount factor approaches unity. At the limit, this type of equilibrium is found when there is a severe mismatch between opposition group's population and surplus shares (that is, when the opposition group is large

but unproductive or small and disproportionately productive). Therefore, the more the future counts, the narrower the range of parameter values for which union is the SPE and the broader the range for secession, either peaceful or after conflict. The main reason for the greater scope for secession as the time discount factor increases is that secession is an end state, that is, with a high time discount factor the short-run costs of secession weigh less by comparison with the stream of future payoffs from independence. The connection thus hypothesized between the types of equilibria in the secession game and the shadow of the future is novel, as far as we know. After characterizing the equilibrium of the game we discuss our predictions in the light of some contemporary and historical examples.

There is by now a substantial body of literature on secessions and the size of nations, summarized below. Most of it concerns the trade-off between the preference heterogeneity of citizens and increasing returns to country size. This trade-off is present in our stage game as well, but the dynamic analysis means this static trade-off is only one of the relevant tensions.

The focal point of many papers is whether there are inter-group [inter-regional] transfers that would deter a group from secession and independence. The various contributions differ in the specification of the preference heterogeneity within and across groups and in the nature of the benefits of country size. Our paper has a different point of departure: remaining united implies that the public decisions will have to be negotiated every period by groups with different preferences and priorities, while secession entails a cost today but no need to bargain with the other group ever again. This inter-temporal argument, in our view, is an essential factor in the reasoning for or against secession and it generates a radically different equilibrium characterization from the static game. One can appreciate its critical importance also by considering the complementary problem of union formation: we should expect such a decision to be guided by the expected future payoffs from the interaction within the union, not by any immediate gains.

A second major difference between our setting and the previous literature is that we explicitly model conflict as an integral component of the secession trade-off. By conflict we do not necessarily mean civil war. Rather, in line with the literature, conflict is defined as a challenge to the status quo, and the expenditure of resources by both parties in order to increase their chances of imposing their preferred alternative. As we discuss below, the conflict literature envisages only a few dynamic frameworks, which typically do not postulate the option of secession.

Our paper then brings together two aspects of secession that have rarely been treated and that generate novel comparative static results. In particular, in order to change the status quo it is indispensable to challenge it. This has a cost and makes the outcome probabilistic. A second difference is that we model the problem as a repeated game, so that the opponent's expected strategy conditions one's own best reply today. In a one shot game, as the cost of conflict (or the cost of producing the public good) increases, the groups will be less inclined to challenge the status quo. But the problem is inter-temporal, so the increase in the cost of conflict also means that the other side know that challenging the status quo in the future becomes less likely. This increases the expected payoff of taking power and maintaining the union: in a union, the other party is unlikely to rebel, the group in power has command over the entire surplus, and produces its preferred public good.

The remainder of the paper is organized as follows: Section 2 reviews the literature. Section 3 sets up the model. Section 4 characterizes the best Stackelberg equilibria, and Section 5 relates the equilibrium characterization to contemporary and historical examples. Section 6 concludes.

2 The literature

This paper belongs first of all to the literature on border formation and secessionism.[4] One key point made by this strand of economic literature is that the size of countries results from the trade-off between economies of scale and the costs of differences in the preferences over public goods and government policies.[5] The literature distinguishes various potential determinants of the incentive for secession: region size (Goyal and Staal, 2004), international openness (Alesina, Spolaore and Wacziarg, 2000, 2005; Gancia, Ponzetto and Ventura, 2017); democratization (Alesina and Spolaore, 1997; Arzaghi and Henderson, 2005; Panizza, 1999); the optimal level of public spending (Le Breton and Weber, 2003; Le Breton et al., 2011); the presence of mobile ethnic groups (Olofsgård, 2003); the presence of natural resources in potentially secessionist regions (Gehring and Schneider, 2017; Hunziker and Ce-

[4] Excellent reviews of the literature on secessionism are provided in Bolton et al. (1996), Alesina and Spolaore (2003) and Spolaore (2014).

[5] See e.g. Friedman (1977), Buchanan and Faith (1987), Barro (1991) and Desmet et al. (2011).

derman, 2017)[6]; or external threats (Alesina and Spolaore, 2005, 2006; Wittman, 2000). Bolton and Roland (1996, 1997) focus on differing preferences for income tax policies owing to inter-regional differences in income distribution.

The literature on secessionism has also studied whether there exist mechanisms of interregional compensation such that potentially seceding regions are better off staying in the union. Haimanko et al. (2005) show that in an efficient union whose citizens' preferences are strongly polarized, the threat of secession cannot be eliminated without interregional transfers. Le Breton and Weber (2003) establish the principle of partial equalization: the gap between advantaged and disadvantaged regions must be narrowed, but should not be completely eliminated.[7] Alesina and Spolaore (2003) point out the problems for compensation transfers, such as feasibility issues and administrative costs, political credibility, or incompatibility with other social goals.[8] The recent paper by Gibilisco (2017) analyzes the potential effects of decentralization in a repeated game in which the periphery, when it is not repressed by the center, may initiate a secessionist mobilization whose probability of success depends on the amount of accumulated resentment. Repression feeds resentment, while a hands-off policy attenuates it. The paper finds that even when decentralization is the center's optimal choice, the relationship between decentralization and the likelihood of secessionist unrest is non-monotonic.

Some authors explicitly introduce a conflict technology in the context of separatism. We have already noted that in Gibilisco (2017) the periphery may pot for a costly mobilization that with some probability may end up in secession. Spolaore (2008) analyzes the choice of regional conflict when a peripheral (minority) region wishes to secede, focusing on the trade-off between economies of scale and heterogeneity of preferences where transfers are barred. Anesi and De Donder (2013) construct a static model of secessionist conflict with an exogenous winning probability; they find the existence of a majority voting equilibrium with government type biased in favor of the minority. Our contribution is complementary to theirs: our dynamic setting features general transfers and links the probability of victory

[6] Collier and Hoeffler (2006) provide case study evidence that secessionist movements emerge when part of the population perceives secession to be economically advantageous.

[7] See also Flamand (2015).

[8] Related to this, Bordignon and Brusco (2001) analyze whether constitutions should include provisions for agreed potential secessions, arguing that if peaceful secession is not foreseen, the society may incur ex-post important efficiency losses due to conflict. Yet, making splitting up less costly makes it more likely to happen.

to group size.

In the conflict literature only a handful of papers have explicitly modelled the incentives for secession. Morelli and Rohner (2015) have built a model allowing for both nationwide and secessionist conflict, showing that the most conflict-prone situations are those in which mineral resources are concentrated in the minority region, leading to secessionist pressures. Their empirical analysis finds that the situations where most oil revenues accrue in minority regions are in fact a major driver of civil war. One major difference between that paper and the present one is that now we have a dynamic model that allows for both conflicted and peaceful secession.[9]

In sum, our's is the first dynamic model of secession and takes into account the incentives for conflict and potential compensating transfers. This framework generates a novel equilibrium comprising zones of peaceful union, peaceful secession, centrist conflict (i.e., endless conflict path where no one secedes) and secessionist conflict. This is later shown to differ very substantially from the one that would be obtained in a static framework.

3 The model

Consider a country with two ethnic groups, i and j, with population size N_i and N_j, $N_i + N_j = N$. If the country remains united, there is a total divisible surplus denoted by $S > 0$, and each group considers its contribution to the total surplus S_h, $h = i, j$, as an important indicator of what it would have in case of secession, i.e., $S_i + S_j = S$.[10] The total surplus S may obtain from production as well as from non-produced rents. We denote by $A > 0$ the cost of running the State, so that the divisible surplus in a given period is $S - A$.

Assume WLOG that group j is in power at the beginning of the game. Taking equal per capita division of the surplus as a benchmark, we say that j makes the strategic choice of treating i with λ fairness if the share of surplus received by group

[9] Another article studying endogenous country borders and war is Caselli, Morelli and Rohner (2015). Unlike our current paper, their static model focuses on interstate wars.

[10] In reality, in a country in which the two groups are geographically segregated in separate regions the assumption is realistic, but if they are much more integrated and production has various kinds of complementarities, a group's expected total output after secession could be lower, in the aftermath, say, of a collapse of domestic trade (see Suesse, 2017b). For simplicity we ignore this complication (but we capture costs of secession through the parameter A, described below).

i is λn, where $n \equiv N_i/N$ denotes the population share of the opposition group. In addition to the divisible surplus, citizens' utility also depends on the type of public goods provided, on which the two groups have different preferences. The group in power chooses the public good it likes most, which gives all its members a payoff differential, so that if group h is in power they obtains $P_h > 0$ extra utility per member over the opposition group, which gets zero public good utility by normalization. The prime examples of public good here are language, culture, legislation, government-favored religion, but the idea could extend more generally to policies and their different utility implications for people with differing ideologies.

In the case of an ethnic secession, with groups i and j forming new states in different regions, each group would have to incur the cost of setting up or maintaining the state institutions and re-organizing production. For simplicity, we assume that he cost of running each new State is A, without differentiating between the cost of the original State and that of each new State. After secession each group can produce its preferred public good. We take the differential public good utility levels P_j and P_i (with j and i in power, respectively) as given, representing the reduced form expected differential effects.

The player in power j has three possible moves: (i) propose a distribution of surplus in the union, with fairness λ; (ii) propose peaceful secession; and (iii) trigger conflict.

The rejection of a proposal by the opposition opens a socially costly period of conflict. The power is challenged. Each group has a probability of victory equal to its population share.[11] The winner can aim either to conquer power in the union and capture the entire surplus or to secede and take away its own surplus forever, making the loser bear the cost of conflict D. We assume that $A < \min\{NP_i, NP_j\}$, $D < \min\{S_i, S_j\}$ and $A < \min\{S_i, S_j\}$.

We use the following normalized notation: $s = \frac{S_i}{S}, a = \frac{A}{S}, d = \frac{D}{S}, \sigma = \frac{S}{N}$.

Notice that $\min\{S_i, S_j\} > A$ implies that $S > A + \min\{S_i, S_j\} > A + D$. The latter inequality, or its equivalent $1 - a - d > 0$, will appear at different stages of our analysis. It is immediate that in a one-shot game, in case of conflict, the winner

[11] For simplicity, we do not assume an advantage for the incumbent. Of course if staying in power strengthens the group in power (see Fearon, 1995), then the equilibrium probability of war and secession should be expected to go up, but qualitatively allowing for this difficult extension does not seem to add anything interesting to our analysis of the structural secession incentives.

always opts to maintain the union: since $\min\{S_i, S_j\} - D > 0$, there is more surplus to be obtained. Hence a violent conflict leading to secession can be an equilibrium solution only if the game has more than one period.

The per-period payoffs to the two players in the three possible scenarios are as follows:

- equilibrium union

$$U_i^U(\lambda) \equiv \lambda n \frac{S - A}{N_i} \text{ and} \tag{1}$$

$$U_j^U(\lambda) \equiv (1 - \lambda n) \frac{S - A}{N_j} + P_j; \tag{2}$$

- secession

$$U_i^S \equiv \frac{S_i - A}{N_i} + P_i \text{ and}$$

$$U_j^S \equiv \frac{S_j - A}{N_j} + P_j; \tag{3}$$

- and in case of conflict, taking into account that the winner takes the entire surplus of that period,

$$U_i^C \equiv n \left[\frac{S - D}{N_i} + P_i \right] \text{ and}$$

$$U_j^C \equiv (1 - n) \left[\frac{S - D}{N_j} + P_j \right]. \tag{4}$$

We conceive of this as a repeated leader-follower Stackelberg game, in which the group in power is leader and the opposition follower. The timeline is as follows:

1. *Production:* Each period starts with a group in power, say j; output is produced, and surplus S is obtained.

2. *Proposal:* The group in power chooses among three options: [i] continued union, distributing the surplus with λ fairness; [ii] peaceful secession; or [iii] trigger conflict.

3. *Peace or conflict:* The opposition can either accept or challenge the proposal. If it is accepted, it is carried out; if it is challenged, conflict follows. Note that conflict may result either from the choice of the group in government or from the opposition's rejection o.f the ruling's group proposal.

4. *Exercise of power.* If there is peace, and hence j remains in power, the policies announced are carried out, these being either (i) the announced distribution of the surplus or (ii) secession. If j remains in power because it has been victorious in the conflict, it can choose between secession and union. In the first case, it splits the country and takes its own produced surplus (while placing the full cost of conflict, D, on the loser); in the second case it appropriates the entire remaining surplus and begins the next period in power.

   If group i wins, it too has the choice between secession and union, appropriating the entire remaining surplus. It thus enters the next period either as an independent country or as the ruler of the union.

5. *Consumption:* At the end of every period the entire remaining surplus is consumed.

The expected payoff of future periods is discounted by the usual discount factor $\delta \in [0, 1]$.

The only state variable is the identity of the group in power. We first characterize all SPE paths and then focus on the best SPE selection.[12]

4 Equilibrium analysis

Given stationarity, any SPE path ending with a peaceful agreement on distribution consists of an initial proposal by group j that is immediately accepted by group i. Accordingly, any path that starts with a rejection ends either with permanent conflict or conflict with eventual secession.

The opposition can influence the initial offer by threatening conflict. But this threat is credible only if such a one-step deviation has a continuation that is itself sub-game perfect, SP. We now analyze the conditions under which such SP continuations after a rejection do exist. When there are multiple SP continuations, we choose the one that is best for i. In other words, we want to identify the SP continuation path starting with conflict that the opposition can precipitate. This will give us the minimum payoff that any SPE has to grant to this player. We shall

[12] Notice that this game bears some resemblance to the mass killings framework of Esteban, Morelli and Rohner (2015). There, the decision after taking power was whether to exterminate part of the defeated population of the defeated, while here it is whether to secede.

start by characterizing the conditions under which the threat of endless conflict is credible.

4.1 Indefinite conflict – type A path

The only way for conflict to last indefinitely is for each player to reject the other's proposal in every period. Such an infinite sequence of conflicts could be an SP path, because neither player would have a profitable deviation (it takes only one to provoke conflict). This path involves the destruction of D surplus in every period and consists of a sequence of strategies each rejecting the other's proposal when in opposition and making an unacceptably unfair proposal when in power (say, allocating zero surplus to the opposition).

After any conflict, the winner decides whether to secede or to maintain union, appropriating the entire remaining surplus for that period. When the winner decides to secede, the strategic interaction is terminated.

Therefore, in order to determine whether or not permanent conflict is an SP path we need to check whether the winner will prefer to deviate from continued conflict and opt for secession. We now compute the value for i of being a winner and continuing with conflict, $\overline{V}_i^{cc}$, and compare it with the value of being a winner in the conflict and deviating by choosing secession, $\overline{V}_i^{cs}$. The value of being the loser is denoted by $\underline{V}_i^{cc}$.

$$\overline{V}_i^{cc} = \frac{S - D - A}{N_i} + P_i + \delta \left\{ \frac{N_i}{N} \overline{V}_i^{cc} + \frac{N_j}{N} \underline{V}_i^{cc} \right\}, \text{ and}$$

$$\underline{V}_i^{cc} = 0 + \delta \left\{ \frac{N_i}{N} \overline{V}_i^{cc} + \frac{N_j}{N} \underline{V}_i^{cc} \right\}.$$

Solving, we obtain

$$\underline{V}_i^{cc} = \frac{\delta \frac{Ni}{N}}{1 - \delta \frac{Nj}{N}} \overline{V}_i^{cc},$$

and hence

$$\overline{V}_i^{cc} = \frac{1 - \delta \frac{N_j}{N}}{1 - \delta} \left[\frac{S - D + N_i P_i - A}{N_i} \right]. \tag{5}$$

Now compute the value of being the winner and seceding $\overline{V}_i^{cs}$:

$$\overline{V}_i^{cs} = \frac{1}{1 - \delta} \left(\frac{S_i + N_i P_i - A}{N_i} \right). \tag{6}$$

Therefore, i will prefer to continue the conflict rather than deviate and secede if

$$S_j - D \geq \frac{\delta N_j}{N}(S - D + N_i P_i - A). \tag{7}$$

Mutatis mutandis, the condition for j to continue conflict rather than deviate and secede is:

$$S_i - D \geq \frac{\delta N_i}{N}(S - D + N_j P_j - A). \tag{8}$$

Clearly, permanent conflict is an SP path following i's rejection of a proposal by j whenever (7) and (8) are both satisfied. We denote the set of parameters satisfying these conditions by $[A]$.

The two foregoing conditions can be rewritten

$$s \leq (1-d)\left[1 - \delta(1-n)\right] - \frac{\delta}{\sigma}(1-n)(nP_i - a\sigma),$$

and

$$s \geq d - \frac{\delta}{\sigma} n\left[(n-1)P_j - (1-a-d)\sigma\right].$$

These expressions are constraints on the share of surplus produced by the opposition i, s, relative to its population, n. Group i in opposition prefers conflict to secession if its share is sufficiently small; that is, if the surplus they will expropriate from the defeated group, $1-s$, is sufficiently large. Similarly for group j: the surplus produced by the opposition has to be large enough to make conflict preferable to secession.

The following lemma summarizes the characterization of the set $[A]$ of parameter values for which a continuation path of endless conflict (type A path) is an SPE.

Lemma 1. *Let the opposition player start by triggering conflict. Then the necessary and sufficient condition for the sequence of endless conflicts to be an SPE is that*

$$s \leq (1-d)\left[1 - \delta(1-n)\right] - \frac{\delta}{\sigma}(1-n)(nP_i - a\sigma), \tag{9}$$

and

$$s \geq d - \frac{\delta}{\sigma} n\left[(n-1)P_j - (1-a-d)\sigma\right]. \tag{10}$$

Furthermore, $a < d$ is the necessary and sufficient condition for the existence of $\delta_A \in (0,1)$ such that for any $\delta > \delta_A$ the set [A] is empty. The precise threshold on δ is

$$\delta_A \equiv \frac{(1-2d)\sigma}{(1-n)n(P_i + P_j) + (1-a-d)\sigma}. \tag{11}$$

The foregoing shows that the conditions for the most destructive path to be an SPE are stringent. For permanent conflict to be an SPE, there must be both, low δ and low d.

4.2 The threat of secession

If either of the conditions characterizing $[A]$ is violated, we can seek to determine the conditions under which continuation involves secession. Consider first the case in which player i, victorious in conflict, opts for secession while j continues to play indefinite conflict. For player i the payoff from secession is exactly what we computed in (6), and should be larger than continuing conflict as in (5). Therefore, player i triggers conflict and secedes after the first victory, knowing that j will always play conflict iff

$$S_j - D \leq \frac{\delta N_j}{N}(S - D + N_i P_i - A). \tag{12}$$

Using the same notation as before, this condition can be rewritten as

$$s > (1-d)\left[1 - \delta(1-n)\right] - \frac{\delta}{\sigma}(1-n)(nP_i - a\sigma).$$

We must now check the conditions under which player j will continue to play conflict even knowing that i will eventually secede. After a victory, the value of continuing conflict is

$$\overline{V}_j^{cc} = \frac{S - D + N_j P_j - A}{N_j} + \delta\left[\frac{N_j}{N}\overline{V}_j^{cc} + \frac{N_i}{N}\left(\frac{1}{1-\delta}\frac{S_j + N_j P_j - A}{N_j} - \frac{D}{N_j}\right)\right].$$

Therefore

$$\overline{V}_j^{cc} = \frac{1}{1 - \delta\frac{N_j}{N}}\left[\frac{S - D + N_j P_j - A}{N_j} + \frac{\delta}{1-\delta}\frac{N_i}{N}\frac{S_j + N_j P_j - A - (1-\delta)D}{N_j}\right].$$

The value $\overline{V}_j^{cc}$ has to be greater than thay of opting for secession after the first victory. That is

$$\overline{V}_j^{cc} \geq \frac{1}{1-\delta}\frac{S_j + N_j P_j - A}{N_j}.$$

This inequality simplifies to

$$S_i \geq D\left(1 + \delta\frac{N_i}{N}\right). \tag{13}$$

Combining inequalities (12) and (13) we fully characterize the set of parameter values for which the path that consists with i triggering conflict, permanent conflict selected by j, and secession by i after first victory is an SPE. We denote this set by $[B_i]$. Using the same simplifying notation as above we have the following result.

Lemma 2. *Let the opposition player start by triggering conflict. Then the continuation path with j playing conflict at every iteration and i seceding after the first victory is an SPE iff the following two inequalities are satisfied:*

$$s > (1-d)\left[1-\delta(1-n)\right] - \frac{\delta}{\sigma}(1-n)(nP_i - a\sigma), \tag{14}$$

and

$$s > d + \delta dn. \tag{15}$$

Furthermore, the set $[B_i]$ is always non-empty.

We now turn to the case in which group j opts for secession at the first victory while the opposition group i chooses indefinite conflict. Group j opts for secession in response to the opposition playing conflict when inequality (8) is reversed, that is, when

$$S_i - D < \frac{\delta N_i}{N}(S - D + N_j P_j - A).$$

In our simplified notation this inequality can be written as

$$s < d - \frac{\delta}{\sigma} n\left[(n-1)P_j - (1-a-d)\sigma\right]. \tag{16}$$

By the same steps as before we obtain that the condition for i to prefer continued conflict knowing that j seeks secession is

$$S_j \geq D\left(1 + \delta\frac{N_j}{N}\right),$$

that is

$$s < \left[1-(1+\delta)d\right] + \delta dn. \tag{17}$$

Inequalities (16) and (17) fully characterize the set $[B_j]$ of all the parameter values for which, after i has rejected the initial proposal, the continuation with i playing indefinite conflict and j seceding at the first victory is an SPE. Formally:

Lemma 3. *Let the opposition player start by triggering conflict. Then the continuation path with i playing conflict at every iteration and j seceding after the first victory is an SPE iff the following two inequalities are satisfied:*

$$s < d + \frac{\delta}{\sigma} n \left[(1-n)P_j + (1-a-d)\sigma \right] \tag{18}$$

and

$$s < [1 - (1+\delta)d] + \delta dn \tag{19}$$

The set $[B_j]$ is always non-empty.

One final case in which an initial rejection by i can be sustained by a credible threat of secession is that in which both groups opt for secession after the first victory. We can obtain the parameter values for which a such continuation is SP. Let us consider the opposition player i. When victorious, the payoff from secession for i is

$$\overline{V}_i^{cs} = \frac{S_i + P_i N_i - A}{(1-\delta)N_i}.$$

The payoff from triggering a new conflict $\overline{V}_i^{cc}$ is

$$\overline{V}_i^{cc} = \frac{S - D + P_i N_i - A}{N_i} + \delta \left[\frac{N_i}{N} \overline{V}_i^{cc} + \frac{N_j}{N} \left(\frac{S_i + P_i N_i - A}{(1-\delta)N_i} - \frac{D}{N_i} \right) \right].$$

Simplifying, we easily obtain that $\overline{V}_i^{cs} \geq \overline{V}_i^{cc}$ iff

$$S_j \leq \left(1 + \delta \frac{N_j}{N} \right) D. \tag{20}$$

Using our simplified notation, this can be rewritten as

$$s \geq [1 - (1+\delta)d] + \delta dn.$$

Performing the same calculations for player j, one obtains $\overline{V}_j^{cs} \geq \overline{V}_j^{cc}$ iff

$$S_i \leq \left(1 + \delta \frac{N_i}{N} \right) D. \tag{21}$$

In our simplified notation, can be rewritten as

$$s \leq d + \delta dn.$$

Inequalities (20) and (21) fully characterize the set $[C]$ of all the parameter values for which after i rejects the initial proposal the SPE continuation is that the winner of this first conflict, whoever it is, chooses secession. Formally:

Lemma 4. *Let the opposition player start by triggering conflict. Then the continuation path where whoever wins decides to secede is an SPE iff the following two inequalities are satisfied:*

$$s \geq [1 - (1 + \delta)d] + \delta dn, \tag{22}$$

and

$$s \leq d + \delta dn. \tag{23}$$

The set $[C]$ *is empty whenever* $d < \frac{1}{2+\delta}$.

4.3 Worst credible punishment after first rejection

For simplicity, in what follows we assume $a < d < 1/3$ and $\delta > \delta_A$, so that, given the above results, both $[A]$ and $[C]$ are empty sets, and hence the worst SP continuation equilibrium in case of initial rejection is either path B_i or path B_j.

Proposition 5. *Let* $0 < a < d < 1/3$ *and that* $\delta_A < \delta < 1$. *Then:*

- *Under the foregoing assumptions the sets* $[A]$ *and* $[C]$ *are empty.*
- *The union of the sets* $[B_i]$ *and* $[B_j]$ *contains all the pairs* n, s *with* $n, s \in [0, 1]$. *The intersection of the two sets is non-empty.*

The payoff for i in the continuation of an initial rejection of j's offer must be the maximum that i could guarantee for itself. Thus, in the intersection of $[B_i]$ and $[B_j]$, we assume that the relevant SP is that which yields the highest payoff to i.

4.4 The value of rejection

First we start compute the value for i of rejection of the first proposal followed by a type B_i SP path, which we denote $V_i^{B_i}$.

If in any iteration player i wins, it secedes and the game ends; and if it loses it gets a period pay of zero and enters the new period with j in power playing conflict. Hence we have

$$V_i^{B_i} = \frac{N_i}{N} \frac{S_i + N_i P_i - A}{(1 - \delta) N_i} + \frac{N_j}{N} \delta V_i^{B_i}.$$

Solving for $V_i^{B_i}$ and using our compact notation we obtain

$$V_i^{B_i} = \frac{nP_i + \sigma(s - a)}{(1 - \delta)\left[1 - \delta(1 - n)\right]}. \tag{24}$$

Let us now compute the value for i of rejection followed by a type B_j path. In this case, whenever i wins, it captures the entire surplus (minus destruction D) and triggers a new conflict in the next iteration. When j wins it secedes.

The value $V_i^{B_j}$ is

$$V_i^{B_j} = \frac{N_i}{N}\left[\frac{S + N_i P_i - A - D}{N_i} + \delta V_i^{B_j}\right] + \frac{N_j}{N}\left[\frac{S_i + N_i P_i - A}{(1-\delta)N_i} - \frac{D}{N_i}\right].$$

Solving now for $V_i^{B_j}$ we obtain

$$V_i^{B_j} = \frac{nP_i - a\sigma}{n(1-\delta)} + \frac{\sigma(n-d)}{n(1-\delta n)} + \frac{s\sigma(1-n)}{(1-\delta)n(1-\delta n)}. \tag{25}$$

Solving for $V_i^{B_i} = V_i^{B_j}$ we obtain the following threshold:

$$s = \frac{\left[1-\delta(1-n)\right](n-d) + (1-n)(1-\delta n)\left(\frac{n}{\sigma}P_i - a\right)}{2n-1}.$$

The implicit function of s in terms of n is discontinuous at $n = 1/2$ and it is easy to show that as $n \to 1/2$ from below, $s \to -\infty$, and the converse from above. Given our previous assumptions we can also compute that $s(n=0) = a + (1-\delta)d < d$ and $s(n=1) = 1 - d$. Therefore, $V_i^{B_i} < V_i^{B_j}$ everywhere in $[B_i] \cap [B_j]$.

4.5 Full Characterization of Best SPE

We can now characterize the best SPE for this game. In (24) and (25) we have computed the payoffs to player i from rejection of the initial proposal.

We now compute the equivalent payoffs for j, $V_j^{B_i}$ and $V_j^{B_j}$. Following the same steps as above we obtain

$$V_j^{B_i} = \frac{P_j}{1-\delta} + \frac{\sigma}{1-n}\left[\frac{1-d}{1-\delta(1-n)} - \frac{a}{1-\delta} + \frac{ns - \delta n}{(1-\delta)\left[1-\delta(1-n)\right]}\right], \text{ and} \tag{26}$$

$$V_j^{B_j} = \frac{P_j(1-n) + (1-a-s)\sigma}{(1-\delta)(1-\delta n)} \tag{27}$$

The potential SPE for the full game can be of the following types:

- U: agreement on distribution of the surplus within the union;
- S: agreement on secession;
- B: conflict followed by secession.[13]

[13] We have excluded permanent conflict, A, because we have already constrained the parameter values so that both players indefinitely playing conflict is not an SPE.

We start by computing the value of mantaining union. For individuals of group i, V_i^U is:

$$V_i^U = \lambda \frac{N_i}{N} \frac{S-A}{(1-\delta)N_i} = \lambda \frac{S-A}{(1-\delta)N} = \lambda \frac{\sigma}{1-\delta}(1-a), \tag{28}$$

where $\lambda > 0$ captures the degree of fairness of the allocation of the surplus. Clearly, $\lambda = 1$ corresponds to full equality in the distribution.

For individuals of the group in power j the value of union V_j^U is

$$V_j^U = \left(1 - \lambda \frac{N_i}{N}\right) \frac{S - A + N_j P_j}{(1-\delta)N_j} = \frac{(1-\lambda n)\left[(1-n)P_j + (1-a)\sigma\right]}{(1-\delta)(1-n)} \tag{29}$$

The value of a peaceful secession V_i^S and V_j^S is

$$V_i^S = \frac{S_i + N_i P_i - A}{(1-\delta)N_i} = \frac{nP_i + \sigma(s-a)}{n(1-\delta)} \text{ and,} \tag{30}$$

$$V_j^S = \frac{S_j + N_j P_j - A}{(1-\delta)N_j} = \frac{P_j(1-n) + (1-a-s)\sigma}{(1-\delta)(1-n)}. \tag{31}$$

Let us start by comparing the value of the proposal of peaceful secession V_i^S with either $V_i^{B_i}$ or $V_i^{B_j}$. Using (24), (25), and (30), we immediately obtain that $V_i^S > V_i^{B_i}$ for all the parameter values. Hence a necessary condition for the rejection of the secession proposal is that the parameters belong to the set $[B_j]$. That is, it has to be player j to secede after the first victory. In fact, it is readily shown that rejection can only happen if in addition the parameters satisfy $s < 1 - \frac{d}{n}$. The set of parameters satisfying this inequality is denoted $[R]$.

Lemma 6. *Let j start by proposing secession. Then i rejects peaceful secession if and only if the parameter values belong to the set $[R]$; otherwise it will be accepted. The set $[R]$ is a subset of $[B_j]$.*[14]

Denoting by $[K]$ the complement of $[R]$, player j knows that for all the parameter values in $[K]$ it can certainly obtain the maximum between secession and the associated conflict path, making this the minimum payoff that player j must get from distribution within the union. If the parameter values belong to $[R]$, so that i would reject secession, distribution within the union is an SPE if the two players get payoffs at least as great as what they get by following the type B_j conflict path. Otherwise, the SPE starts with conflict followed by the secession of j.

[14] The last statement follows from the fact that $s(n) = 1 - \frac{d}{n}$ is strictly increasing and concave with respect to n and that $s(1) = 1 - d$.

Denote by λ_j^S the fairness offer by j that would make j indifferent between the outcomes U and S. Similarly, denote by $\lambda_i^{B_j}$ and $\lambda_j^{B_j}$ the λ's of indifference with respect to the conflict payoff for i and j respectively. Using this notation and the simple partition of the space described above with $[R]$ and $[K]$, we can prove the following characterization result:

Proposition 7. *For every array of feasible parameter values there is a unique SPE. The types of SPE are as follows:*

- Peaceful Union*: j proposes a distribution with λ_i fairness and i accepts it when:*
  - $(n,s) \in [R]$ *and* $\lambda_i^{B_j} \leq \lambda_j^{B_j}$ *and* $\lambda_i^{B_j} \leq \frac{1}{n}$
  - $(n,s) \in [K] \cap B_i$, $s \leq \frac{d}{1-n}$ *and* $\lambda_i^{B_i} \leq \lambda_j^S$ *and* $\lambda_i^{B_i} \leq \frac{1}{n}$
  - $(n,s) \in [K] \cap B_i$, $s > \frac{d}{1-n}$ *and* $\lambda_i^{B_i} \leq \lambda_j^{B_i}$ *and* $\lambda_i^{B_i} \leq \frac{1}{n}$
  - $(n,s) \in [K] \cap B_j$ *and* $\lambda_i^{B_j} \leq \lambda_j^S$ *and* $\lambda_i^{B_j} \leq \frac{1}{n}$
- Peaceful Secession*: j proposes secession and i accepts it when:*
  - $(n,s) \in [K] \cap B_i$, $s \leq \frac{d}{1-n}$ *and* $\lambda_j^S < \lambda_i^{B_i}$
  - $(n,s) \in [K] \cap B_j$ *and* $\lambda_j^S < \lambda_i^{B_j}$
- Conflict Secession*: j's proposal is rejected and either i or j secedes after the first victory when:*
  - $(n,s) \in [R]$ *and* $\lambda_i^{B_j} > \lambda_j^{B_j}$ *or* $\lambda_i^{B_j} > \frac{1}{n}$
  - $(n,s) \in [K] \cap B_i$, $s > \frac{d}{1-n}$, *and* $\lambda_i^{B_i} > \lambda_j^{B_i}$ *or* $\lambda_i^{B_i} > \frac{1}{n}$

The proof is in the appendix. The following subsection offers an intuitive comparison of the equilibria intuitively and a graphical representation for $\delta \to 1$.

4.6 Characterization result for $\delta \to 1$

The key λ thresholds that permit identification of the different equilibria become simpler when $\delta \to 1$:

$$\lambda_j \equiv \lambda_j^{B_j} = \lambda_j^{B_i} = \lambda_j^S = \frac{\sigma s}{n\Big[P_j(1-n) + \sigma(1-a)\Big]} \tag{32}$$

and

$$\lambda_i \equiv \lambda_i^{B_j} = \lambda_i^{B_i} = \frac{nP_i + \sigma(s-a)}{n\sigma(1-a)}. \tag{33}$$

Here it is irrelevant which group provokes secession following the first victory. After all, in both cases the two players will have their respective secession payoffs forever. It also becomes undistinguishable from the case in which secession starts in the first period. In other words, the great simplification of the limiting case is that we have just one critical fairness threshold for each group.

We can easily obtain the following

Lemma 8. *The degrees of fairness* (λ_i, λ_j) *satisfy*

$$\lambda_i < \lambda_j \text{ iff } s < s^U \equiv \frac{[(1-n)P_j + (1-a)\sigma][a\sigma - nP_i]}{(1-n)P_j\sigma}. \tag{34}$$

Further, the feasibility of transfers implies that

$$\lambda_i \leqslant \frac{1}{n} \text{ iff } s \leqslant s^\lambda \equiv 1 - \frac{nP_i}{\sigma}. \tag{35}$$

Given the assumption that $\min\left\{\frac{P_i}{\sigma}, \frac{P_j}{\sigma}\right\} > a$, it follows that $s^U < s^\lambda$ and thus the feasibility constraint is always satisfied.[15]

Using this information we can characterize the SPE in terms of the parameter values. We know that unless the group in power prefers secession, $\lambda_j \geq \lambda_i$ is a necessary and sufficient condition for a peaceful union to be an SPE in which the group in power will offer λ_i to the opposition. Here we give a complete characterization of the SPE.

Proposition 9. *For* $\delta \to 1$ *the SPE is:*

- Peaceful Union *iff* $s \leq s^U$*;*
- Peaceful Secession *iff* $s > s^U$ *and either* $s < \frac{d}{1-n}$ *and* $(n, s) \in B_i$ *or* $s > 1 - \frac{d}{n}$ *and* $(n, s) \in B_j$*;*

[15] This is equivalent to assuming that $\min\{NP_i, NP_j\} > A$; that is, the aggregate benefit of the public good if enjoyed entirely must be greater than the cost of running a State and providing this public good.

- Conflict Secession *iff* $s > s^U$ *and either* $s \geq \frac{d}{1-n}$ *and* $(n,s) \in B_i$ *or* $s \leq 1 - \frac{d}{n}$ *and* $(n,s) \in B_j$.

Inequality (34) tells us whether or not the degree of fairness that j has to offer for the opposition to accept union rather than conflict is lower than the maximum j would tolerate before preferring any other option. Therefore, the necessary and sufficient condition for there to exist a degree of fairness that makes union an SPE is that the pair (n,s) must satisfy $s \leq s^U(n)$. Let us examine the properties of the function $s^U(n)$. First note that s^U is strictly decreasing and concave. Since we are assuming that $\min\left\{\frac{P_i}{\sigma}, \frac{P_j}{\sigma}\right\} > a$, we have that $s^U(0) = a + (1-a)a\frac{\sigma}{P_j} < 1$ and $\lim_{n\to 1} s^U = -\infty$. Therefore the larger P_i and P_j relative to the per capita economic surplus, σ, the smaller the set of parameter values for which a peaceful union is an SPE. Finally, an increase in the cost of running an independent State a enlarges the set of parameter values for which union is an SPE.

Summing up, arizing the analysis of the SPE with peaceful union, we find that for this outcome the opposition should be neither too populous nor too productive (measured by the surplus they produce). The threshold values for population and economic power that yield union as a SPE increase with a and decrease with P_i and P_j. Note that these threshold values are independent of d.

When a peaceful union is not possible secession is an SPE, either by a peaceful agreement or subsequent to a conflict.

There are two areas of parameter values in which the SPE entails conflict followed by secession, and both display a *mismatch* between the relative strength and the relative productivity of the opposition group. One area corresponds to the case in which the opposition produces a high share of the surplus (high relative productivity) but is not populous (low relative strength). Secession is profitable to the opposition group because they will control a large surplus. For this reason, the group in power finds the size of the transfer necessary to ensure union unacceptable. Since the group in power is the larger, it has a high probability of winning the conflict and securing a large surplus. Hence, group j prefers to postpone secession as long as possible by triggering a sequence of conflicts until eventually the opposition wins and secedes.

The second area consists of the SPE paths in which the opposition triggers conflict in every period until group j wins and secedes. In this area the opposition is characterized by relatively low productivity but large population (high relative strength), giving it an advantage in conflict. To see this, imagine the group in power

as a tiny minority that produces almost the entire economic surplus. It is immediate that it pays the super-majoritarian opposition to trigger conflict indefinitely with the near certainty of victory. Accordingly, it is optimal for the group in power to separate from the large and poor group.

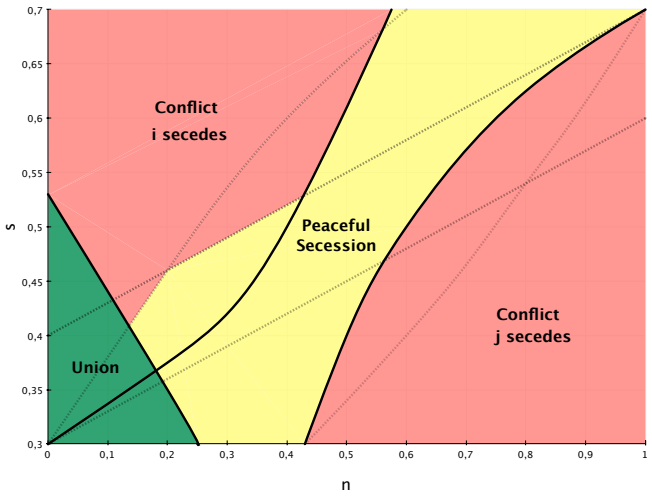
In both cases, not surprisingly, an increase in the cost of conflict reduces the set of parameter values for which conflict followed by secession is an SPE. Also aligned with intuition is the notion that the value of the public good payoffs relative to the economic surplus is not relevant here. The reason is that we are comparing two paths that both lead to secession, differing only in whether it comes by agreement or after conflict. And this essentially depends on d.

Peaceful secession is an SPE when the opposition group is large and productivity differences are small. In this case, the opposition has a significant chance of winning a conflict. Since productivity does not differ greatly between the two groups, the main advantage of taking power or of seceding is the possibility of producing the preferred public good. In order to preserve union, the group in power would have to compensate the opposition economically for giving up their preferred public good. Given comparable productivity, and given that from the perspective of the group in power the opposition is "too large" to be compensated, both groups prefer to bear the cost of a separate State and enjoy their preferred public good.

Figure 1 depicts the different equilibria on the (n, s) space ($[0, 1] \times [0, 1]$) for $\delta = 1$, $\sigma = 1.5, P_i = P_j = 0.5, d = 0.3$ and $a = 0.15$.[16]

Figure 1: Equilibria with $\delta = 1$

[16] Note that in this specification we cannot have SPE consisting of permanent conflict.



his set of parameter values allows us to compare the implications of our model with the basic results in the literature. In Alesina and Spolaore (1997) and Spolaore (2008), the larger the minority opposition group the more likely a secession will take place. A higher probability of winning has the same effect. On the other hand, in Anesi and De Donder (2013) such an increase in population has an ambiguous effect on the likelihood of secession. Here the effect of an increase in n —which also increases the probability of victory— depends on the productivity of the opposition group. Even if the opposition group is arbitrarily small, if their productivity is high —say, they produce more than half the surplus— they will reject any proposal and reach secession after a sequence of conflict periods. Union requires that the opposition be small in population and not too productive. If the opposition group makes up than 25% of total population, union is not an option. If the opposition group is sufficiently productive it will opt for conflictual secession, otherwise we have peaceful secession. And when the opposition population exceeds 43% it is the group in power that might precipitate a violent separation, or else a peaceful secession. And the larger n is —hence, the smaller the group in power— the larger is the set of parameter values that yield conflictual secession.

Essentially, the model predicts that union will will be preserved when the group out of power is not too large not too productive. The critical threshold might depend on the cost of setting up a State and the relative importance of non-economic gains vis-à-vis monetary gains. Secessions can be peacefully agreed or result from costly conflict. When the opposition is powerful and productivity differences are modest we expect secession by agreement. Conflict takes place only when there is a

substantial imbalance between population size and share of surplus, i.e., when there are substantial differences in “productivity".

4.7 Equilibria with short-sighted players

To show the importance of a dynamic theory to explain secessions, in this section we characterize the equilibria for the alternative extreme case of $\delta = 0$, i.e., the static benchmark.

When only present costs and benefits count, the fundamental features of the model change. Challenging a proposal leads to conflict with a value that depends solely on the one period cost and the potential benefits of grabbing the surplus. Clearly, as long as $D < \min\{S_j, S_i\}$, the winner of this conflict does not secede but takes power over the entire country and expropriates the entire surplus. In terms of the model, in the static benchmark opposition can threaten only with standard conflict, while as we have seen path A, endless conflict, is not, as we have seen, a credible threat when the discount factor is sufficiently high.

The static Stackelberg game has a simple equilibrium, in which the group in power chooses the best proposal, taking into account the only threat available.

Let us start by characterizing the opposition group's best reply to any proposal. Knowing this, we can derive the equilibrium proposals that the group in power will make.

There always exists a degree of fairness – denoted by λ_i^A– for which the opposition i weakly prefers union over conflict. However, the transfer associated with λ_i^A might be unfeasible or unacceptable to the group j in power.[17]

Let us examine the conditions under which i will accept or reject the proposal for a peaceful secession. In view of (3) and (4) player i accepts iff

$$\frac{S_i + N_i P_i - A}{N_i} \geq \frac{S + N_i P_i - A - D}{N}.$$

Using our normalized notation, the condition can be rewritten as follows

Lemma 10. *Player i accepts secession when proposed by j iff*

$$s \geq \zeta(n) = a + \left(1 - a - d - \frac{P_i}{\sigma}\right) n + \frac{P_i}{\sigma} n^2. \tag{36}$$

[17] The other type of subgame is one in which the group in power triggers conflict. In that case there is nothing player i can do but play conflict as well.

In sum, the following conclusions emerge: (i) the response to conflict is conflict; (ii) the response to proposed secession is acceptance if $s \geq \zeta(n)$ and otherwise conflict; and finally (iii) union is accepted if $\lambda \geq \lambda_i^A$, and otherwise rejected.

Given the above characterization of the opposition's best reply , we now examine the proposals preferred by the group in power. For proof of he following proposition, see the appendix. Denote by n^c the value of n such that

$$\frac{1}{n} - \frac{1 - a - d + \frac{P_i}{\sigma} n}{1 - a} = 0.$$

Similarly, denote by n^{cc} the value of n that constitutes the positive solution of

$$\sigma d + nP_j - (P - i + P_j)n^2 = 0.$$

Define

$$\phi(n) \equiv d + \left[1 - a - d + \frac{P_j}{\sigma}\right] n - \frac{P_j}{\sigma} n^2,$$

and

$$\vartheta(n) \equiv (1 - a - d)n + \frac{P_i}{\sigma} n^2.$$

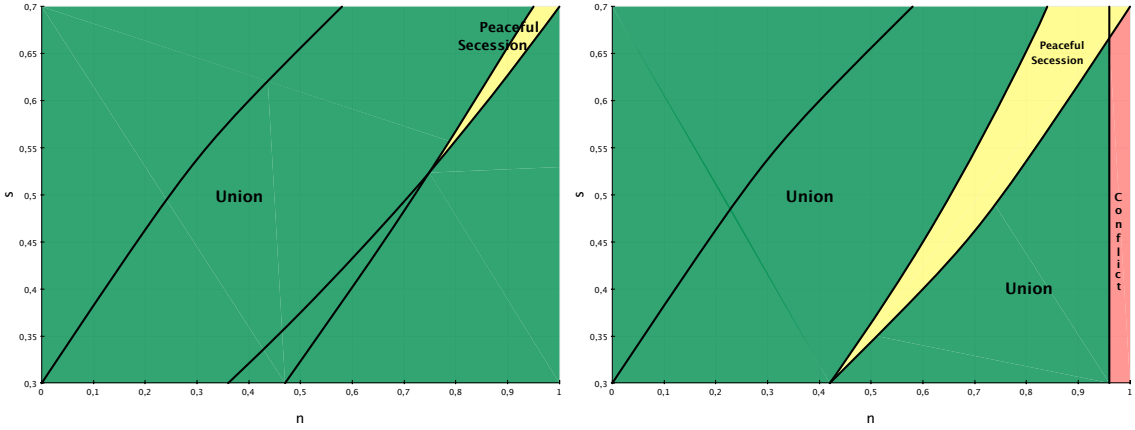
Proposition 11. *The unique equilibrium when $\delta = 0$ is as follows:*

- *Let $n \leq \min\{n^c, n^{cc}\}$.*[18] *Then, for the parameter values such that $s \in [\zeta(n), \phi(n)]$ the equilibrium is peaceful secession; otherwise the equilibrium is a fair union.*
- *Let $\min\{n^c, n^{cc}\} \leq n < 1$ —so that $d < \frac{P_i}{\sigma}$. Then:*
  - *for all $s \geq \vartheta(n)$, the unique equilibrium is conflict;*
  - *for all $\phi(n) < s < \vartheta(n)$, the unique equilibrium is conflict.*
  - *for all $\zeta(n) \leq s \leq \phi(n)$, the unique equilibrium is secession; and*
  - *for all $s < \zeta(n)$, the unique equilibrium is conflict.*

Figure 2 depicts in Panels a and b the different equilibria on the (n, s) space ($[0, 1] \times [0, 1]$) for $\delta = 0$ and the rest of parameter values as in Figure 1: $\sigma = 1.5, Pj = 0.5, d = 0.3$ and $a = 0.15$.

[18] Note that when $d > \frac{P_i}{\sigma}$ this inequality entails no effective restriction on the values of n.

Figure 2: Equilibria with $\delta = 0$, $P_i = 0.3$ (Panel a) and $P_i = 0.5$ (Panel b)



The intuition is as follows. Take the case $d > \frac{P_i}{\sigma}$ (Panel a). Since the cost of conflict is high relative to the benefit of obtaining the preferred public good, conflict is never an equilibrium. It is always feasible for the group in power to buy the opposition off. Hence the only possible equilibria are union with a fair distribution and agreed secession. Where the opposition is sufficiently large and productive, the equilibrium is peaceful secession. On the one hand, such an opposition group prefers peaceful secession to conflict, since the gain from going from triggering a conflict and possibly expropriating the whole surplus is not that large (the cost of conflict is high and the opposition is already almost as wealthy as the group in power). On the other hand, it is costly to buy this opposition, and so the group in power prefers peaceful secession to union.

When $d < \frac{P_i}{\sigma}$ (Panel b) and the opposition group is sufficiently large, group j is no longer willing to concede a very high λ; hence, the conflict area appears in the right Panel b of Figure 2. Observe, however, that there is no conflict when s is sufficiently large, since in that case the opposition prefers peaceful secession to conflict, and so does the group in power.

Higher cost of conflict obviously increases the cost of rejecting a proposal. Knowing this, the group in power can buy the opposition off for less. An increase in P_i, starting from $P_i < \sigma d = \frac{D}{N}$, broadens the set of parameter values for which agreed secession is the equilibrium outcome. Further, as soon as $P_i > \frac{D}{N}$, provided that the opposition is large enough, the group in power will not be prepared to offer a large enough transfer to make union acceptable. In that case, the equilibrium is conflict except in the area where both the power and the opposition group prefer peaceful

secession to conflict.

Decreasing the returns to scale —lowering A— or the preference diversity — increasing P_i— has the effect of broadening the set of parameter values for which secession is the equilibrium outcome. These predictions are broadly in line with those of Alesina and Spolaore (1997): As the size of the opposition nears 1/2 the possibility of secession reaches its maximum. In our case, the prediction is qualified by requiring the productivity of this group, s/n, to be around 2/3 of the national average.

However, when we compare Figures 1 and 2 —i.e. with and without valuing the future— the predictions generated by our dynamic model differ radically from the foregoing. When the future is not taken into account, peaceful union is the equilibrium, except for a sharply restricted set of parameter values, as described above. In a dynamic setup, however, the future benefits from secession can outweigh the one-shot cost of conflict. Thus the demand for aggreeing to remain in the union become unaffordable and peaceful union less likely.[19] This leads to either peaceful secession or one party triggering conflict in order to enjoy the infinite future stream of utility from secession.

We now examine the different SPEs for intermediate values of the time discount factor.

4.8 Intermediate δ

For a more nuanced understanding of the role of the time discount factor δ beyond the sharp comparison of Figures 1 and 2, consider first the parameter space in which the continuation equilibrium after proposal rejection involves j seeking secession at first victory while i would continue struggling for power within continued union. The value of eventual secession for j increases with the discount factor. Hence j wants to retain a larger share of the surplus in case of peace with respect to low values of δ where the outside option is continuous conflict. Consequently, the set of equilibria with peaceful union must be smaller in the dynamic than in the static game. And the higher the discount factor, the greater the difference between the predictions.

The same argument holds where the opposition plans to secede after the first

[19] A similar logic can be found in McBride and Skaperdas (2014). In a model of repeated conflict they find that the larger the discount factor the more likely conflict is to be a SPE.

victory (i.e., we are in B_i). The time-discounted payoff from this strategy is greater than that from continued conflict, and again the difference increases with the discount factor. Therefore, the peaceful distribution demanded to stay in the union will be higher, hence harder to satisfy.

To further clarify the role of the future, let us now consider a few intermediate examples for $\delta = 0.6, 0.8, 0.96$, and 1 (as in Figure 1). The rest of the parameter values are as above: $\sigma = 1.5, d = 0.3, a = 0.15$, and $P_i = P_j = 0.5$. Notice that with such high d we do not get permanent conflict as an SPE for high time discount factors. The case of a low d relative to a is discussed further on.

Figure3: Equilibria with $\delta = 0.6$ [Panel a], $\delta = 0.8$. [Panel b

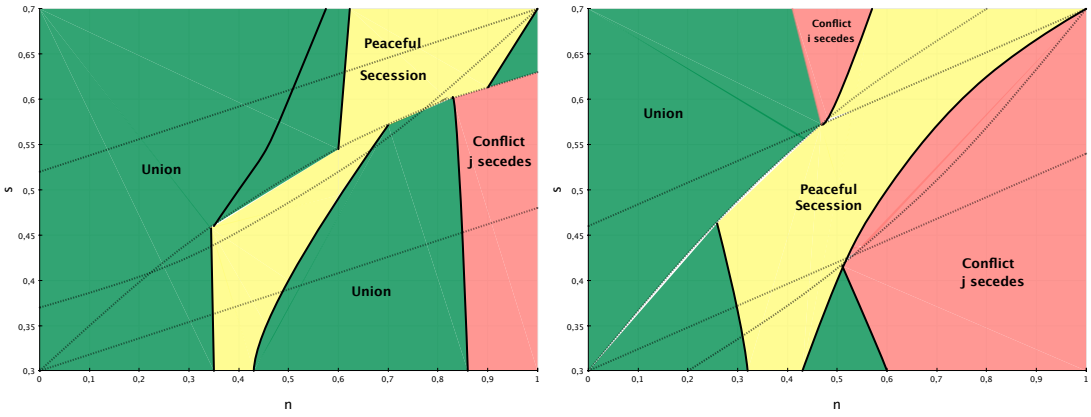
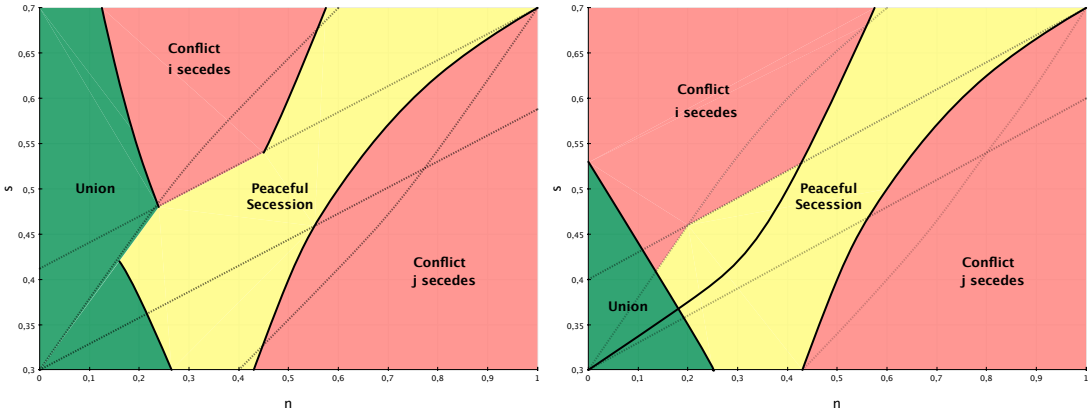


Figure3: Equilibria with $\delta = 0.96$ [Panel c], $\delta = 1$ [Panel d].



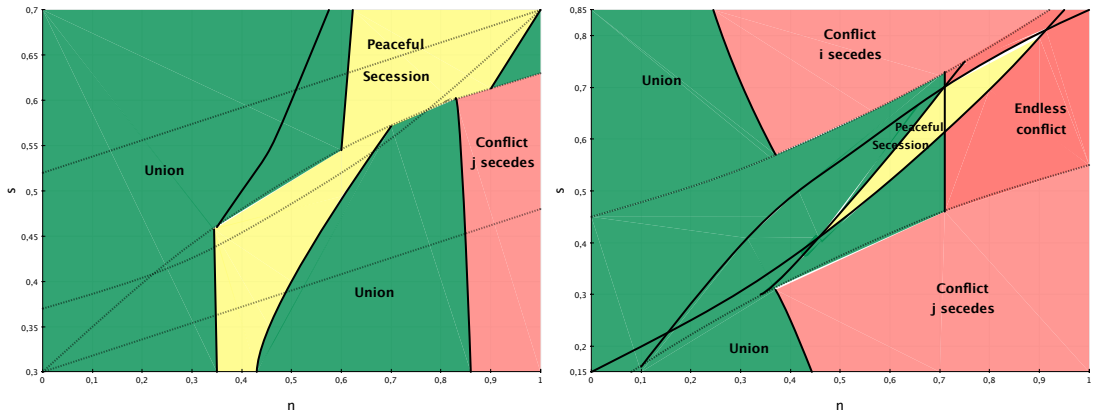
The four Panels in Figure 3 display some common features. There is always an area in which the SPE is peaceful secession. This is the case when the opposition group is sufficiently large. At the same time, the productivity of this group is roughly

at a par with the group in power. Union is more likely to be an SPE when n is small. In spite of these common features, however, in line with our argument above, as the future counts more and more the infinite stream of benefits from seceding (producing own public good and consuming own surplus) dominates the one-shot cost of conflict. Hence, we see that the parameter space for which union is an SPE contracts as the opposition's size shrinks, and at the same time the area of conflict leading to secession expands. Overall, we shift from a situation where union is the SPE for most of the parameter values to a one where secession —peaceful or conflictual— is the dominant SPE.

Unlike the static models of secession, our dynamic setting yields the novel prediction that as the time discount factor increases, the incentives for secession expand. Aboce all, the parameter values for which conflictual secession is the SPE come to be the largest set. As for peaceful union as the SPE, the maximum compatible size of the opposition group depends on the proportion of the surplus it produces. The smaller the opposition, the larger the surplus share for which union can be an SPE.

Lastly, let us examine the case with $d < a$ in which infinitely repeated conflict can be an SPE. Figure 4, Panel a, is the same as Figure 3, Panel a, with $\delta = 0.6$; Figure 4 Panel b also has $\delta = 0.6$ but with $d = 0.10$ and $a = 0.15$. Since conflict is less costly, we now have a wider range of parameter values for which conflict is the SPE, at the expense of union and peaceful secession. Indeed, the key point is that now the two groups can engage in infinitely repeated conflict. This is the case when the population share of the opposition group is sufficiently high —about 0.7 in our numerical example— and their productivity is moderately below the national average.

Figure 4: Equilibria with $\delta = 0.6$: $d = 0.30, a = 0.15$ [Panel a]; $d = 0.10, a = 0.15$ [Panel b]



5 Empirics

The equilibrium characterization of our model contains predictions about the parameter values for which union or secession should prevail and about the conditions for peaceful vs. conflictual secession. We take the case of $\delta \to 1$ as our baseline and evaluate first how such predictions correspond to the existing empirical evidence.

5.1 The existing evidence

5.1.1 Presence of particularly rich or particularly poor minorities associated with secessionist conflict

In our theory there is a zone of secessionist conflict where the opposition group is small or intermediate in size but highly prosperous. In such a situation, our theoretical model predicts that it will seek secession – and by force if necessary.

In the literature to date several studies have presented systematic evidence that natural resource-rich ethnic minorities have a relatively high propensity to engage in separatist conflict (see e.g. Sorens, 2012; Morelli and Rohner, 2015; Paine, 2017). In fact, there are many examples of conflicts in which resource-rich ethnic minority groups aim at secession.[20] Examples include the armed separatist movement in now independent Timor-Leste, the civil war in Nigeria's Biafra region and the recent fighting in the Niger Delta regions of Nigeria, Katanga's attempt to secede from the Congo in 1960-1963, the Basque country's armed struggle for independence from Spain, the rebellion of the Aceh Freedom Movement in Indonesia starting in 1976, and the Sudan People's Liberation Army struggle beginning in 1983. Other ethnically divided countries with separatism linked to a wealth of local natural resources include Angola, Myanmar, Democratic Republic of Congo, Morocco and Papua New Guinea.

These cases just mentioned have often involved actual political violence, but the impact of resource spoils is also perceptible in less violent calls for secession. Gehring and Schneider (2017) find that the Scottish bid for independence has been systematically fuelled by the value of prospective oil fields, while Suesse (2017) shows that at the moment of the collapse of the Soviet Union popular support for a new sovereign state was stronger in the oil rich republics.

[20] This draws on the more detailed accounts of Ross (2004), Collier and Hoeffler (2006) and Morelli and Rohner (2015).

Although in these examples above the prosperity of separatist regions is linked to natural resources, this is not indispensable. In fact, there are many more cases of prosperous regions aiming for secession even where the source of wealth is not natural resource spoils. Conflictual secessions by regions that were substantially richer than the country as a whole include Slovenia and Croatia's separation from Yugoslavia, and Eritrea's war of independence from Ethiopia.[21] In all these cases the secessionist region is prosperous relative to the rest of the country and small or at most intermediate in size. In line with our model, this creates an explosive mix.

Not only the richest but also some of the poorest regions seek to go independent. There are anecdotal accounts and case studies indicating that both the poorest and the richest regions tend to develop grievances against the central state and build nationalist movements (see Gourevitch, 1979; Horowitz, 1985; Bookman, 1992). Further, for a sample of 31 federal states, Deiwiks, Cederman and Gleditsch (2012) show that secessionist conflict takes place in regions whose income is either substantially below or substantially above the national average, and that roughly average regions are the most peaceful.

While the desire of the rich regions wanting to secede is perfectly in line with our model, the other part of their results requires explanation. First of all, it is hard to establish empirically which of the two parties actually triggers the conflict. What we observe is just conflict and eventual secession. Further, notice that where it is the group in power that wants to split, this could equally well take the form of an unfair distribution of the collective surplus, provoking rebellion by the opposition group. Therefore, the theoretical distinction –which party is the one to trigger conflict and secede– seems unlikely to be fully discernable empirically.

Second, the measures of horizontal inequality used here are post-transfer, whereas our variable s reflects the pre-transfer potential. In other words, a region can end up poor either (i) for lack of economic potential (in which case it definitively does not want to split), or (ii) due to exploitation by the government group (in which case it may want to secede if the economic potential s is large and poverty is only due to exploitation). The currently available data do not allow us to distinguish between poverty for lack of potential and poverty due to exploitation. Take for example the case of separatist Chechnya, which has a living standard well below the Russian

[21] In 1993, when Eritrea won its independence, its GDP per capita (at constant 2005 US dollars) was 70 percent larger than Ethiopia's (World Bank, 2017) and in the next year the difference jumped to more than 100 percent.

average, but lies in an oil- and gas-rich region, hence with a potentially large s. According to Cederman, Gleditsch and Buhaug (2013: 113), Chechen separatism has been fuelled by the fact that the Soviet state had economically discriminated against Chechens to the benefit of Russians. And if indeed Chechnya's poverty is due to discrimination rather than lack of economic potential, then the drive for secession is perfectly in line with our framework.[22]

5.1.2 Evidence on separatism being less violent when the groups involved are of intermediate or large size and of similar prosperity

Our model also generates additional predictions. In particular, according to our equilibrium characterization there is peaceful secession when the opposition group is of intermediate or large size and is about as rich as the governing group. For example the separation between Czech Republic and Slovakia – two lands of comparable size and prosperity– was peaceful, like the division of the ancient Roman Empire into two similar halves – West and East. Britain is of similar per capita GDP to the EU average and large in size, and its split from the EU has been –so far– within the boundaries of the law. Other examples of peaceful secessions with similar features include Singapore-Malaysia, Austria-Hungary and Norway-Sweden (see Young, 1994).

Another striking illustration is the collapse of the Soviet Union at the beginning of the 1990s. While separatist demands were met with violence in groups of relatively small size (e.g. Tbilisi, Georgia, in April 1989; Baku, Azerbaijan, in January 1990; and Vilnius, Lithuania, in January 1991), the declaration of sovereignty of Yeltsin's Russia, the heavyweight of the USSR, in June 1990 and its further drift towards independence did not result in any significant violence (see McCauley, 2017).

5.1.3 Evidence on peaceful union when minority groups are small

According to our model, we should expect the survival of peaceful union when the group out of power is small and not overly productive or resource endowed.

[22] According to Collier and Hoeffler (2006) Bangladesh's separation from Pakistan and the Southern attempt to secede from the United States Confederacy can also be seen as partially motivated by the desire to escape trade policies that were perceived as harmful for the separatist regions. Another example of separatist tensions fuelled by the perception of government favoritism is the challenge to Kenya's government by the Luo and allied ethnic groups (Childress, 2008).

When confronting this prediction to the empirical facts, note first of all that many enduring states are characterised either by ethnic homogeneity or by extreme ethnic fractionalisation; ethnically polarized countries are less likely to experience persistent peaceful union (Montalvo and Reynal-Querol, 2005; Esteban, Mayoral and Ray, 2012). As our model predicts, when potential separatist groups are absent (in the case of ethnic homogeneity) or very small in size (in the case of high ethnic fractionalization), forming a separate state would be very costly, so peaceful union is more easily sustained. Think for example of such cases as German-speaking Südtirol in Italy, Martinique and Guadeloupe in France, Galicia in Spain or the Sami people in Northern Scandinavia. Suesse (2017) also shows that during the collapse of the Soviet Union smaller regions were on average less likely to seek independence and more likely to favor maintaining the union.

5.1.4 Evidence on endless conflict

As we have seen, for there to be a permanent conflict in equilibrium, a country must have low δ and low d, which could apply, say, to some sub-Saharan countries. Recall that low d is the correct parametric assumption when the few sources of wealth are mineral resources yet to be extracted and the destruction cost of conflict is low. It is a standard result in the literature that conflict incidence is correlated positively both with poverty and with natural resource abundance (see e.g. Collier, Hoeffler and Rohner, 2009).

5.2 New stylized facts

5.2.1 Words of caution: Three pitfalls

Below we present some simple stylized descriptive statistics, linking n and s to union, secessionist conflict, centrist conflict and accepted secession.

To start with, some words of caution are in order. A series of problems precludes a full empirical analysis, so what is presented below should be taken, at best, as suggestive correlations.

There are three important limits to any formal empirical test of our theory: (i) measurement error, (ii) conceptual mismatch between our variables and the data currently available, and (iii) variability of model predictions depending on other parameter values.

First, we discuss measurement error. Quantifying group-level incomes is very challenging. In fact, until recently no suitable measures existed, but now three types of measures of group-level wealth, income and inequality have been developed. In particular, there are group income variables based on survey data (see Bahgat et al., 2017), such as the Demographic Health Survey (DHS). This survey data suffers from rather limited coverage and reporting bias (different groups may interpret the same question differently, and may have different wealth structures – which impedes comparison based on simple survey questions). Second, there are satellite night-light measures (NOAA, 2014) which can proxy for economic activity in ethnic group homelands (see Henderson et al., 2012; Alesina et al., 2016). As these measures are left- and right-censured, however, they are poor at picking up very low levels of income in rural areas and very high incomes in urban areas.

This may not be a severe problem for other applications, but in our case it is particularly problematic, as many secessionist conflicts are waged in areas close to borders and far from the capital. If these areas are on average more rural than those producing other outcomes, estimations could suffer from non-classical measurement error (i.e. the error could be greater for secessionist conflicts than for other outcomes). The third, and for our purpose perhaps the most promising option are G-Econ data (Nordhaus et al., 2006), which can proxy for ethnic group level incomes. However, the units of G-Econ are rather large with respect to the typically fine-grained patterns of ethnic group location, making these measures too relatively imprecise.

The second measurement pitfall is conceptual: In our model, the variable s captures *pre-transfer* economic production, hence post-secession economic potential. All measures above, by contrast, pick up *post-transfer* incomes. If, for example, an ethnic group is very productive and with great economic potential, but heavily exploited by the governing group, it would be classified as poor in our data, while its post-secession potential would be great.[23] This could generate a misleading correlation, namely between poor groups and separatist movements, whereas in our framework it is the groups with high economic potential that seek secession.

The third empirical complication is that for the variable s in particular the outcomes for any given s can depend heavily on other variables such as δ (see

[23] For instance, Burgess et al. (2015) show that the location of public infrastructures is strongly biased in favor of the homeland of the ethnic group in power. Therefore, night light might just reflect this bias, not the potential to generate surplus.

Figures 1, 2 and 3). The fact that some of these other parameters are not easy to measure compounds the difficulty in confronting the model to the data.[24]

Bearing all these limitations and pitfalls in mind, it is still worth presenting a set of descriptive stylized facts. This should be seen purely as suggestive correlations: no claim is made to testing the model or providing a causal analysis – which is ruled out in any case by the data limitations, and beyond the scope of this paper.

5.2.2 The data

For this simple correlation exercise we draw on a series of existing datasets at the ethnic group level. That is, the unit of observation is an ethnic group e, in country c and year t. We follow the overall inclusion criteria of the "GrowUp" dataset (Girardin et al., 2015), which "covers the ethnic groups from all countries in the period 1946 - 2013 that meet the following criteria: (i) Administered by an intact sovereign state, i.e. overseas colonies and failed states are not included; (ii) Population in 1990 is greater than or equal to 500'000 inhabitants".[25] Due to limitations of the data on group-level prosperity, our sample starts in 1991. Like in previous work using this data (Cederman et al., 2011), our sample only covers groups that have a clear geographical home base and are not involved in running the government[26] – given that in the underlying conflict data fighting for secession and being part of the government are mutually exclusive.

To measure secessionist and centrist group-level conflict (i.e. the endless conflict in our model that never ends in secession) we rely on the dummy variables "incidence terr flag" and "incidence gov flag", respectively (data from Wucherpfennig et al., 2012). Using a measure of whether a group actively seeks secession (i.e. the variable "status selfexclusion" from Wucherpfennig et al., 2011), we can (roughly) distinguish between "secessionist conflict with i wanting to secede" (territorial conflict in the presence of separatism by the ethnic group e) and "secessionist conflict

[24] A further caveat is that even the distinction between secessionist and centrist conflict is not always easy to make in the data. Say the group seeking independence is group j and it loses the secessionist conflict. The union is thus preserved but power shifts to group i, and one may be tempted to code this as centrist conflict, whereas it was actually triggered by a secessionist motivation.

[25] We download the main original datasets through the GrowUp system.

[26] In particular, we only include an observation in the sample when the variables "geo dispersed", "status monopoly", "status dominant", "status senior", "status junior" are all equal to zero (all these variables are from Wucherpfennig et al., 2011).

with j wanting to secede" (territorial conflict in the absence of separatism by e).

Our model's variable n is given by the variable "groupsize", namely "this group's population size as a fraction of the country's total population" (Wucherpfennig et al., 2011). The variable s corresponds to the proxied GDP of a given group divided by the national GDP.[27]

Finally, we compute a synthetic measure of how close a given group in a given year is to the 45 degree line in our previous graphs (where n and s are of the same magnitude). To this end, we construct a time-varying measure of population analogous to the n measure described above[28] and compute the per capita GDP of a group with respect to the national average of the GDP per capita.

5.2.3 Descriptive correlations

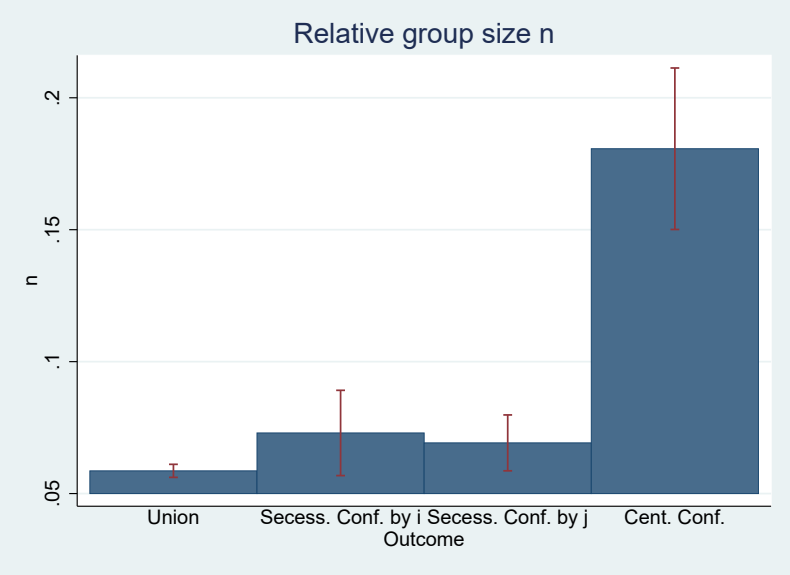
First of all, let us look at the values for peaceful secession. Such events are rare indeed: Macedonia seceding from Yugoslavia in 1991 as well as the split of Czechoslovakia in 1992. All the other secessions in our sample period were accompanied by some form of violence. The average relative population share, n, of Macedonians in 1991 and of Czechs and Slovaks in 1992 was 0.33 and their average share of the economy, s, was 0.35 – clearly in the yellow region of peaceful secession in our main figure. These value are substantially higher than for the rest of the sample, 0.19 and 0.22, respectively. The limited number of cases for accepted secession does not allow for a formal means comparison.[29]

Figure 5: Level of n across regimes

[27] In particular, we start from the variables "gdp90 corr" (for the years before 1995), "gdp95corr" (for 1995-1999), "gdp00corr" (for 2000-2004) and "gdp05corr" (for the years after 2005). These variables are defined as "the group's contribution to host country's GDP" in a given year, constructed by overlaying the ethnic territory polygons with the G-Econ data on economic activity (Nordhaus et al., 2006). We then calculate the relative share of group GDP in national GDP.

[28] While this measure –based on the overlay of geo-referenced population data with the polygons of ethnic territory (i.e. using the variables "pop90corr", "pop00corr" and "pop10corr", from CIESIN, 2011)– is arguably less precise than the "groupsize" measure used above, it is constructed in a exactly analogous manner to the s measure and also, like the latter, time-varying which has the virtue of avoiding the possible biasing of the ratio of s/n by a mismatch of reference years – a particularly important issue in countries with high population growth.

[29] Given that accepted secession includes government groups, the numbers above correspond to the full sample including all groups, government groups among them (unlike the rest of the analysis where we focus on the groups out of power – as explained in the previous subsection).



Accordingly, from here on we focus exclusively on the zones of union, secessionist conflict (distinguishing whether it is i or j that wants to separate) and centrist conflict (i.e. in our model eternal conflict without secession). In Figure 5 we display the average group population shares, n, using our main variable from Wucherpfennig et al. (2011), for each of these categories. The bars represent the mean; the lines the error bands for the 95 percent confidence interval. In accordance with the model's predictions, average relative group size is smallest where there is union or secessionist conflict, and largest for centrist conflict.[30] The difference between centrist conflict and all of the other three outcomes is statistically significant at the 1 percent level. The differences between union and the two types of secessionist conflict are not statistically significant, with the exception of secessionist conflict with j seeking to split, where n is significantly larger than in the case of union (at the 10 percent level).[31] This picture corresponds roughly to the theoretical predictions displayed in the Figures 1 to 3.

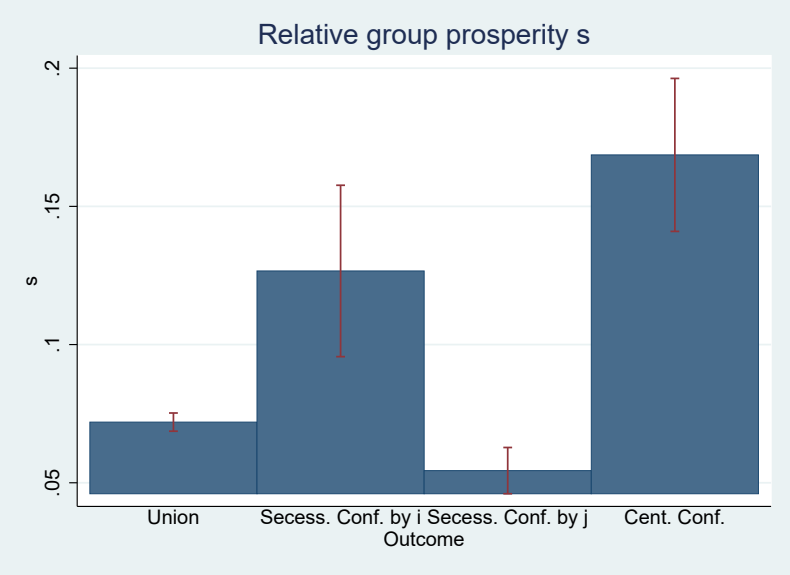
Next we compare the groups' average shares of national GDP for each of the

[30] To see this easily, refer to the model's predictions as displayed in Figure 4b, where the centroid of the polygon of peaceful union has the lowest n, followed by secessionist conflicts started by j or i, and the centroid of the polygon of endless conflict has the highest n.

[31] Reproducing this figure using the alternative population measure from CIESIN (2011) we find again that in observations with centrist conflict n is statistically significantly higher than in the other three outcomes, and that the differences among the latter three are not statistically significant.

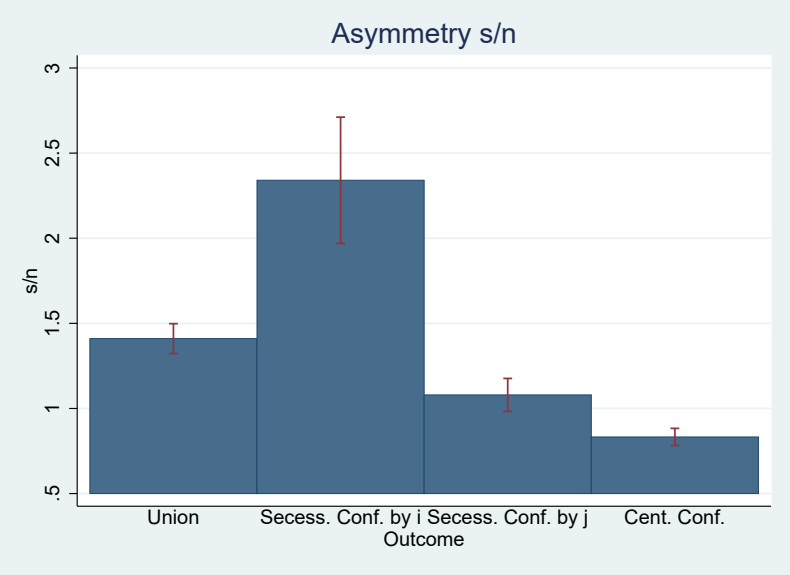
zones (Figure 6). Both secessionist conflict with group i seeking to split and centrist conflict have statistically higher levels of s than both peaceful union and secessionist conflict triggered by j. Recall that the high levels of s for centrist conflict partly reflect the fact that on average this type of conflict involves larger groups.

Figure 6: Level of s across regimes



In addition to examining n and s separately, it is interesting to analyse how the ratio s/n differs between the four zones, i.e. how close they are to the 45-degree line in our characterization picture. Figure 7 shows that being a relatively more productive group correlates statistically significantly with secessionist conflict where group i wants to split – in line with our model the most productive groups (i.e. those with the highest s/n) are most often seen to push for conflictual secession.

Figure 7: Level of s/n across regimes



Again, while the big picture emerging is broadly consistent with the theoretical predictions of the model, it is crucial to bear our caveats in mind – which means that the above stylized facts are rough correlations at best, with no claim to having demonstrated causality or tested the model.

6 Conclusion

Previous work on secession has focused largely on the trade-off between economies of scale and heterogeneity of preferences, and none has considered simultaneously the scope of conflict and long-run incentives. We link the literature on secession with that on conflict and build a dynamic model that highlights the effect of inter-temporal incentives. The model generates a novel picture that features some interesting and empirically testable predictions: When an opposition group is of comparatively small size and not especially productive, seeking independence is not very attractive, and peaceful union is a stable outcome. At the other extreme, when the potential secessionist group is large and about as productive as the group in power, conflict can also be avoided – albeit at the cost of dismantling the original union, via peaceful secession.

When the potential separatist group is large enough to be viable but not to have military power that commands restraint on the part of the governing group, and especially where there is a miss-match between population size and economic

potential, the risk of political violence is severe, as the more prosperous group wants separation, while the other fights to maintain union. A zone of eternal conflict without secession may also exist, for opposition groups that are large in size but with somewhat below average prosperity.

The paper thus answers some questions, but raises others: In particular, an important issue is what policies and institutions can affect the incentives for secession. We plan to investigate this issue in our framework, considering such matters as regional autonomy, the promotion of multi-linguism, and federalism. Another highly promising line of research is the collection of suitable data for a meaningful empirical test of the model (in particular, groups' pre-transfer economic potential).

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Appendix

Proof of Proposition 7

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Let us start with the parameters in $[R]$, in which i rejects peaceful secession. We check whether j can find a distribution within the union such that preserving union is weakly preferable for both players to conflict of type B_j. If such a distribution exists, this will be the unique SPE. If it does not exist, the only SPE is permanent conflict by player i and secession by j with its first victory. We now obtain the degree of fairness that would make each player indifferent to conflict and then verify whether they are mutually compatible. A distribution within the union can be an SPE iff $\lambda_j^{B_j} \geq \lambda_i^{B_j}$, that is, the fairness required to make i accept the distribution is less than would be needed to make j prefer that distribution over conflict along the path B_j. By the same argument, if the parameters belong to $[R]$ and $\lambda_j^{B_j} < \lambda_i^{B_j}$, the unique SPE consists in conflict after the initial proposal and j seceding.

Using (29) and (27), the $\lambda_j^{B_j}$ that equates the two payoffs is

$$\lambda_j^{B_j} = \frac{1}{n(1-\delta n)}\left[\frac{\sigma(1-n)s}{P_j(1-n)+\sigma(1-a)} + (1-\delta)n\right] \tag{37}$$

Repeating this exercise with player i we obtain $\lambda_i^{B_j}$ to be

$$\lambda_i^{B_j} = \frac{1}{(1-a)n}\left[\frac{nP_i}{\sigma} - a + \frac{s(1-n)+(1-\delta)(n-d)}{1-\delta n}\right]. \tag{38}$$

For the distribution to be feasible, it must hold that $\lambda_i^{B_j} < \frac{1}{n}$.

Let us now analyze the case in which player i would accept a secession if proposed. Specifically, we first restrict the parameters to the set $[B_i] \subset [K]$. We are interested in checking whether j would indeed propose a peaceful secession knowing that i would accept it.

We start by verifying whether j would prefer conflict along the path B_i to a consensual secession acceptable to i. From (31) and (26), with some manipulation, we can obtain that

$$V_j^S - V_j^{B_i} = \frac{\sigma}{(1-n)\big[1-\delta(1-n)\big]}\left[d-(1-n)s\right],$$

which is positive if and only if $s < \frac{d}{(1-n)}$. Suppose this is true and thus j prefers peaceful secession to conflict. We still need to verify that there is no distribution that is acceptable to i and that j would prefer to peaceful secession. We have that a distribution within the union is an SPE if and only if $\lambda_j^S \geq \lambda_i^{B_i}$. Otherwise, the SPE consists in j proposing a secession and i accepting it. Using (28), (29), (24), and (26) we readily obtain:

$$\lambda_i^{B_i} = \frac{\sigma(s-a)+nP_i}{\sigma(1-a)\left[1-\delta(1-n)\right]}, \tag{39}$$

and

$$\lambda_j^S = \frac{s\sigma}{n\left[(1-n)P_j+(1-a)\sigma\right]}. \tag{40}$$

Suppose now that $s > \frac{d}{(1-n)}$, so that j prefers conflict to peaceful secession. We easily obtain that

$$\lambda_j^{B_i} = \frac{\sigma\left[ns+(1-\delta)d\right]}{n\left[1-\delta(1-n)\right]\left[(1-n)P_j+(1-a)\sigma\right]}. \tag{41}$$

Finally, suppose we are in $[K \cap B_j]$ where i would accept a secession proposed by j, but in that part of $[K]$ that coincides with B_j. Within this set, we know that a peaceful secession proposal would be accepted. Notice first that j could not trigger conflict following a path B_j because it would end up deciding to secede rather than continuing conflict. Hence this must also be true in the first iteration, hence j would prefer peaceful secession to conflict followed by a path B_j, knowing that i would accept a secession proposal.

Now it only remains to be checked whether j would propose a peaceful secession or a distribution within the union. Following the same steps as before we obtain the degree of fairness that makes i indifferent to a path B_j, $\lambda_i^{B_j}$, and j indifferent to secession, λ_j^S. Once again a distribution preserving union will be an SPE iff $\lambda_j^S > \lambda_i^{B_j}$. Otherwise, j proposes secession and i accepts. This completes our characterization of SPE.

QED.

Proof of Proposition 11

We first check when the group in power will prefer union to both conflict and secession. As before, we compute the level of fairness necessary to make the group in power j indifferent between union and secession λ_j^S and between union and conflict λ_j^A. Union is preferred to either secession or conflict whenever $\lambda_i^A < \lambda_j^S$ and $\lambda_i^A < \lambda_j^A$, respectively.

A union proposal will be accepted by the opposition provided the degree of implicit fairness is not less than λ_i^A. Using (2) and (4), we can easily compute the value of λ_i^A that makes i indifferent between accepting and rejecting a distribution within the union as

$$\lambda_i^A = 1 + \frac{N_i P_i - D}{S - A} = \frac{1 - a - d + \frac{P_i}{\sigma} n}{1 - a}. \tag{42}$$

Since by assumption $a + d < 1$ (as described above), it follows that $\lambda_i^U > 0$ for all parameter values satisfying this assumption.

Let us now check the condition that $\lambda_i^A \leq \frac{1}{n}$. Define

$$\kappa(n) \equiv \frac{1}{n} - \lambda_i^A(n) = \frac{1}{n} - \frac{1 - a - d + \frac{P_i}{\sigma} n}{1 - a}.$$

This is a *decreasing* function of n. Hence, if we implicitly define n^c as the solution to $\kappa(n^c) = 0$, we have that λ_i^A will be feasible for all $n \leq n^c$. Note that $\kappa(1) = \frac{d - \frac{P_i}{\sigma}}{1-a}$. Therefore, whenever $d \geq \frac{P_i}{\sigma}$, that is $D > P_i N$, we have that $n^c \geq 1$, and hence this constraint will not be binding. Fairness λ_i^A will be feasible for all $n \in (0, 1)$. When $d < \frac{P_i}{\sigma}$ we have that $n^c < 1$ and hence for all $n \in (n^c, 1)$ the opposition will not be offered a fair distribution within the union: even surrendering the entire surplus would not be enough to appease the opposition.

Solving $\kappa(n^c) = 0$ we obtain

$$n^c \equiv \frac{\sigma}{2P_i} \left[-(1 - a - d) + \sqrt{(1 - a - d)^2 + 4(1 - a)\frac{P_i}{\sigma}} \right]. \tag{43}$$

Intuitively, if the cost of conflict is very low relative to the gain in the public good and the opposition's probability of victory is very high –greater than n^c– the group in power will be unable to buy the opposition off and will have to choose conflict.

We can now compare the payoffs for j in case of conflict and of secession.

We start with a fair distribution of the surplus within the union that is preferred to conflict, that is $\lambda_i^A \leq \lambda_j^A$.

Using (2) and (4) we obtain λ_j^A:

$$\lambda_j^A = 1 + \frac{1-n}{n}\frac{d}{1-a} + \frac{1-n}{(1-a)\sigma}P_j. \tag{44}$$

Comparing λ_j^A with λ_i^A it is immediate that the necessary and sufficient condition for $\lambda_i^A \leq \lambda_j^A$ is

$$\psi(n) = \sigma d + nP_j - (P - i + P_j)n^2 \geq 0.$$

Let n^{cc} be the positive solution to $\psi(n^{cc}) = 0$. Then

$$n^{cc} = \frac{P_j}{2(P_i+P_j)} + \sqrt{\left[\frac{P_j}{2(P_i+P_j)}\right]^2 + \frac{P_j}{P_i+P_j}\frac{D}{P_j N}}. \tag{45}$$

It is readily obtained that $\psi(n) \gtrless 0$ as $n \lessgtr n^{cc}$. Furthermore, $n^{cc} \gtrless 1$ as $d \gtrless \frac{P_i}{\sigma}$.

Combining the two foregoing observations we have the following result.

Lemma 12. *Union with fairness λ_i^A is preferred to conflict by the group in power j*

- *when $d \geq \frac{P_i}{\sigma}$ for all consistent parameter values,*
- *when $d < \frac{P_i}{\sigma}$ for $n \leq \min\{n^c, n^{cc}\}$.*[32] *Otherwise group j prefers conflict to union.*

It is worth emphasizing group j will prefer conflict to the most favorable fair distribution in a union only when the cost of conflict is small relative to the benefits of the public good, $d < \frac{P_i}{\sigma}$, and the opposition population is large enough, $n > \min\{n^c, n^{cc}\}$. The intuition is simple. If the cost of conflict is high relative to the benefits of the independent public good, the opposition will be ready to accept moderate appeasing transfers. As the cost decreases, large opposition groups with high probability of victory will find conflict so profitable that no transfer acceptable to j can appease them.

[32] By computing the derivative of n^c and n^{cc} evaluated at $d = \frac{P_i}{\sigma}$, that is, at $n^c = n^{cc} = 1$ we obtain that for d close to $\frac{P_i}{\sigma}$, $\min\{n^c, n^{cc}\} = n^{cc}$. At the other end, we can show that as d approaches zero $n^c < \sqrt{\frac{\sigma(1-a)}{P_i}}$ and $n^{cc} \to \frac{P_j}{P_i+P_j}$. Which of the two is lower cannot be established without further restrictions on the parameter values.

We now examine the conditions under which j prefers a fair distribution maintaining union to peaceful secession, that is, $\lambda_i^A \leq \lambda_j^S$. Using (2) and (3) we obtain the λ_j^S that makes group j indifferent between the two options:

$$\lambda_j^S = \frac{s}{(1-a)n}. \tag{46}$$

Comparing (42) with (46) we obtain the condition for group j to prefer union to secession.

Lemma 13. *Player j prefers a union with fairness λ_i^A to secession if and only if*

$$s \geq \vartheta(n) \equiv (1-a-d)n + \frac{P_i}{\sigma}n^2. \tag{47}$$

ϑ is a strictly increasing, convex function with $\vartheta(0) = 0$ and $\vartheta(1) = 1-a-d+\frac{P_i}{\sigma}$. Note that $\vartheta(1) = 1-a-d+\frac{P_i}{\sigma} \gtrless 1-a$ as $d \lessgtr \frac{P_i}{\sigma}$.

The condition of Lemma 13 is straightforward. When the opposition has little surplus to contribute, the group in power prefers to secede and keep the own surplus.

The conditions under which j will prefer secession over union with fairness λ_i^A is precisely the complement of the conditions in Lemma 13, just discussed. We can finish the analysis of j's choices by considering when secession will be preferable to conflict. From expressions (3) and (4) we obtain the conditions under which player j prefers secession to conflict.

Lemma 14. *Player j prefers secession to conflict if and only if*

$$s \leq \phi(n) = d + \left[1-a-d+\frac{P_j}{\sigma}\right]n - \frac{P_j}{\sigma}n^2. \tag{48}$$

ϕ is a concave function with $\phi(0) = d$ and $\phi(1) = 1-a$.

Consider first the case in which $d > \frac{P_i}{\sigma}$. This implies that $\min\{n^c, n^{cc}\} > 1$ and hence for all parameter values satisfying this restriction a fair distribution is acceptable to both groups.

From Lemma 13 we know that for all $s \geq \vartheta(n)$ group j prefers union to secession, and from Lemma 12 that it also prefers union to conflict. Since union has been evaluated at the fairness level that makes it acceptable to i, we can conclude that for all $s \geq \vartheta(n)$ the unique equilibrium is a fair distribution of the surplus, maintaining the union.

Again from Lemma 13 for all $s < \vartheta(n)$ group j prefers secession over a fair union. Furthermore, since also $s < \phi(n)$, by Lemma 14, we add that j also prefers secession to conflict. Even though j prefers secession overall, by Lemma 10 player i will accept it only if $s \geq \zeta(n)$. Therefore, for all $s \in [\zeta(n), \phi(n)]$ the unique equilibrium is peaceful secession. When $s \leq \min\{\zeta(n), \phi(n)]\}$ then i would reject any secession proposal. Since by Lemma 12 j prefers fair union to conflict, the unique equilibrium is fair union.

We now examine the changes to be made to our characterization of equilibria when $d < \frac{P_i}{\sigma}$, that is, when $\min\{n^c, n^{cc}\} < 1$. To simplify the analysis of this case of low cost of conflict we assume that d cannot be arbitrarily small. Specifically, we take the case in which $\frac{P_i}{\sigma} - a \leq d < \frac{P_i}{\sigma}$.

By Lemma 12 we know that for all $\min\{n^c, n^{cc}\} < n < 1$ group j will choose conflict rather than union and this alters our analysis for these values of n. But note that a higher d also shifts the function $\vartheta(\cdot)$ upwards, so that this function now intersects the function $\phi(\cdot)$. It is readily verified that this intersection takes place precisely at $n = n^{cc}$.

Notice first that for all $n \leq \min\{n^c, n^{cc}\}$ the analysis is exactly the same as before. Hence, for $n \leq \min\{n^c, n^{cc}\}$ and for all $s \in [\zeta(n), \phi(n)]$ the unique equilibrium is peaceful; otherwise the equilibrium is fair distribution maintaining union.

From Lemma 13 we know that for all $s \geq \vartheta(n)$ group j prefers union to secession and from Lemma 12 that conflict is preferred to union. Hence, for all $s \geq \vartheta(n)$ the unique equilibrium is conflict.

We now examine the parameter values such that $\phi(n) < s < \vartheta(n)$. Notice that since we are in the set $n \geq n^{cc}$ fair distribution is excluded as an option. The only choices for j are secession and conflict. By Lemma 14, whenever $\phi(n) < s$ player j prefers conflict to secession, and by Lemma 13 whenever $s < \vartheta(n)$ player j prefers secession to union. Therefore, we can conclude that the equilibrium chosen by player j will again be conflict.

Let us now consider the case in which $\zeta(n) \leq s \leq \phi(n)$. By Lemma 14 j prefers secession to conflict and by Lemma 10 player i would accept the proposed secession. Therefore, for these parameter values the equilibrium is secession.

Finally, for $s < \zeta(n)$ we know that the only options for player j are secession and conflict. But by Lemma 10, for these parameter values i will reject secession. Hence, for this set of parameters the only equilibrium is conflict.

This completes the characterization of equilibria.

QED.