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ABSTRACT

Stochastic Shocks and Incentives for (Dis)Integration*

I present a political economy model of limits to regional redistribution under the threat of secession. The model depicts a union composed of two regions with centralized fiscal policy. The key feature is the trade-off between the benefits of secession embodied by autonomous fiscal policy and the benefits of integration – efficiency gains and risk sharing. I argue that previously stable unions may disintegrate in response to specific patterns of region-specific output shocks. The decision on secession depends on correlation and persistence of shocks. Integration is sustainable if the shocks are positively correlated and/or transient. On the other hand, the combination of negative correlation and high persistence of the shocks makes integration fragile. Benefits from risk sharing are greatest when shocks are negatively correlated and transient.

JEL Classification: E62, F2, H73
Keywords: disintegration, median voter, risk sharing, optimum currency areas, Central and Eastern Europe

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NON-TECHNICAL SUMMARY

The aim of this paper is to shed some light on the economic background of disintegration and integration of countries. The last decade brought an increased activity on both fronts, especially in Europe: On the one hand, the process of European integration progressed in strides – Austria, Finland and Sweden acceded to the European Union, the process of eastward enlargement got under way, and the Economic and Monetary Union (EMU) finally became reality. On the other hand, multinational federations in Central and Eastern Europe – Czechoslovakia, Yugoslavia and the Soviet Union – disintegrated amidst political and economic turmoil, while other countries – Belgium, Spain, Italy and the United Kingdom – had to struggle with rising separatism.

This paper is motivated by the observation that secession and separatism were typically preceded by asymmetric economic developments and conflicts over regional redistribution. For example, disintegrations in Central and Eastern Europe occurred in the middle of reform induced recession with highly asymmetric regional effects. Economic disparities between regions played an important role in encouraging separatism in Belgium, Spain and Italy. In the present paper, I model such asymmetric economic developments by means of region-specific shocks. The shocks affect regional preferences over fiscal redistribution, which in turn can provide incentives for secession.

I construct a dynamic version of the model introduced by Bolton and Roland (1997), with region-specific shocks. The model depicts a union composed of two regions with centralized fiscal policy. With integration, fiscal policy is determined by the preferences of the union's median-income voter. In general, the union's fiscal policy is a compromise between the regions' preferred fiscal policies. Asymmetric regional shocks can induce regions to secede by driving their preferred fiscal policies further apart. On the other hand, centralized fiscal policy indirectly facilitates redistribution of income from the region hit by a positive shock to the one hit by a negative shock. Hence, integration brings the benefits of increased efficiency and risk sharing, but comes at the cost of losing autonomous fiscal policy.

The purpose of this paper is to determine what patterns of region-specific shocks undermine, or increase, political stability of unions. The decision on secession is taken by a vote in each region at the beginning of every period, before the shocks become known. Therefore, the outcome of the vote depends on the expectations of shocks based on information about previous shocks and their persistence. I argue that two aspects of shocks are important for stability of unions – the correlation of shocks across regions and their persistence over time. Positive correlation of shocks makes unions stable,

regardless of persistence. On the other hand, negatively correlated and persistent shocks render unions politically fragile. Finally, with transient shocks, integration brings about the benefit of risk sharing and this benefit is particularly large when the shocks are negatively correlated. This adds another dimension to the argument put forward by the literature inspired by Mundell's (1961) *Theory of Optimum Currency Areas*, which only considers correlation of shocks. In my paper, I show that persistence is also crucial and the argument put forward by the Optimum Currency Areas literature is only relevant for persistent shocks. Moreover, the results of the present model expose the limits of the traditional argument of the Optimum Currency Areas literature, which posits that asymmetric shocks can be mitigated by an effective fiscal transfer mechanism. The present paper shows that there are political limits on such transfers, especially if the shocks are persistent and/or particularly large.

1 Introduction

The aim of this paper is to …nd economic rationale for disintegration and integration of nations. As The Economist pointed out in a recent article[1], the number of countries grew from 62 in 1914 to 193 at present. The majority of the new countries arose through the end of colonial rule. More recently, multinational federation in Central and Eastern Europe — Soviet Union, Yugoslavia and Czechoslovakia — disintegrated amidst political and economic turmoil. Developed countries of the West also face rising separatism — Quebec, Scotland, Catalonia, Flanders, or Padania may be the new countries of tomorrow.

Traditionally, the theoretical rationale for integration — or disintegration — was provided by the theory of optimum currency areas. This stream of literature was started by Mundell (1961), and extended by McKinnon (1963) and Kenen (1969).[2] The optimum currency area (OCA) theory is concerned with identifying the criteria determining whether two or more countries should use the same currency, or whether they would be better o¤ with separate currencies. Monetary integration comes at the cost of giving up autonomy over monetary policy. If the countries adopting a single currency are subjected to symmetric (positively correlated) shocks, monetary integration is optimal. In the absence of independent monetary policy, the e¤ects of asymmetric shocks have to be mitigated by migration of labor and/or relative price and wage adjustments. Finally, it is argued, …scal inter-regional transfers can also be used to counter the adverse e¤ects of asymmetric shocks, and thus make monetary integration sustainable.

More recently, accelerating integration in Western Europe on the one hand, and wave of break-ups of countries in Eastern Europe on the other hand, brought about rising interests in political economy aspects of (dis)integration. While the OCA story can explain the process of monetary uni…cation in Europe, it o¤ers little rationale for European integration moving beyond the monetary union. Moreover, it has generally been argued that the recent disintegrations in Eastern Europe re‡ected political con‡icts rather than economic factors.[3] Political economy of disintegration seeks to …ll this gap.

Bolton and Roland (1997) explain secession as the outcome of political con‡ict over redistribution policies. Regions trade o¤ e¢ciency gains of integration against the cost of not having the redistribution policy preferred by the median voter. Consequently, when income inequality di¤ers across regions and the e¢ciency gains from integration are small, unions break up. Alesina and Spolaore (1997) present a model with endogenous formation of nations. Integration yields economies of scale but

[1] "Small but perfectly formed," The Economist, January 3, 1998, pp. 63-65.

[2] De Grauwe (1994) describes the current state of the OCA literature. Frankel and Rose (1996) apply the OCA theory in their advice the Swedish government on its entry to the EMU.

[3] A recent exception is Fidrmuc and Horvath (1998) who apply the OCA theory in an empirical analysis of the break-up of Czechoslovakia. This paper also contains refereces to the literature endorsing the political motives for disintegration.

comes at the cost of increased heterogeneity of unions. They show that democratization and economic integration lead to a higher number of nations. The latter result is further pursued by Alesina, Spolaore and Wacziarg (1997). They argue that trade liberalization increases the incentives for regions to secede. This conclusion is then supported by their empirical analysis. Alesina and Spolaore (1996) point out that the reduction of threat of international con‡icts also leads to secession, and a larger number of smaller countries.

A related stream in the literature looks into the bene…ts of risk sharing and mutual insurance against stochastic idiosyncratic shocks. Person and Tabellini (1996a,b) and Alesina and Perotti (1995) look at the world where regions face stochastic productivity shocks. Person and Tabellini (1996a,b) focus on the role of risk sharing and inter-regional redistribution under alternative federal …scal constitutions. Alesina and Perotti (1995), on the other hand, point out that the bene…t of risk sharing may come at the price of increased political risk. In other words, under their assumptions, integration reduces uncertainty of the tax base (risk sharing) but increases the volatility of the tax rate (political risk). Empirical evidence on risk sharing is presented by Sachs and Sala-i-Martin (1992), Asdrubali, Sorensen, and Yosha (1996), and Sorensen, and Yosha (1998).

Finally, there is a growing stream in the literature that points out ine¢ciencies due to integration. Easterly and Levine (1997) and Rodrik (1998) show empirical evidence that political con‡ict, caused by ethnic fragmentation and/or income inequality, has strong negative e¤ect on economic growth. Alesina, Baqir and Easterly (1997) argue that provision of public goods is inversely related to ethnic or racial fragmentation of the society. They also present empirical evidence for US metropolitan areas supporting their theoretical argument. Sala-i-Martin (1992) presents a model where individuals with low productivity cause an overall negative externality to the society. Although he is primarily concerned with social security as a way of bribing low productivity workers (pensioners) out of labor force, the same argument could be applied to countries with high and low productivity regions, such as Italy, Belgium, former Yugoslavia, or Czechoslovakia.

In this paper, I draw a line between the modern political economy of disintegration literature and the optimum currency area literature. I construct a dynamic model motivated by the static model of Bolton and Roland (1997). The model features two regions that initially form a union with a single common …scal policy determined by the union's median voter. The regions may di¤er in terms of income distribution and/or average income, and hence their preferences over …scal policy will generally di¤er as well. In the present model, output is subject to region speci…c stochastic shocks. The shocks a¤ect the regions' preferences over …scal policy. The decision between integration and secession then re‡ects the trade o¤ between the e¢ciency gains from integration and the cost of not having the region's preferred …scal policy.

The model yields interesting implications regarding the role of …scal federalism in enhancing the stability of integration. The OCA literature argues that the adverse

effects of asymmetric shocks can be countered by inter-regional fiscal redistribution. In the present paper, I show that this may not be possible because of the political constraints. Asymmetric shocks drive the preferred fiscal policies of the two regions even further apart, and the disutility of having the wrong fiscal policy may eventually outweigh the benefits of integration. The possibilities for international risk sharing are hence limited unless countries can credibly and irrevocably commit to integration. In particular, the present model predicts that risk sharing is politically feasible only if shocks are transient. In case of permanent shocks, on the other hand, integration will be politically fragile.

In addition, the paper at hand extends the OCA literature by considering both correlation[4] and persistence of shocks. The OCA theory, on the other hand, only considers the former. I show that unions are stable if the shocks are positively correlated, regardless whether persistent or transient. If the shocks are negatively correlated and transient, integration is beneficial because of risk sharing. On the other hand, negatively correlated and persistent shocks render integration fragile.

The paper is structured as follows: Section 2 introduces the model. Section 3 discusses the regions' incentives for secession, and shows how stability of integration is determined by the nature of shocks. Finally, Section 4 concludes.

2 The Model

Consider a union composed of two regions of equal size, denoted by $k = a; b$. The production function of region k has deterministic and stochastic components: $Y_{k;t} = K_k^{\alpha} L_k^{1-\alpha} + E_{k;t}$. K_k and L_k stand for capital and labor (constant over time), respectively, with $\alpha \in [0;1]$ being the capital share. $E_{k;t}$ is the stochastic component of region k's output in period t. The output of the union is given as the sum of regional outputs. The region's production functions can be rewritten in per capita terms:

$$y_{k;t} = k^{\alpha} + \varepsilon_{k;t} = \bar{y}_k + \varepsilon_{k;t} \tag{1}$$

where $\bar{y}_k$ is the output in the absence of the shock and ε_k is the per-capita output shock. I assume the shock follows an AR(1) process

$$\varepsilon_{k;t} = \rho_k \varepsilon_{k;t-1} + \eta_{k;t} \tag{2}$$

where $\eta_{k;t}$ is white noise with a zero mean and variance σ_k^2, and the persistence parameter ρ_k is such that $0 \leq \rho_k \leq 1$. The union's average output is then, setting $\varepsilon_t \equiv \frac{\varepsilon_{a;t} + \varepsilon_{b;t}}{2}$:

$$y_t = \frac{\bar{y}_a + \bar{y}_b}{2} + \frac{\varepsilon_{a;t} + \varepsilon_{b;t}}{2} = \bar{y} + \varepsilon_t. \tag{3}$$

[4] The traditional terminology of the OCA literature distinguishes symmetric and asymmetric shocks. This corresponds to positive and negative correlation of shocks, respectively, which are the terms I use throughout this paper.

For simplicity, I assume individuals receive a time-invariant income endowment every period that can take values between 0 and V.[5] The distribution of income endowments is skewed so that the median income is smaller than or equal to the average income: $\Psi_m \leq \bar{\Psi}$ and $\Psi_{mk} \leq \bar{\Psi}_k$, where Ψ_m denotes the union's median and Ψ_{mk} denotes the region k's median. I assume that the distribution function, while skewed, is continuous.[6] The income endowment Ψ_i of an individual i is subjected to a region specific shock $\varepsilon_{k;t}$. To ensure tractability, I assume that all individuals suffer the same shock, and individual i's actual income is thus $v_i = \Psi_i + \varepsilon_{k;t}$. The choice of additive instead of multiplicative shock can be justified by pointing out that high income individuals diversify their assets and have better opportunities for hedging. Therefore, idiosyncratic shocks affect a smaller fraction of their total income. Finally, note that the identity and the level of income of the union's median voter change every period as long as $\varepsilon_{a;t} \neq \varepsilon_{b;t}$. On the other hand, the identities of the regional median voters do not change — although their incomes change in response to the shocks. For the sake of tracktability, I assume that the union's median income is $v_{m;t} = \Psi_m + \varepsilon_t$; this assumption is quite realistic provided that the distribution function is continuous and not too asymmetric.

An individual i has concave utility function $U(c_{i;t})$. Consumption $c_{i;t}$ equals to the individual's total disposable income which is composed of his/her net income $(1 - t_t)v_{i;t}$, and a lump-sum transfer g_t from the government, financed by linear income tax t_t. Taxation, however, is inefficient, and a part of the revenue, $\frac{t_t^2}{2}$, is lost,

$$g_t = (t_t - \frac{t_t^2}{2})y_t \tag{4}$$

The consumption of individual i hence equals:

$$c_{i;t} = (1 - t_t)v_{i;t} + (t_t - \frac{t_t^2}{2})y_t. \tag{5}$$

The tax rate is determined by a union-wide vote. I assume voting takes place each period after the regional shocks have realized. Since voters' preferences are single-peaked, the optimum tax rate will be the rate maximizing the median voter's consumption:

$$t_t^*(y_t; v_{m;t}) = \frac{y_t - v_{m;t}}{y_t} \tag{6}$$

The optimum tax rate reflects the degree of inequality of income distribution. The greater is the difference between the average and the median incomes, the higher will be the tax rate. In case of secession, each region imposes its own optimum tax rate

[5] This simplifying assumption could be replaced by specific assumptions on distribution of individuals' labor and capital endowments, see Bolton and Roland (1997).

[6] Hence, I specifically rule out discontinuos distributions such as the one assumed by Alesina and Perotti (1995).

that maximizes consumption of that region's median-income voter:

$$t^{\alpha}_{k;t}(y_{k;t}; v_{mk;t}) = \frac{y_{k;t} \ i \ v_{mk;t}}{y_{k;t}}: \tag{7}$$

Clearly, the regional tax rate depends on region-speci…c income distribution and shock and will thus in general be di¤erent from the union's optimum tax rate t^{α}.

The tax rate depends on the realization of regional shocks: $\frac{@t^{\alpha}_t}{@"_{k;t}} = \ ¡ \frac{1}{2}\frac{y_t \ i \ v_{m;t}}{y_t^2} < 0$, the tax rate rises during recessions and falls during booms.[7] On the other hand, the e¤ect of shocks on the transfer is positive: $\frac{@g_t}{@"_{k;t}} = \frac{1}{4}t_t^2 > 0$. Hence, although the tax rate declines in response to a positive shock, this decline is not large enough to leave the government spending at the same level as in the absence of the shock.

The result indicating changing tax rates in response to stochastic shocks contradicts the well known Barro's (1979) proposition that agents prefer constant tax rates over time. However, this result is driven by the features of the present model, in particular the assumption of balanced budget every period, and endogenous determination of government expenditure. Nonetheless, this model shows that integration has the additional bene…t of reducing the tax rate volatility. This is so because the optimal tax rate responds to both regional shocks, and the overall change is thus mitigated — unless the shocks are exactly identical.

3 Shocks and Secession

3.1 Gain from Secession

The tax rate, derived in equation (6), is obtained under integration: the vote takes place on a union-wide basis and the equilibrium tax rate t^{α}_t maximizes the consumption of the union's median voter. This tax rate re‡ects the average of the two regional shocks, $"_t \ ´ \ \frac{"_{a;t} + "_{b;t}}{2}$. The tax rates preferred by the two regional median voters are often di¤erent from the union's optimum tax rate, and from each other. This is so for two reasons: First, income distributions can be di¤erent in the two regions. Second, regions are subject to indiosyncratic economic shocks. Integration thus carries the cost of compromising over …scal policy — or, in other words, having the …scal policy dictated by the central government. On the other hand, integration also carries two important bene…ts. First, it brings e¢ciency gains — such as economies of scale because of having access to a larger market. Second, integration also implies risk sharing — centralized …scal policy facilitates redistribution from the region experiencing a positive shock to the region hit by a recession.

I assume the following timing of events: First, the regions vote to choose between integration and secession. Then, the region-speci…c shocks unfold. Finally, the tax

[7] The change in the preferred tax rate re‡ects the fact that a positive shock actually reduces the skewness of income distribution because the ratio $\frac{v_{m;t}}{y_t}$ rises. Moreover, a positive shock increses the tax base, and thus a lower tax rate is necessary to …nance a given amount of government expenditure.

rate is determined, reflecting the actual realization of the shocks, taxes are collected and redistributed. The decision on secession thus reflects voters' expectations of the current period's shocks, based on the information about previous shocks and their persistence. The union breaks up whenever at least one region votes for secession.

I assume secession comes at a cost $\gamma_{k;t} \geq 0$. This reflects the efficiency loss e.g. due to trade barriers, as well as the initial cost of creating new regional government, military, etc. $\gamma_{k;t}$ therefore need not be constant over time, it is reasonable to assume that it is highest at the time of secession and falls afterwards.

Definition 1 Region k has an incentive to secede if the median voter expects greater consumption under secession than under integration, i.e. secession brings about a positive expected gain from secession (EGS)

$$\phi_{k;t} \equiv E_t \left[c^k_{m;t}(\varepsilon_{k;t}; \gamma_{k;t}) - c^u_{mk;t}(\varepsilon_{k;t}; \varepsilon_{-k;t}) \right] > 0 \tag{8}$$

Here, $\varepsilon_{k;t}$ is the domestic shock, $\varepsilon_{-k;t}$ is the other region's shock,[8] $c^k_{m;t}(\varepsilon_{k;t}; \gamma_{k;t})$ is the level of consumption of the median voter of region k in case of secession, and $c^u_{mk;t}(\varepsilon_{k;t}; \varepsilon_{-k;t})$ is his/her consumption in case of integration. Given the pattern of shocks, (8) can be rewritten as follows:

$$\phi_{k;t} \equiv c^k_{m;t}(\rho_k \varepsilon_{k;t-1}; \gamma_{k;t}) - c^u_{mk;t}\left[\rho_k \varepsilon_{k;t-1}; \rho_{-k} \varepsilon_{-k;t-1}\right] > 0 \tag{9}$$

The outcome of the vote on secession therefore depends on the realization of previous period's shocks, and their persistence.

Equation (8) is necessary but not sufficient condition for secession. Whether secession occurs depends on the net present value of the gain from secession, $NPV_{k;t} \equiv \sum_{s=0}^{1} \delta^s E_t \phi_{k;t+s}$ (assuming secession is irreversible). The sufficient condition for secession then is $NPV_{k;t} + NPV_{-k;t} > 0$, reflecting the fact that as long as at least one region prefers integration, it can offer concession to the other region to prevent it from seceding.[9] For the sake of simplicity and tractability, I focus on condition (8) when analyzing the effects of stochastic economic shocks on the decision to secede. This allows me to keep the model rather simple — as the analysis involves only two periods — and still draw conclusions on intertemporal effects of the shocks. The model in this section thus looks at a union that has been a priori stable until period t. At period t, regions consider seceding based on the expected current shocks — with expectations being formed using information about period $t-1$ shocks, and their persistence.

[8] Where, for the sake of generality, I do not distinguish the regions explicitly by subcripts a and b, I use the following notation: the home region is denoted by a subscript k whereas the other region has a subscript $-k$.

[9] Bolton and Roland (1997) discuss bargaining over tax rate as union preserving measure. Another possibility is to incorporate a direct inter-regional transfer (Dixit and Londregan, 1998).

To derive condition (8), note that the consumption of individual i under integration is:

$$c^u_{i;t}(\varepsilon_{k;t};\varepsilon_{\neg k;t}) = v_{i;t} + \frac{1}{2}\frac{y_t - v_{m;t}}{y_t}[(y_t - v_{i;t}) + (v_{m;t} - v_{i;t})] \tag{10}$$

Accordingly, the consumption of region k's median voter under integration is:

$$c^u_{mk;t}(\varepsilon_{k;t};\varepsilon_{\neg k;t}) = v_{mk;t} + \frac{1}{2}\frac{y_t - v_{m;t}}{y_t}[(y_t - v_{mk;t}) + (v_{m;t} - v_{mk;t})]: \tag{11}$$

Finally, the consumption of region k's median voter under secession is the following (note that it incorporates the cost of secession, $\gamma_{k;t}$):

$$c^k_{m;t}(\varepsilon_{k;t};\gamma_{k;t}) = v_{mk;t} + \frac{1}{2}\frac{(y_{k;t} - v_{mk;t})^2}{y_{k;t}} + \gamma_{k;t} \tag{12}$$

After substituting from equations (12) and (11), the expected gain from secession $\phi_{k;t}$ can be rewritten in the following manner:[10]

$$\phi_{k;t} = E_t\left[\frac{1}{2}\frac{(v_{m;t} - v_{mk;t})^2}{y_t} + \frac{1}{2}(y_{k;t} - y_t)\left(1 - \frac{v^2_{mk;t}}{y_{k;t}y_t}\right)\right] + \gamma_{k;t} \tag{13}$$

The first term in equation (13) reflects the differences in income distributions between the union as a whole and region k. The greater is the difference, the greater is the incentive for region k to split away. The second term captures the effect of tax-base differences (combined again with the income distribution effect). The higher region k's mean income is compared to the union's mean income, the greater is the incentive to secede. Finally, the last term is the cost of secession.

To see how the political mechanism works, consider first the following simple case: Suppose there are no region specific shocks, and the cost of secession is zero, $\gamma_{k;t} = 0$. Then, integration is never sustainable unless $v_{mk} = v_m$ and $y_a = y_b = y$: In equation (13), the first term is positive for any $v_{mk} \neq v_m$, whereas the second term is positive for the region with $y_{k;t} > y_t$. Therefore, the richer region will always find it advantageous to secede, unless $v_{mk} = v_m$ and $y_a = y_b = y$, when the region is indifferent.

3.2 Effects of Shocks

Next, I analyze the role played by the region specific shocks. Voters in one or both regions may be induced to vote for secession in response to the home-region's shock or the other region's shock — either shock can raise or reduce the incentive for secession captured by the expected gain from secession, $\phi_{k;t}$.

[10] Note that the variables pertaining to the union, $v_{m;t}$ and y_t, depend on both shocks, $(\varepsilon_{k;t};\varepsilon_{\neg k;t})$, whereas $v_{mk;t}$ and $y_{k;t}$ only depend on $\varepsilon_{k;t}$.

To make the analysis tractable, some simplifying assumption are necessary:

A1 Median voter's income is higher in region A than in region B: $v_{ma;t} > v_{m;t} > v_{mb;t}$;
A2 Income distribution is more equal in region A than in region B: $\frac{v_{ma;t}}{y_{a;t}} > \frac{v_{m;t}}{y_t} > \frac{v_{mb;t}}{y_{b;t}}$. This implies that the preferences over …scal policy are such that $t^{¤}_{a;t} < t^{¤}_t < t^{¤}_{b;t}$.
A3 The median income in either region does not exceed the union's average income: $v_{mk;t} < y_t$ (i.e.neither median voter would prefer $t^{¤}_t = 0$ if pivotal in the union).

Because the vote on secession takes place before the shocks are realized, the decision is based on the expectations of current period's shocks, $E_t"_{k;t} = ½_k"_{k;t¡1}$ and $E_t"_{¡k;t} = ½_{¡k}"_{¡k;t¡1}$. Hence, the expected gain from secession at time t re‡ects the realizations of the shocks at $t ¡ 1$, $"_{k;t¡1}$ and $"_{¡k;t¡1}$, and their persistence.. I look at the impact of the other region's shock …rst:

Proposition 1 (a) A positive shock in the other region at time $t ¡ 1$ reduces the home region's incentive to split o¤ at time t, a negative shock increases the incentive to split o¤.

$$\frac{@¢_{k;t}}{@"_{¡k;t¡1}} < 0$$

(b) Region A is more likely to secede than region B (ceteris paribus).

(c) The change in incentive for secession following the other region's shock is independent of the di¤erence between average incomes in the two regions, $jy_{a;t} ¡ y_{b;t}j$.

Proof. (a) Di¤erentiating $4_{k;t}$ with respect to $"_{¡k;t¡1}$ while holding $"_{k;t¡1}$ constant yields:

$$\frac{@4_{k;t}}{@"_{¡k;t¡1}} = \left[\frac{1}{2}\frac{v_{m;t} ¡ v_{mk;t}}{y_t} ¡ \frac{1}{4}\frac{(v_{m;t} ¡ v_{mk;t})^2}{y_t^2} ¡ \frac{1}{4}\frac{y_t^2 ¡ v_{mk;t}^2}{y_t^2}\right] ½_{¡k} \qquad (14)$$

The RHS of equation (14) can be reduced to $4y_t^2(y_t ¡ v_{m;t} + 2v_{mk;t})(v_{m;t} ¡ y_t)½_{¡k}$, which is negative for both regions. (b) Assumption A1 implies $v_{ma;t} > v_{mb;t}$, so that the absolute value of this expression is higher for region A than for region B. (c) Only the unions mean income, y_t, appears in the RHS of equation (14). $\frac{@4_{k;t}}{@"_{¡k;t¡1}}$ is thus not a¤ected by the di¤erence in regions' average incomes, only by the union's average. ■

The upshot of Proposition 1 is that for a given realization of a region's own shock, $"_{k;t¡1}$, this region is more likely to secede after a negative shock in the other region, $"_{k;t¡1} < 0$. The intuition underlying this result is simple. For a given home-region shock, $"_{k;t¡1}$, a positive shock in the other region reduces the expected union tax rate (tax-rate e¤ect) and raises the expected level of government spending (transfer e¤ect). The transfer e¤ect increases the consumption of median voters in both regions. The tax e¤ect is di¤erent, though. The median voter in region A prefers tax rate that is lower then the union tax rate, $t^{¤}_{a;t} < t^{¤}_t$, by assumption A1. A positive shock in region

B decreases the expected union tax rate, and hence the expected disparity between the two tax rate shrinks. The incentive for region A to vote for secession therefore falls after a positive shock in region B. On the other hand, the region B's median voter's preferred tax rate is higher then the union tax rate, $t^{¤}_{t} < t^{¤}_{b;t}$. Thus, as the expected union tax rate falls, the expected disparity between the two tax rates actually further widens. Hence, the tax e¤ect and the public good e¤ect go in opposite directions. The response of region B will therefore be relatively smaller than the response of region A, even though the overall e¤ect is shown to be positive.

Analyzing how the decision on secession is a¤ected by the region's own shock is less straightforward. Di¤erentiating $4_{k;t}$ with respect to $"_{k;t¡1}$ while holding $"_{¡k;t¡1}$ constant yields:

$$\frac{@4_{k;t}}{@"_{k;t¡1}} = \left[¡\frac{1}{2}\frac{v_{m;t} ¡ v_{mk;t}}{y_t} ¡ \frac{1}{4}\frac{(v_{m;t} ¡ v_{mk;t})^2}{y_t^2} + \frac{v_{mk;t}}{y_{k;t}} ¡ \frac{v_{mk;t}}{y_t} ¡ \frac{1}{2}\frac{v_{mk;t}^2}{y_{k;t}^2} + \frac{1}{4} + \frac{1}{4}\frac{v_{mk;t}^2}{y_t^2} \right] ½_k \tag{15}$$

The sign of this expression is analytically ambiguous. Therefore, I consider …rst a simpli…ed case:

Proposition 2 If mean incomes before shocks are the same in both regions, i.e. $y_{a;t} = y_{b;t} = y_t$, then:

(a) A positive shock in region A will increase this region's incentive to split o¤. A negative shock in region A will reduce this region's incentive to split o¤:

$$\frac{@¢_{a;t}}{@"_{a;t¡1}} > 0$$

(b) The response of region B depends on the di¤erence between the median income in B and the union's median: $\frac{@¢_{b;t}}{@"_{b;t¡1}}$ is positive for small $(v_{mb;t} ¡ v_{m;t})$ and negative otherwise.

Proof. For $y_{a;t} = y_{b;t} = y_t$, equation (15) can be rewritten as follows:

$$\begin{aligned} \frac{@4_{k;t}}{@"_{k;t¡1}} &= \left[¡\frac{1}{2}\frac{v_{m;t} ¡ v_{mk;t}}{y_t} ¡ \frac{1}{4}\frac{(v_{m;t} ¡ v_{mk;t})^2}{y_t^2} + \frac{1}{4}\frac{y_t^2 ¡ v_{mk;t}^2}{y_t^2} \right] ½_k \\ &= \left[\frac{1}{4}\left(y_t^2 ¡ v_{m;t}^2\right) + \frac{1}{2}(v_{mk;t} ¡ v_{m;t})(y_t ¡ v_{mk;t}) \right] y_t^2 ½_k \end{aligned}$$

The …rst term of the expression in the second line above is always positive. The second term is positive for region A and negative for region B — this follows from assumptions A1 and A3. Hence, $\frac{@4_{a;t}}{@"_{a;t¡1}}$ is positive, whereas $\frac{@4_{b;t}}{@"_{b;t¡1}}$ can be either positive or negative. When $(v_{mb;t} ¡ v_{m;t})$ is small in absolute value, the …rst term outweighs the second term, and the opposite is true for large $(v_{mb;t} ¡ v_{m;t})$. ■

Remark 1 If the average output in the two regions is different, $y_{a;t} \neq y_{b;t}$, then the effect of the region's own shock on its incentive to separate is analytically ambiguous for both regions. Numerical simulations[11] with $y_{a;t} > y_{b;t}$, nevertheless, yield result identical to Proposition 2, i.e. $\frac{@4_{a;t}}{@"_{a;t-1}}$ is always positive whereas $\frac{@4_{b;t}}{@"_{b;t-1}}$ is positive for small $(v_{m;t} - v_{mb;t})$ and negative otherwise.

The result described in Proposition 2 and Remark 1 again reflects the tax effect and the transfer effect. A positive shock in either region reduces the expected union tax rate and raises the expected amount of lump-sum transfer. In case of region A, the median voter's preferred tax rate is lower than the union's tax rate. After the shock, the expectations of both the union's tax rate and the region's tax rate fall. However, the region's preferred tax rate falls by more,[12] thus further increasing the difference between the two tax rates. In case of the transfer, it rises in the union. However, the region A's tax base $y_{a;t}$ rises by more that the union's tax base y_t, . This further increases the potential expected transfer in case of secession. Both these effects make secession more attractive after a positive shock.

On the other hand, in case of region B, the median voter's preferred tax rate is above the union's tax rate. A positive shock results in the reduction of both the expected union's tax rate as well as the region B's expected tax rate. The expectation of the region's preferred tax rate falls by more, and the difference in this case thus shrinks. The transfer effect compounded with the effect of increase in tax base, y_b, works similarly as described above.

To see how output shocks affect incentives for secession via raising or lowering the tax base in the home region, I consider now the case where the median incomes in the two regions are equal.

Proposition 3 If the median incomes before shocks are equal in both regions, $v_{ma;t} = v_{mb;t} = v_{m;t}$, then for given values of y_t and $v_{m;t}$, $\frac{@4_{k;t}}{@"_{k;t-1}}$ as a function of $y_{k;t}$ follows an inverted U-shaped curve, with the maximum at $y_{m;t} = v_{m;t}$. $\frac{@4_{k;t}}{@"_{k;t-1}}$ is always positive for the poorer region with $y_{k;t} < y_t$, it is also positive for the richer region with $y_{k;t} > y_t$ for values of $y_{k;t}$ relatively close to y_t, and negative otherwise.

Proof. For $v_{ma;t} = v_{mb;t} = v_{m;t}$, equation (15) can be rewritten as follows:

$$\frac{@4_{k;t}}{@"_{k;t-1}} = \left(\frac{v_{m;t}}{y_{k;t}} - \frac{v_{m;t}}{y_t} + \frac{1}{4} + \frac{1}{4}\frac{v_{m;t}^2}{y_t^2} - \frac{1}{2}\frac{v_{m;t}^2}{y_{k;t}^2} \right) \frac{1}{2}_k \qquad (16)$$

[11] I performed numerical simmulations using $y = 10$ and $v_m = 7{:}5$. Regional shocks were given values between -3 and 3. The values for y_a, y_b, v_{ma} and v_{mb} varied around their respective means.

[12] Recall that the regions preferred tax rate fully responds to the home-region shock $"_{k;t}$, whereas the union's tax rate responds to the average shock, $"_t \equiv \frac{"_{a;t}+"_{b;t}}{2}$. Unless $"_{a;t} = "_{b;t}$, the region's tax rate fall by more than the union's tax rate in response to a positive home shock.

Differentiating this expression with respect to $y_{k;t}$ while treating y_t and $v_{m;t}$ as constants yields a single maximum at $y_{k;t} = v_{m;t}$, and the above expression thus indeed follows an inverted U-shaped curve. Evaluated at $y_{k;t} = v_{m;t}$, the above expression simplifies to $\frac{@4_{k;t}}{@"_{k;t-1}} = \frac{3}{4} - \frac{v_{m;t}}{y_t} + \frac{1}{4}\frac{v^2_{m;t}}{y^2_t}$, which is positive for any $0 < \frac{v_{m;t}}{y_t} < 1$ (the case with $\frac{v_{m;t}}{y_t} = 1$ and $\frac{@4_{k;t}}{@"_{k;t-1}} = 0$ implies that both median incomes and average incomes are equal to y_t and the union hence never breaks up). The case with $y_{k;t} = y_t$ yields also positive $\frac{@4_{k;t}}{@"_{k;t-1}}$ as has already been argued in Proposition 2. Because the expression for $\frac{@4_{k;t}}{@"_{k;t-1}}$ has only a single maximum with respect to $y_{k;t}$, it follows hence that it is positive for any $v_{m;t} < y_{k;t} < y_t$, and the poorer region is thus more likely to secede after a positive shock.

The response of the richer region is positive for $y_{k;t}$ relatively close to y_t and negative otherwise. To see this, note that equation (16) can be rewritten as

$$\frac{@4_{k;t}}{@"_{k;t-1}} = \left[\frac{1}{4} - \frac{1}{2}\phi^2\left(\frac{v^2_{m;t}}{y^2_t} + (\phi - 1)\frac{v_{m;t}}{y_t} + \frac{1}{4}\right)\right]_k$$

where $\frac{v_{m;t}}{y_{k;t}}$ is substituted by $\phi\frac{v_{m;t}}{y_t}$, with $\frac{1}{2} < \phi < 1$.[13] Solving for ϕ yields $\phi = .75107$, for this value $\frac{@4_{k;t}}{@"_{k;t-1}} = 0$ for any $\frac{v_{m;t}}{y_t}$. $\frac{@4_{k;t}}{@"_{k;t-1}}$ is positive for $\phi > .75107$, and negative otherwise. Hence, the incentive of the richer region to secede following a positive shock increases if its mean income is lower than y_t=.75107 (i.e. for approximately half of its feasible range). ■

Proposition 3 implies that a positive shock in the home region increases the incentive for secession unless $y_{k;t}$ is much greater than y_t. The opposite is true for a negative shock. The intuition for this result is straightforward: A positive shock increases the opportunity cost of staying in the union for the richer region, because part of this gain has to be shared with the poorer region via common fiscal policy. For the poorer region, a positive shock implies that the region is now relatively less dependent on the net transfer from the richer region. This in turn makes secession less costly. Moreover, the poorer region in this situation is also the one with less skewed income distribution. In the limiting case with $y_{mk;t} = v_{m;t}$, income distribution is symmetric and the region prefers a zero tax rate. Moreover, in this particular case, zero tax rate is the preferred tax rate every period, regardless of the region specific shock, because the shock cancels out in $t^{\alpha}_{k;t} = \frac{y_{k;t} - v_{mk;t}}{y_{k;t}}$ and the tax rate stays always zero. Hence, by seceding, this region can avoid taxation altogether.

[13] The lower bound is given by symmetry: if the poorer region's mean income is equal to v_m, the richer region's mean income is $2y - v_m$. This case with $v_m = 0$ implies $\phi = \frac{1}{2}$. Any other combination of feasible mean and median incomes yields $\phi > \frac{1}{2}$.

3.3 Stability of Integration

As discussed above, region speci…c shocks can alter incentives for secession, and thus potentially lead to the break-up of the union. Stability of integration (i.e. the likelihood of disintegration) depends on the nature of shocks — in particular their persistence, and correlation across regions.

Proposition 4 Persistence: Assume the union is a priori stable, i.e. neither region would vote for secession in the absence of shocks:

$$\Phi_{k;t}\left[0, 0, \rho_k \varepsilon_{k;t-1}, \rho_{-k} \varepsilon_{-k;t-1}\right] \leq 0$$

Then, assuming the other region's shock is zero, $\varepsilon_{-k;t-1} = 0$, for every home region's shock $\varepsilon_{k;t-1} > 0$ there is a value of the persistence parameter $\bar{\rho}_k$ such that $\Phi_{k;t}(\rho_k \varepsilon_{k;t-1}; 0) \leq 0$ for every $\rho_k \leq \bar{\rho}_k$. Similarly, assuming the home region's shock is zero, $\varepsilon_{k;t-1} = 0$, for every other region's shock $\varepsilon_{-k;t-1} < 0$ there is a value of the persistence parameter $\bar{\rho}_{-k}$ such that $\Phi_{k;t}\left[0, \rho_{-k} \varepsilon_{-k;t-1}\right] \leq 0$ for every $\rho_{-k} \leq \bar{\rho}_{-k}$.

Proof. Note that the expected gain from secession rises for $\varepsilon_{k;t-1} > 0$ and/or $\varepsilon_{-k;t-1} < 0$ (and falls for $\varepsilon_{k;t-1} < 0$ and/or $\varepsilon_{-k;t-1} > 0$). As follows from equations (14) and (15), $\frac{\partial \Delta_{k;t}}{\partial \varepsilon_{k;t-1}}$ and $\frac{\partial \Delta_{k;t}}{\partial \varepsilon_{-k;t-1}}$ equal zero for $\rho_k = 0$ and $\rho_{-k} = 0$, respectively. Hence, if shocks are of temporary nature (white noise), they do not a¤ect the expected gain from secession and hence do not undermine the stability of integration. If shocks do persist, i.e. $\rho_k > 0$ and $\rho_{-k} > 0$, then the following holds

$$\Phi_{k;t}(\rho_k \varepsilon_{k;t-1}; 0)\big|_{\varepsilon_{k;t-1}>0} > \Phi_{k;t}\left[\rho_k \varepsilon_{k;t-1}, \rho_{-k} \varepsilon_{-k;t-1}\right]\big|_{\varepsilon_{k;t-1}=\varepsilon_{-k;t-1}=0}$$

$$\Phi_{k;t}\left[0, \rho_{-k} \varepsilon_{-k;t-1}\right]\big|_{\varepsilon_{-k;t-1}<0} > \Phi_{k;t}\left[\rho_k \varepsilon_{k;t-1}, \rho_{-k} \varepsilon_{-k;t-1}\right]\big|_{\varepsilon_{k;t-1}=\varepsilon_{-k;t-1}=0}$$

By continuity, $\Phi_{k;t}(\rho_k \varepsilon_{k;t-1}; 0) \leq 0$ ($\Phi_{k;t}\left[0, \rho_{-k} \varepsilon_{-k;t-1}\right] \leq 0$) holds for at least part of the interval $0 < \rho_k \leq 1$ ($0 < \rho_{-k} \leq 1$). ■

The upshot of Proposition 4 is that if shocks are temporary, they will not provide su¢cient incentives for regions to secede. Permanent or strongly persistent shocks, on the other hand, can bring unions down, depending on the correlation of shocks. To study this aspect, I know relax the assumption that regional shocks are independent.

Proposition 5 Correlation: Positive correlation of shocks reduces the probability of secession, whereas negative correlation increases the probability.

Proof. Assume shocks are correlated so that $\frac{\partial \varepsilon_{kt;}}{\partial \varepsilon_{-kt;}} = \circ$. Then, a shock in the other region a¤ects the median voter's expected gain from secession in the following manner:

$$\frac{@4_{k;t}}{@\varepsilon_{i\,k;t\,i\,1}} = \left[\frac{1}{2}\frac{v_{m;t}\ i\ v_{mk;t}}{y_t}\ i\ \frac{1}{4}\frac{(v_{m;t}\ i\ v_{mk;t})^2}{y_t^2}\ i\ \frac{1}{4}\frac{y_t^2\ i\ v_{mk;t}^2}{y_t^2}\right]\frac{1}{2}_{i\,k} +$$
$$\left[i\ \frac{1}{2}\frac{v_{m;t}\ i\ v_{mk;t}}{y_t}\ i\ \frac{1}{4}\frac{(v_{m;t}\ i\ v_{mk;t})^2}{y_t^2} + \frac{v_{mk;t}}{y_{k;t}}\ i\ \frac{v_{mk;t}}{y_t}\ i\ \frac{1}{2}\frac{v_{mk;t}^2}{y_{k;t}^2} + \frac{1}{4} + \frac{1}{4}\frac{v_{mk;t}^2}{y_t^2}\right]\circ\frac{1}{2}_k$$

The …rst term corresponds to the expression for $\frac{@4_{k;t}}{@\varepsilon_{i\,k;t\,i\,1}}$ when shocks are independent, as in equation (14), whereas the second term re‡ects the e¤ect that the shock in the other region has via the home shock — cf. equation (15). According to Proposition 1, the term in the …rst brackets is negative, while the term in the second brackets is positive as argued in Proposition 2 and Remark 1 (assuming $v_{mb;t}\ i\ v_{m;t}$ is su¢ciently small). Hence, if shocks are positively correlated, $\circ > 0$, the second term mitigates the e¤ect of the …rst term. On the other hand, if shocks are negatively correlated, both e¤ects go in the same direction, thus increasing the probability of secession. ■

The importance of persistence and correlation of shocks for the stability of integration is summarized in Table 1:

Table 1
Nature of Shocks and Stability of Integration

Persistence	Correlation of shocks		
	positive	negative	none
persistent	stable	fragile	fragile
transient	stable	stable	stable

The last two propositions extend the main …ndings of the Optimum Currency Area literature, which only considers correlation (symmetry) of shocks.. The present paper adds another dimension: it points out to the importance of persistence of shocks. In particular, unions can be stable despite negatively correlated shocks — as long as these shocks are only transient.

Assessing correlation of shocks has been a common approach in studies evaluating the viability of the EMU. Bayoumi and Eichengreen (1993) use bivariate VAR's to estimate the correlations of permanent and temporary shocks among the EU member countries, and compare them with the correlations among US regions. Funke (1997), using the same methodology, compares the correlations among the EU member countries with the correlations for the German federal states. Both studies report generally higher correlations for permanent shocks than for temporary shocks. However, neither paper discusses the implications of this di¤erence. The present paper argues that high correlation of permanent shocks is in fact much more critical for the stability of monetary unions than high correlation of temporary shocks.

Few additional observations can be made based on the present model:

Remark 2 Risk sharing: Fiscal policy — the tax rate and the transfer — is more volatile under secession than under integration. Integration hence smooths taxes and reduces the volatility of disposable income and consumption, and thus provides insurance against region speci…c shocks. The potential bene…ts from risk sharing are greatest when shocks are negatively correlated and transient.

This result is easy to see — union's tax rate and transfer are a¤ected by the average shock, ε_t. After secession, regional …scal instruments fully respond to the regional shocks, and are therefore more volatile. Centralized …scal policy stabilizes both the tax rate as well as the tax base, and indirectly redistributes income from the region hit by a positive shock to the one hit by a negative shock. Because agents are risk averse, the potential bene…ts from risk sharing are greatest when the shocks are negatively correlated, because in this case the volatility of union's …scal instruments is smallest. However, if the shocks are persistent, the bene…ts from risk sharing have to be weighted against the e¤ects of shocks upon diverging preferences regarding …scal policy in the two regions. Therefore, the potential for risk sharing is greatest when shocks are negatively correlated and transient.

In evaluating the potential bene…ts from risk sharing, the present paper di¤ers from Alesina and Perotti (1995). In their model, the union's median voter is only a¤ected by the shock in his home region. Because they assume discontinuous distribution of income and multiplicative e¤ect of shocks (i.e. $y_k = (1 + \varepsilon_k)\bar{y}_k$), the tax rate is stochastic in case of integration but constant in case of secession.

Remark 3 An increase in the variance of either shock, σ_k^2 increases the probability of disintegration if the shocks are persistent, and reduces the probability of .disintegration if the shocks are transient.

High variance in case of persistent shocks implies greater likelihood that a suf-…ciently large shock will occur to prompt one of the region to split o¤. On the other hand, if shocks become more volatile but are generally transitory in nature, the potential bene…ts from risk sharing increase.

An increase in the variance of region speci…c shocks was probably one of the factors behind disintegration processes in Central and Eastern Europe — abandoning the planned economy implied a substantial increase in the volatility of economic activity. In addition, implementation of radical economic reforms probably resulted in changes in correlation and persistence of shocks, and integration arrangements became unsustainable.[14]

Remark 4 Decentralization may actually destabilize integration arrangements.

Decentralization in general implies that regions are increasingly subject to di¤erent policies. For example, promoting the use of regional minority languages — such

[14] See Fidrmuc and Horvath (1998) for an empirical analysis of the break-up of Czechoslovakia.

as French in Quebec, Catalan in Catalonia, Celtic in Wales, Russian in the Baltics, or Hungarian in parts of Slovakia and Romania — will impair labor mobility across language boundaries. Similarly, regional policies promoting di¤erent industries make regions more vulnerable to asymmetric shocks. These measures in turn reduce the correlation of shocks across regions, and then this in fact only makes the union more fragile politically. Frankel and Rose (1996) indeed show empirical evidence that the degree of correlation of output shocks across countries is determined endogenously, by the degree of integration. Hence, the e¤orts to rescue troubled unions by increasing autonomy may indeed be futile, and federalization, or devolution, may indeed be merely a step toward the slippery slope of disintegration.[15] Moreover, The process of increasing …scal autonomy of regions — as it was implemented in former Czechoslovakia in 1990-92 or in Belgium at present — directly reduces the potential for risk sharing — thus reducing the bene…ts of integration even further.

4 Conclusions

The last decade has been marked with increasing incidence of integration and disintegration: Germany reunited. European Union expanded from twelve to …fteen member countries, and is now set to implement the monetary union. Six associated countries o¢cially started accession negotiations leading toward the next round of EU enlargement. On the other hand, Soviet Union, Yugoslavia and Czechoslovakia disintegrated. Russia and Serbia have been facing growing, and often violent, separatist movements. Quebec's secession was rejected in referendum by a margin of less than one percent. The process of federalization of Belgium continues. Scotland and Wales will have their own parliaments. Con‡icts over …scal redistribution and autonomy in Spain and Italy have continued.

In the present paper, I analyze the political economy of …scal redistribution in the presence of stochastic economic shocks. Integration delivers the bene…ts embodied in e¢ciency gains and mutual insurance against adverse e¤ects of stochastic shocks. On the other hand, secession brings the bene…t of autonomy over regional …scal policy. The presence of stochastic economic shocks increases the potential bene…ts from risk sharing, but if the shocks are persistent it may also cause diverging preferences regarding …scal policy in the regions. If the shocks are positively correlated, the potential for risk sharing is little, but so is the desire for autonomous …scal policy. If the shocks are uncorrelated or negatively correlated, the potential bene…ts from risk sharing are large. However, when the shocks are persistent, the bene…ts from risk sharing have to be weighted against the divergent preferences over …scal policy. Hence, the potential for integration is greatest when the shocks are positively correlated (regardless of their persistence), or transient.

[15] This challenges the often held view that devolution can save unions — see the Economist, September 20, 1997, "Scotland: Surprisingly brave," p. 46.

The results of the present paper can be applied to give insights for several real-world (dis)integration examples. The distribution of costs and bene…ts of economic reforms in the countries of Central and Eastern Europe was highly asymmetric, and reform-related shocks had rather persistent e¤ects (see Fidrmuc and Horvath (1998) for empirical evidence and discussion of the break-up of Czechoslovakia, and Fidrmuc (1998) for discussion of political implications of regional economic asymmetries in four post-communist countries). Indeed, the break-up of Czechoslovakia was preceded, and largely caused, by con‡icts over the design and speed of reforms, as well as about the money pipeline from the Czech Republic to Slovakia. Besides political and historical motives, economic exploitation of the Baltics by the rest of the Soviet Union also played a role in these countries' strive for independence. Similar arguments were brought up to justify the secession of Slovenia and Croatia from Yugoslavia.

In Western Europe, …scal redistribution in Belgium, Italy and Spain lies at the hear of secessionism in these countries. Instead of mutual insurance, …scal redistribution in these countries largely serves the purpose of income equalization and solidarity, and as such may not be politically feasible in the long run. The one-way nature of transfers has caused political concerns also in reunited Germany, and the EU. Finally, the result of recent devolution referendum (in particular the part on taxation powers) in Scotland shows that regions do care about the autonomy over …scal policy.

Future research should further address the decision making process regarding secession. In particular, postponing secession — if secession is irreversible — can be seen as an investment. By postponing the decision, the region retains the option to secede in the future, when more information becomes available. This option can be evaluated just as a …nancial call option, and the option value of waiting can prove to be positive.[16]

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