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A volatility-based theory of fiscal union desirability

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ABSTRACT

Heterogeneous countries may rationally choose to form a currency union first, and a fiscal union later. We find, and illustrate empirically for the EMU countries, reasonable volatility conditions under which this sequencing in the deepening process is indeed rationalizable. Changes in the distribution of expected income shocks require a reassignment of political weights to restore unanimous support for an added fiscal dimension. The bargaining space depends on countries' relative income, size, and cross correlation of shocks.

1. Introduction

A set of heterogeneous countries may choose a sequential path of integration, both in terms of admission (or *widening*) and in terms of institutional integration (or *deepening*). The sequential widening process undertaken by the European Union between 1957 up to the 1990s can be explained by the observation that a slowly enlarging Union made it "cheaper" to admit the initially left out countries, because of a negative externality mechanism.[1] This paper focuses instead on the potential and rationale for sequential deepening of a Union. The adoption of a single currency can be seen as a first step in the direction of substantial deepening of the economic integration process. The interesting question then becomes: Why did Europe choose to deepen in the monetary front first, and only later bring to the fore the possibility of further fiscal and political integration?[2]

We argue that the decision to form a currency union without further integration can be rationalized if volatility of income shocks is relatively low, as perceived at the time of the creation of the European Central Bank (henceforth ECB). However, a later realization that the volatility of income shocks is much higher than initially expected, can make deepening in the fiscal front a necessary step for the survival of the union. An illustration of our argument requires us to consider three regimes, namely policy independence (or autarky), monetary union, and monetary union combined with fiscal union, and focusing on how preferences

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[1] In any given period, the current members of a union have greater access to (and credibility on) making and receiving side payments within the union, and greater trade among themselves, causing negative externalities on the trade opportunities of non members. This increasing disadvantage for outsiders makes the bargaining power of the initial insiders overall higher with a sequential admission process than admitting them all at once. See Morelli (2012).

[2] See Spolaore (2013) for a discussion of the political economy aspects of European integration, including Monnet's chain mechanism of progressive integration. See Silbert (1992), Sims (1999) and Bottazzi and Manesse (2002) for standard macro arguments in favor of the inseparability of monetary and fiscal policy, leading to the conjecture that going for monetary union alone could lead to dangerous decoupling. See Bordo et al. (2011) for the history of several monetary unions, including the EMU, and de Grauwe (2011) for the implications of a fragile Eurozone for its governance.

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of different countries of varying income and size over these different regimes vary with volatility.

By a fiscal union we mean here a level of institutional integration that permits to establish a mechanism that involves the determination of counter-cyclical transfers across countries or regions.[3] Our goal in this paper is to highlight that introducing some elements of a fiscal union may be essential to sustain the benefits of a common currency in a scenario of increased income volatility. If one or more countries' income volatility increases sufficiently, their preferences might change so that a fiscal union is preferred, and, if that is not possible, they would want to revert to autarky, bringing the whole currency union to collapse. However, we argue, negotiation over economic and political incentives can sustain the common currency. In other words, there exist reallocations of political weights to convince all countries to adhere to the fiscal union. We highlight the role of heterogeneity in income per capita and population size, both in terms of the positive analysis of country preferences, and in terms of normative analysis of the type of reallocations of decision power that would make a fiscal union consensus feasible. We find that, given each country policy independence threat point, countries with large relative incomes and large relative sizes will demand a higher decision weight in the fiscal union.

The consensus bargaining space (henceforth CBS) consists of the set of all vectors of country weights that guarantee a higher utility to all countries in the fiscal union relative to reverting to autarky and independent policy making.[4] The likelihood of a consensus favorable to the formation of a fiscal union decreases with the degree of countries' heterogeneity in income and population size, and decreases with the correlation between countries' shocks. We also use simulations to illustrate that, for a union formed by heterogenous countries with given shock correlations, there exist voting weights in the non-empty bargaining space that make all countries better off when moving toward fiscal union.

When volatility is relatively low for all countries, we show that it is difficult to sustain unanimous support in favor of a fiscal union. Any proposal in this direction would be defeated. Tables 1 and 2 in this paper show that, after a few years of monetary policy unification, volatility of GDP per capita and volatility of individual consumption have increased dramatically for most European countries, and this may have altered their regime preferences.[5] Our model will allow us to predict (1) which countries will be unhappy with the common currency, namely, the status quo; (2) how these countries rank the different options, namely fiscal union independent policy making; and (3) the extent to which some countries are willing to lose political weight in exchange for unanimous adoption of the fiscal union.

The pioneering work of Gordon (1983) presented a now classic argument highlighting the insurance benefits of a common fiscal policy.[6] The ensuing literature focused on the possible negative co-movement of output across jurisdictions and on the value of institutions providing insurance against such negative co-movements. However, a common fiscal policy involves *both* risk sharing and redistribution.[7] If on the one hand the so called "economic risk" can be reduced by a fiscal union, on the other hand the common tax rate could become more volatile and alter incentives. This effect can be termed "political risk", and is what often discourages the establishment of a common fiscal policy. The mechanism is simple: faced with non-synchronous fluctuations in output over time, countries or regions decrease economic risk by sharing budgetary decisions and stabilizing the tax base; however, the non-synchronous shocks may lead the country which holds decision power to respond to a negative shock by imposing a higher tax rate on the union. In sum, in fiscal unions among heterogeneous jurisdictions, there might be a trade-off between economic insurance and political risk. Even if shocks are negatively correlated, a country holding little decision power may prefer to stay away from a fiscal union.

Table 1
Columns 2 and 3 in Table 1 compare the average volatility of GDP per capita in two periods: 13 years before (1986–1998) and 13 years after (1999–2011) the adoption of the euro. Columns 4 and 5 compare the average volatility of GDP per capita in two alternative periods: 2002–2006 and 2007–2011.

GDP per cap. volatility	1986–1998	1999–2011	2002–2006	2007–2011
Austria	1.66	4.24	1.29	3.51
Belgium	3.39	5.25	1.29	2.56
Finland	9.56	5.85	3.03	6.48
France	4.60	7.80	1.93	2.73
Germany	5.61	4.02	1.87	3.03
Greece	6.67	14.94	9.29	14.10
Ireland	16.29	63.35	8.99	10.31
Italy	10.63	13.50	2.20	3.27
Luxembourg	17.31	21.93	2.36	5.13
Netherlands	4.12	9.53	1.39	3.87
Portugal	19.38	23.00	1.01	2.70
Spain	9.54	18.91	3.80	4.96

Our model examines how the allocation of voting power across jurisdictions interacts with the correlation of shocks and heterogeneity in income and population size to determine the likelihood of unanimous adhesion to a fiscal union. Our work is in the tradition of constitutional design exemplified by Buchanan and Tullock (1967) and Curtis (1972), where economic and political fundamentals are incorporated to show that certain allocations of voting rights enlarge the set of parameters for which a fiscal union is formed. In a sense, we enlarge the parameter set so that Gordon (1983) and Alesina and Perotti (1998) can be seen as particular cases of our broader discussion, where economic risk, political risk, and voting weights are jointly considered.

Voting weights in collective decision making are a central part of treaties,[8] and there is recent work on reallocations of voting weights when countries are faced with the prospect of *widening* of the Union.[9] However, the issue of weights ascribed to countries of differing size and economic conditions has never been explicitly related to the case of deepening integration by creating a fiscal union. We contribute to the literature on fiscal federalism by explicitly discussing the relationship between voting arrangements on the one hand, and the decision over adopting a joint fiscal policy or abandoning the existing common policy — in this case, a monetary union.

[3] For an early and powerful argument in favor of the inter-regional transfer role of fiscal policy, see Kenen (1969). This concept is substantially different from the idea of a "fiscal stability union" debated by the EU leaders, or from the fiscal compact, as discussed, for instance, by Paul Krugman in The New York Times (December 10, 2011): "*Rather than creating an inter-regional insurance mechanism involving counter-cyclical transfers, the version on offer would constitutionalize pro-cyclical adjustment in recession-hit countries, with no countervailing measures to boost demand elsewhere in the eurozone. Describing this as a "fiscal union," as some have done, constitutes a near-Orwellian abuse of language*".

[4] Even though the consensus rule is the one most likely to be considered, we also consider, in our working paper version (Luque et al. (2012)), an alternative scenario where the support by a fraction of countries is sufficient to form the fiscal union.

[5] See also Persson et al. (1997) for a discussion of different preferences over deepening of European policy-making in diverse policy areas.

[6] Shiller (1995) presented an empirical study of risk hedging possibilities across countries. Fidrmuc (2004) studied the effects of shock correlation and persistence on the optimality of fiscal unions.

[7] Bolton and Roland (1997) and Alesina and Spolaore (1997) analyze how the threat of secession by the rich imposes a binding constraint on federal fiscal policy, in a model of pure interregional redistribution, whereas Persson and Tabellini (1996a) investigate the trade-off between risk sharing and redistribution when jurisdictions are asymmetric as far as aggregate risk parameters are concerned. Persson and Tabellini (1996b) focus instead on the trade-off between interregional risk sharing and the presence of moral hazard in local government behavior. See Casella (1992a, 2001) for different formalizations of the main issues at stake, and Ruta (2005) for a survey.

[8] See Felsenthal and Machover (2001), and references therein.

[9] See e.g. Sutter (2000) and Barsan-Pipu and Tache (2009).

Table 2
Columns 2 and 3 in Table 2 compare the average volatility of "individual consumption" in two periods: 13 years before (1986–1998) and 13 years after (1999–2011) the adoption of the euro. Columns 4 and 5 compare the average volatility of "individual consumption" in two alternative periods: 2002–2006 and 2007–2011.

Indiv. consump. volatility	1986–1998	1999–2011	2002–2006	2007–2011
Austria	5.93	6.02	1.01	1.56
Belgium	4.92	4.36	0.39	0.67
Finland	8.02	3.58	3.48	4.00
France	3.64	4.33	1.27	1.74
Germany	11.86	9.29	1.01	1.15
Greece	4.68	22.75	9.18	16.91
Ireland	5.51	36.57	7.58	12.92
Italy	8.25	8.69	1.61	1.80
Luxembourg	16.84	21.64	3.27	1.41
Netherlands	2.80	10.33	0.82	2.14
Portugal	18.02	24.41	1.97	4.36
Spain	7.89	18.97	6.24	8.18

A related strand of literature focuses on the distribution of voting weights among the countries entering a monetary union.[10] Our paper takes the country benefits of belonging to a monetary union as a given parameter, and opens the black box of bargaining toward the formation of a fiscal union. Given the finding that the likelihood of a fiscal union increases the smaller is the correlation between shocks and the smaller the heterogeneity in income and size between countries, the effects of country size and the correlation of income shocks move in opposite directions when the formation of a monetary union and a fiscal union are compared.[11] Also, in contrast to Casella (1992b), our analysis of fiscal union formation in the presence of a common policy asserts that the country with a larger relative size will demand a higher decision weight given its independent policy making threat point. In other words, the assignment of political weights when going from independent policy making to the formation of a monetary union follows a logic that contrasts with the assignment of political weights necessary to deepen a monetary union going toward a common fiscal policy.

Risk sharing can be attained not only through a fiscal union, but also through capital markets and population flows.[12] In this paper we do not consider these mechanisms. As shown by Asdrubali et al. (1996) and Sørensen and Yosha (1998), these risk sharing mechanisms are limited. Nor are financial markets a perfect substitute for a fiscal union. As shown in Celentani et al. (2004), a set of decentralized fiscal entities can manipulate relative prices, leading to inefficient risk sharing, even if countries have access to a sequentially complete financial structure of assets. In fact, these authors highlight how the creation of a fiscal union can recover the efficiency of risk sharing. A fiscal union, they argue, plays an important role and is necessary even if countries have access to complete markets. Similar arguments have been recently put forward by Farhi and Werning (2012), who also show that indeed volatility can increase as a consequence of the formation of a currency union without a common fiscal policy.[13]

The paper is organized as follows. Section 2 presents the model. Section 3 presents our theory of volatility for the formation of a fiscal union. Section 4 provides empirical evidence of an increase in income volatility for a selection of Euro countries, and discusses alternative explanations of fiscal union desirability, pointing to some limitations of our analysis and directions for future research. Section 5 concludes.

2. Model

The model we are about to describe rests on the following assumptions:

- *Integration benefits* — An economic union of countries is typically motivated by the existence of beneficial exploitation of economies of scale, cooperation and coordination gains, and reduction of transaction costs.[14] The degree to which these benefits apply vary with the type of union and the depth of integration, but they are a critical ingredient for the rationalization of the integration decision. Denote by g^0 the overall benefit of the initial level of economic integration before the consideration of currency or fiscal union. To fix ideas, think of time 0 here as Europe in the late 80s–early 90s, before the currency union. We will then denote by $g^c > g^0$ the overall benefits obtained when moving toward a currency union.[15]
- *Volatility* — The other parameter to consider is the volatility of income shocks. In an economic union with neither fiscal nor monetary policy integration, each country has two policy instruments to counter shocks, whereas in a currency union each country has discretion only on fiscal policy (and only if away from a "debt ceiling" or a credible "deficit limit" jointly imposed by the union). Hence, it is natural to assume that the volatility of disposable incomes across countries in the union is lower than that in a currency union, and this difference will be captured by the inequality $\sigma^c > \sigma^0$ in the notation below.[16] Tables 1 and 2 show how this assumption holds for the European case. Section 4 will highlight the determinants of such a phenomenon.[17]
- *Fiscal union* — As mentioned in the Introduction, by fiscal union we mean here a mechanism that involves some measure of countercyclical transfers across countries or regions. Given the basic nature of a fiscal union as a commitment mechanism to cross-country transfers, the fiscal union makes no difference in terms of economies of scale, and it is not obvious whether g should be at all affected. Therefore, for simplicity we will assume that the overall benefit of economic integration remains the same, $g^f = g^c$.

The decision to form a fiscal union depends on the realization of volatilities. As we explain in Section 3, countries prefer to form a monetary union, without fiscal policy integration, if volatility is low for all (or some) countries, as was the case for Europe in the 90's. However, when volatility jumps for some countries, as it was the case in the 2000's, support for a move toward a fiscal union increases. If sufficient countries prefer to add a fiscal dimension to the status quo, it may be in their interest to compensate countries with low volatility through economic and political incentives, to make them approve the creation of the fiscal union.

[10] See Alesina and Barro (2002) and Casella (1992b).

[11] See also Cooper and Kempf (2004) for the questions arising when the correlation of shocks is considered as metric for evaluating the welfare gains from a monetary union. A related model is Dixit and Lambertini (2003) where, in addition to a monetary union, the authors consider separate fiscal policies by member countries. See also Dixit (2000) and Fuchs and Lippi (2006) as models in which the monetary union characteristics are optimal. As Fuchs and Lippi point out, the optimal monetary policy in a currency union does involve some self-enforcing transfers that can perform functions similar to that occurring in a fiscal union, but, as shown in Farhi and Werning (2012), the need for fiscal insurance mechanism remains even in the presence of optimal monetary policy.

[12] See Demiank et al. (2008), Kalemli-Ozcan et al. (2004), Ortuno-Ortin and Sempere (2006), Sørensen and Yosha (1998), and Wildasin (1991). See Wildasin (1991) on the likely impact of increased labor mobility in Europe on fiscal policy, as well as the role of potential Turkish migration in the discussion of the accession of Turkey to the European Union.

[13] See Luque and Taamouti (2013) for empirical evidence that the adoption of the Euro has changed the effect of Eurozone countries' economic fundamentals on per capital Gross Domestic Product (GDPpc) growth rate volatility.

[14] An economic union can take several forms, as laid down in Balassa (1961) and Fernandez and Portes (1998).

[15] See Mundell (1961), Alesina and Barro (2002), and Baldwin and Wyplosz (2006) for a survey of all the extra common benefits coming from monetary integration.

[16] Beside the intuitive argument in the text about one instrument versus two, other arguments showing that volatility increases in a currency union are found in Farhi and Werning (2012).

[17] The interesting theoretical question about the precise conditions under which a volatility jump should be expected endogenously when entering a currency union without political or fiscal union is left for future research.

2.1. Country characteristics and union effects

Consider a set of M countries with fixed frontiers and population. As a measure of a country's economic activity, we use "income per capita", a summary of its economic performance affected by shocks. Countries may differ in terms of population size and income. Let country i's pre-tax income be $Y_i \in R_+$. We assume that all individuals in country i have the same income, shutting down therefore the issue of internal redistribution and tax competition.[18] Country i's population is denoted by $N_i \in R_+$. Total population is therefore $N = \sum_{i=1}^{M} N_i$. The relative population size of country i in the union is $n_i = N_i/N$ with $n_i \neq 0$.

All countries are subject to idiosyncratic random productivity shocks that change their income levels. Country i's after shock income level is denoted by $X_i = Y_i(1 + \varepsilon_i)$. Let $\varepsilon = (\varepsilon_1, \ldots, \varepsilon_M)$ denote a vector of shocks for this economy. The vector ε is drawn by Nature according to an M-dimension distribution $Pr(\varepsilon)$. We denote by $\mathbf{C}$ the space of symmetric matrices $[\rho_{ij}]_{M \times M}$ of pair-wise correlation coefficients with generic element ρ_{ij}. A *state* $\omega = (C, (Y_i, N_i)_{i=1,\ldots,M})$ is a vector of shock correlations and country incomes and sizes. The state space is denoted by $\Omega = \mathbf{C} \times \mathbb{R}_+^M \times \mathbb{R}_+^M$. We assume that the distribution of these shocks changes when the countries adopt a common currency, as argued above and confirmed below in Section 4, but our argument will not require any additional assumption on the distribution of shocks in case of a fiscal integration step. To the contrary, given that the fiscal integration step only implies, in a world without internal heterogeneities, a redistribution across countries, there are strong reasons to believe that the generating process of income shocks remains the same as in the currency union without transfers.

Assume a logarithmic utility for the representative agent[19]:

$$V_i^k = ln\left(g_i^k X_i\right), \tag{1}$$

where the coefficient g_i^k captures the multiplier advantages accruing to country i from being in a union of type k, $k = 0, c, f$.[20] As suggested above, the three regimes considered are the independent policy making regimes ($k = 0$); the currency union ($k = c$); and the fiscal union, where both monetary policy and fiscal policy are centralized ($k = f$). To be precise, the above simple expression of utility applies to $k = f$ only in the absence of transfers, but since transfers are an essential component of a fiscal union, the argument of the logarithm will have to include consideration of such transfer schemes. Once the transfer system is in place, the utility of the representative agent of country i is altered as follows:

$$V_i^f(T(\varepsilon)) = lng_i^f + ln\left((1-T(\varepsilon))X_i + \left(T(\varepsilon) - \frac{1}{2}T(\varepsilon)^2\right)x\right) \tag{2}$$

where $T(\varepsilon)$ denotes the tax rate that is chosen in the union as a function of shocks ε. The term $(1 - T(\varepsilon))X_i$ is the after-tax income after the shock is realized and the common tax is imposed. The term $\left(T(\varepsilon) - \frac{1}{2}T(\varepsilon)^2\right)x$ corresponds to the amount received after tax rebates, which depends on the average income x in the fiscal union, as well as on the deadweight loss ($-\frac{1}{2}T(\varepsilon)^2$) generated by the transfer system.[21]

We assume henceforth that $g_i^0 = 1$, $\forall\, i$. g_i^c can instead vary across countries, but is always greater than one. g_i^c being greater than one implies that income is higher, while shocks are amplified.

Denote by $\sigma_i^k < 1$ the standard deviation of shocks for country i in regime $k = 0, c, f$, with $\sigma_i^0 < \sigma_i^c = \sigma_i^f$. The productivity shocks in regime c and regime f are assumed to be the same because the only thing f adds to c is the possibility of commitment to side payments, but the pre-tax economic shocks in regime 0 is unchanged. On the other hand, the variance of pre-tax income shocks in regime 0 is lower because independent central banks can absorb part of the idiosyncratic shocks through exchange rate adjustments.

In summary, the basic assumption of the model is that going from an economic union with independent fiscal and monetary policies to a currency union or fiscal union determines two effects, namely an increase in coordination and efficiency benefits captured by a higher g coefficient for all, but, on the other hand, an increase in pre-transfer income shocks (see Farhi and Werning (2012) for the most recent model generating such a consequence from a currency union).

2.2. Time line

- $t = 0$: Currency union is formed[22];
- $t = 1$: Realization of σ^c and consequent collective decision to form fiscal union, go back to independent policy making, or keeping the status quo currency union[23];
- $t = 2$: Disposable incomes are realized, and, in case of a fiscal union, the transfers are made.[24]

At date 1, either all countries agree to remain in regime c, or opt between two other options, namely a unanimous shift to regime f, or a return to independent policy making, which we will also refer to as "autarky".[25] We make the simplifying assumption that all the M countries are necessary for either type of common policy union, or else, if one country decides to go back to independent monetary and fiscal policy, the possibility of a common policy disappears also for the other remaining countries. This strong assumption can be relaxed, along similar lines as in Maggi and Morelli (2006), but certainly the case of *all or none* would apply to at least some minimum set of crucial countries, hence we might as well make it for our assumed number M of countries.

We assume that the creation of a fiscal union requires unanimity. In case of a unanimous decision to form a fiscal union, the countries need

[18] As pointed out in the Introduction, the purpose of this study is to analyze the "country incentives" to add a fiscal union dimension to an existing set of international institutions. The "class incentives" in countries with heterogeneous internal income levels have been studied, e.g. by Casella (2001), Persson and Tabellini (1996a, 1996b), Barbera and Jackson (2006), and Morelli et al. (2012), and references therein. There is a basic feasibility trade-off: when allowing for internal heterogeneous incomes it is difficult to allow for asymmetric population sizes and country incomes in the analysis of strategic institutional choice. In this paper the elimination of internal heterogeneities allows us to introduce the relevant heterogeneities across countries. We will argue below, in Section 4, that there are good reasons to believe that if one could manage allowing for within country heterogeneity and factor mobility as well, our main results on the importance of volatility would be qualitatively unchanged.

[19] Any concave utility function would serve our purposes of representing risk aversion.

[20] The possibility of heterogeneous benefits, e.g. $g_i^k > g_j^k$, comes from the possibility that for example country i trade more with their monetary union counterparts or exports more outside the union.

[21] The quadratic deadweight loss prevents the poor individual from imposing a tax rate that fully expropriates the rich, a standard assumption in the literature.

[22] Assume that at time 0 the M countries had decided to form a currency union. Such a partial integration decision can be optimal, we will argue, when volatility is low and not certain to rise. Even if policy makers could fully anticipate the rise of volatility after the creation of the currency union, this partial integration step could still be rationalized, either by making reference to the voters' lack of knowledge of this, or by invoking a functionalist argument, the preferred one by Monnet: "… *the launching of an "incomplete" monetary union would set the steps for further integration in due course, as predicted by functionalist theories.*" See Spolaore (2013) for a discussion of the political economy aspects of European integration.

[23] We focus on time 1, when volatility changes for many or all countries. One can think of this as an unanticipated change. This is consistent with assuming that at date 0 the relevant players were "myopic" with respect to the possibility of volatility changes due to the introduction of the common currency, but would also be consistent with other assumptions: for example, it is conceivable that the signers of the monetary union at date 0 attached some positive probability to the event of an increased volatility, but decided to postpone dealing with the consequences of such a change only in case it would occur.

[24] Uncertainty is resolved at date 2, when random productivity shocks alter countries' income levels.

[25] We do not explicitly account for the potentially very high costs of going back to autarky. For instance, one could argue that if the Euro area breaks, the huge costs of the dissolution among all countries would create a gigantic blame game across European politicians that would jeopardize all European project for several years. Adding a cost parameter to reflect these reversion problems would simply scale down the preferences for going back to regime 0, but the analysis would be substantially unchanged.

to agree (at time 1) on how (i.e., with which decision weights) to decide the ex-post transfers at time 2.

Denoting by $T_i(\varepsilon)$ the preferred ex-post tax rate (bliss point) of country i, one way to describe the bargaining problem at time 1 is to imagine that at time 1 the M countries have to agree, if they want a fiscal union, on a vector of probabilities with which each member will determine the taxes in period 2. In other words, we consider that, if a fiscal union is formed, the tax rate is chosen by a random dictator mechanism. In a decision by a *random dictator mechanism* what matters is the frequency with which country i decides, or the "*weight*" p_i country i has in the decision system. The weights must obviously satisfy $p_i \in [0, 1]$ for all i, and $\sum_{i=1}^{M} p_i = 1$. For a given system $(p_1,\ldots,p_M)$ of proportional weights, expected utility in a fiscal union under such weights is given by

$$E\left[V_i^f(\varepsilon)\right] = p_i E\left[V_i^f(T_i(\varepsilon))\right] + \sum_{j\neq i} p_j E\left[V_i^f\left(T_j(\varepsilon)\right)\right]. \tag{3}$$

Alternatively, and with no qualitative differences, one could think of those weights as sort of proportional representation weights, so that the implemented tax rate, rather than being one of the bliss points of randomly chosen dictators, would always be a weighted average of all the bliss points. In this alternative interpretation of the weights to be decided at time 1, the above expression for expected utility would (for every ε) become

$$V_i^f(\varepsilon) = V_i^f\left(\hat{T}(\varepsilon)\right) \tag{4}$$

where $\hat{T}(\varepsilon) \equiv \sum_{i=1}^{M} T_i(\varepsilon)$. In the analysis below, we follow the first interpretation of the weights, but the equivalent analysis of the proportional interpretation is available upon request.[26]

3. Equilibrium

3.1. Expected utilities across regimes

At date 1 countries realize that there has been an increase in the volatility parameter and face the uncertainty of shock realizations at date 2. In order to obtain simple close form solutions for the expected utility, let us assume that, for each country i, the random productivity shock ε_i follows a discrete distribution[27] and can take two possible values, $\overline{\varepsilon}_i \in [0, 1)$ and $-\overline{\varepsilon}_i$.[28] For any pair of countries (i, j) with shocks $(\varepsilon_i, \varepsilon_j)$, there are four possible realizations $(\overline{\varepsilon}_i, \overline{\varepsilon}_j)$, $(-\overline{\varepsilon}_i, -\overline{\varepsilon}_j)$, $(\overline{\varepsilon}_i, -\overline{\varepsilon}_j)$ and $(-\overline{\varepsilon}_i, \overline{\varepsilon}_j)$. We assume that, for any pair of countries, asymmetric shocks, $(\overline{\varepsilon}_i, -\overline{\varepsilon}_j)$ and $(-\overline{\varepsilon}_i, \overline{\varepsilon}_j)$, occur with the same probability, denoted as $q_{ij}^a \equiv Pr(\overline{\varepsilon}_i, -\overline{\varepsilon}_j) = Pr(-\overline{\varepsilon}_i, \overline{\varepsilon}_j)$. Likewise for symmetric shocks, $(\overline{\varepsilon}_i, \overline{\varepsilon}_j)$ and $(-\overline{\varepsilon}_i, -\overline{\varepsilon}_j)$, which occur with probability $q_{ij}^s \equiv Pr(\overline{\varepsilon}_i, \overline{\varepsilon}_j) = Pr(-\overline{\varepsilon}_i, -\overline{\varepsilon}_j)$.[29] Clearly, we must have that $q_{ij}^a + q_{ij}^s = 1/2$ and $E(\varepsilon_i) = 0$. With this normalization it is easy to show that $\sigma_i = \overline{\varepsilon}_i$, so that the explanation given in words above for why independent policy making reduces pre-tax income volatility is simply captured by a reduction in the size of the income shocks themselves, once again because of the possibility of exchange rate adjustments. Of course the overall distribution $Pr(\varepsilon)$ must be consistent with the two-dimensional distributions proposed for all pairs.[30]

The following lemma easily follows:

Lemma 1. *Country i's expected utility in a currency union is increasing in the benefit of the union and in the pre-shock per-capita income, and decreasing in the volatility of its own shock, as follows:*

$$E\left[V_i^c(\varepsilon_i)\right] = \ln g_i^c + \ln Y_i + \frac{1}{2}\ln\left(1-(\sigma_i^c)^2\right). \tag{5}$$

Analogously, country i's expected utility if reverting to independent policy making is increasing in the pre-shock per-capita income and decreasing in the volatility of its own shock, as follows:

$$E\left[V_i^0(\varepsilon_i)\right] = \ln Y_i + \frac{1}{2}\ln\left(1-\left(\sigma_i^0\right)^2\right). \tag{6}$$

From the first order condition of $V_i^f(T(\varepsilon))$ with respect to $T(\varepsilon)$, country i's preferred ex-post tax rate is given by

$$T_i(\varepsilon) = \begin{cases} 1-\dfrac{X_i}{x} & \text{if } X_i < x \\ 0 & \text{otherwise} \end{cases}. \tag{7}$$

The lower the country i's after shock income relative to the average income, the higher is its preferred tax rate in the fiscal union. Observe that the term X_i/x makes the preferred tax rate for a given country depend on the income and population of all other countries in the union. In particular, it is possible to show that country i's desired ex-post tax rate is (weakly) decreasing in its relative size and relative income.

To compute the expected utility for a country from a fiscal union, note that country i's expected utility in the fiscal union when country i determines the tax rate ex-post is

$$E\left[V_i^f(T_i(\varepsilon))\right] = \sum_{\varepsilon\in\{\overline{\varepsilon}_i,\,-\overline{\varepsilon}_i\}^M} Pr(\varepsilon)\left(\ln g_i^f + \ln\left(\frac{X_i^2}{2x}+\frac{x}{2}\right)\right) \tag{8}$$

whereas the expectation in case some other country j is the dictator ex-post is

$$E\left[V_i^f\left(T_j(\varepsilon)\right)\right] = \sum_{\varepsilon\in\{\overline{\varepsilon}_i,\,-\overline{\varepsilon}_i\}^M} Pr(\varepsilon)\left(\ln g_i^f + \ln\left(\frac{X_j\left(2X_i-X_j\right)}{2x}+\frac{x}{2}\right)\right). \tag{9}$$

When country i decides on the tax rate, its expected utility in the fiscal union is always above its expected utility in autarky.[31] Country i chooses a positive tax rate when it is after-shock poorer, and a zero tax rate when it is after-shock richer, as the optimality condition (Barbera and Jackson, 2004) shows. On the other hand, if it is the case that country j is the one that decides on the tax rate, then country i's expected utility in the fiscal union is closer to autarky levels when it is relatively very poor (as $lim_{Y_i\to 0}\left(\frac{X_j(2X_i-X_j)}{2x}+\frac{x}{2}-X_i\right)\to 0$), and thus not expropriated by j. However, country i becomes worse off than under independent policy making as its relative income increases (in the limit we have $lim_{Y_i\to\infty}E\left[V_i^f(T_j(\varepsilon))\right] - lim_{Y_i\to\infty}E\left[V_i^0(\varepsilon_i)\right] = -\infty$). Following these lines, one can show that countries with a large relative income and a large relative size will demand a higher decision weight in the fiscal union given their autarky threat point.[32]

[26] It would be instead substantially more difficult to conduct the analysis for institutions like, for example, the double majority system prescribed by the Lisbon treaty for most issues where the EU Council currently has jurisdiction. Note, however, that in case of a transformation of the union in the direction of a fiscal union, the governance structure would definitely be up for discussion, and that a double majority system would almost surely not apply to transfer decisions.

[27] Similar results are obtained when using a continuous distribution, such as the multivariate normal. However, in the latter case, closed form solutions cannot be obtained.

[28] We require aftershock incomes to be non-negative and so take the lower bound of ε_i to be -1. By symmetry we take the upper bound of ε_i to be 1.

[29] In terms of the relationship between these parameters we now introduce q because of the discretization assumption, and with the ρ matrix defined earlier, it can be shown that $q_{ij}^A = (1-\rho_{ij})/4$. See Luque et al. (2012).

[30] Notice that there are many M-dimensional distributions consistent with a single set of two-dimensional distributions. See Stoyanov (1996, p. 53) for examples showing that pairwise independence does not imply joint independence.

[31] Mathematically, this follows as $\left(\frac{X_i^2}{2x}+\frac{x}{2}\right)-X_i = \frac{(X_i-x)^2}{2x} \geq 0$.

[32] The proof is available upon request.

3.2. The role of volatility

We can now focus on the key role of the shock volatility parameter. First, countries agreed to have a common monetary policy, in a context of low volatility; at some later date, it became clear that the system was subject to a greater volatility than before; countries now face the choice between abandoning the status quo and reverting to autarky, or adding the fiscal policy dimension to the monetary union, with an "appropriate" distribution of voting weights. Let us define at date 1, for each country *i*, three thresholds:

- $\hat{\sigma}_i$ will denote the volatility of shocks that makes country *i* indifferent between the status quo and the fiscal union;
- $\tilde{\sigma}_i$ will denote the threshold at which country *i* is indifferent between staying in the monetary union and reverting to independent policy making;
- $\overline{\sigma}_i$ will denote the threshold that makes country *i* indifferent between fiscal union and reverting back to independent policy making.

Country *i*'s expected utility in a currency union is decreasing and concave in σ_i, while the expected utility with independent policy making is a straight line. These two facts guarantee that $\tilde{\sigma}_i$ is uniquely determined. In order to have $\hat{\sigma}_i$ and $\overline{\sigma}_i$ also uniquely defined, we need the single crossing property to hold between, respectively, functions (3) and (5), and (3) and (6). This property holds when $\frac{dE[V_i^f(\varepsilon)]}{d\sigma_i} < 0$ and $\frac{d^2E[V_i^c(\varepsilon_i)]}{d(\sigma_i)^2} < \frac{d^2E[V_i^f(\varepsilon)]}{d(\sigma_i)^2} < 0$, for all $\sigma_i \in [0, 1)$.[33] Fig. 1 illustrates the thresholds $\hat{\sigma}_i$, $\tilde{\sigma}_i$ and $\overline{\sigma}_i$ for a country *i* in a two country fiscal union. Heterogenous countries naturally may have different volatility thresholds. All volatility thresholds depend in a continuous manner on the weights, and on the relative size and income.

The following proposition establishes how volatility affects preferences over the different regimes:

Proposition 1. *For a set of realizations* $(Y_i, N_i)_{i \in \mathbf{I}}$, *there are three thresholds* $\hat{\sigma}_i$, $\tilde{\sigma}_i$ *and* $\overline{\sigma}_i$ *such that:*

a) a) $\hat{\sigma}_i < \tilde{\sigma}_i < \overline{\sigma}_i$.
b) *if* $\sigma_i^c < \hat{\sigma}_i$, *the status quo currency union is preferred to fiscal union, which in turn is preferred to autarky.*
c) *if* $\hat{\sigma}_i < \sigma_i^c < \tilde{\sigma}_i$, *the fiscal union is preferable to currency union alone, which in turn is preferred to autarky.*
d) *if* $\tilde{\sigma}_i < \sigma_i^c < \overline{\sigma}_i$, *the fiscal union is preferred to autarky, which in turn is preferred to the currency union.*
e) *if* $\overline{\sigma}_i < \sigma_i^c < 1$, *autarky is preferred to the fiscal union, which in turn is preferred to the status quo currency union.*

Being in a currency union at time 1 is consistent with σ_i^c being estimated at time 0 to be less than $\hat{\sigma}_i$ for all *i*. Consider an upwards shift in some of the σ_i^c at time 1 that makes at least one of the countries have $\sigma_i^c > \hat{\sigma}_i$. Now, given (Y_i, N_i) and the new σ_i^c, we can characterize four different relevant scenarios, in the absence of additional economic or political incentives, as far as the distribution of country preferences over regimes is concerned.

Proposition 2. *We can identify the following regions characterizing all the possible consequences of changes in the perceived volatility of shocks at time 1 in the currency union*[34]*:*

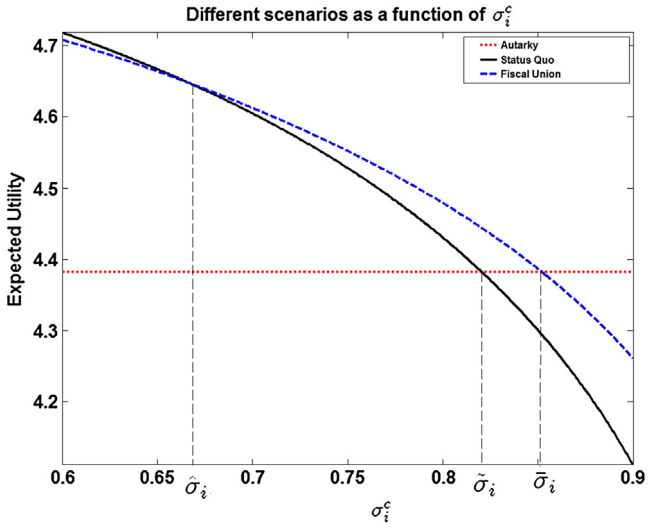

Fig. 1. Volatility thresholds for country i in a two country economy with $N_i = N_j$, $Y_i = Y_j$, and $p_i = p_j$.

Region 1 *Countries remain in a currency union at time 1 if all countries have* $\sigma_i^c < \tilde{\sigma}_i$ *and there are at least two countries i and k with* $\sigma_i^c \in (\hat{\sigma}^i, \tilde{\sigma}^i)$ *and* $\sigma_k^c < \hat{\sigma}^k$, *respectively.*
Region 2 *Countries form a fiscal union if all countries have* $\sigma_i^c \in (\hat{\sigma}_i, \overline{\sigma}_i)$.
Region 3 *The union reverts to autarky if there are at least two countries i and k with* $\sigma_i^c < \hat{\sigma}_i$ *and* $\sigma_k^c \in (\tilde{\sigma}_k, \overline{\sigma}_k)$.
Region 4 *The union reverts to autarky if there is at least one country with* $\sigma_i^c > \overline{\sigma}^i$.

In Region 1, at least one country prefers a fiscal union, but there is no unanimity in support of that move. Since all countries prefer status quo currency union to autarky, the regime remains in status quo. Notice that, if sufficient countries have $\sigma_i^c \in (\hat{\sigma}^i, \tilde{\sigma}^i)$, where they prefer fiscal union to the status quo, it may be in their interest to compensate countries with $\sigma_i^c < \hat{\sigma}^i$ through economic and political incentives, and make them approve the creation of the fiscal union.

In Region 2, the fiscal union is formed since there is unanimity. Notice that even if all countries have $\sigma_i^c \in (\tilde{\sigma}_i, \overline{\sigma}_i)$, so that all prefer autarky to the status quo, they unanimously prefer the fiscal union.

In Region 3, country *i* prefers to remain in status quo, and country *k* prefers to move to the fiscal union. Thus, without compensation, no unanimity is attained and the union reverts to autarky. Similarly to region 1 above, if enough countries have $\sigma_i^c \in (\hat{\sigma}^i, \overline{\sigma}^i)$, they could use economic and political incentives to convince countries with $\sigma_i^c < \hat{\sigma}^i$ to vote in favor of the fiscal union.

In Region 4, country *i* has $\sigma_i^c > \overline{\sigma}^i$, so it prefers autarky to both status quo and fiscal union. Again, by a similar argument as above, only if there are sufficiently many countries with $\sigma_i^c \in (\hat{\sigma}^i, \overline{\sigma}^i)$ to compensate countries with $\sigma_i^c > \overline{\sigma}^i$, will the unanimous creation of the fiscal union be possible.

In Regions 3 and 4 we observe the interesting trade-off pointed out in the Introduction: *without a fiscal union, high volatility may kill the common currency*.

The question that we shall address in the next section is: Are there political incentives that the countries in favor of the fiscal union can use to convince those other countries that prefer a reversion to autarky?

3.3. Bargaining space

As shown above, there are instances (namely Regions 3 and 4 in Proposition 2) where an interesting trade-off arises between moving unanimously to fiscal union and reverting to autarky. Institutional design comes to the scene precisely at this point. By choosing the

[33] Condition $\frac{dE[V_i^f(\varepsilon)]}{d\sigma_i} < 0$ simply means that countries in the fiscal union regime dislike volatility increments in expectation. Condition $\frac{d^2E[V_i^c(\varepsilon_i)]}{d(\sigma_i)^2} < \frac{d^2E[V_i^f(\varepsilon)]}{d(\sigma_i)^2} < 0$ can be read as follows: when volatility increases, a country's expected utility loss is larger in a currency union than in the case of a monetary and fiscal union.

[34] In principle one could imagine that some global events can determine changes also in σ_i^0, and in that case the proposition would have to be restated in terms of the consequences of changes in the perceived "difference" between the volatility with and without a currency union.

appropriate proposal weights, countries can provide the necessary incentive to convince all countries to adhere to the fiscal union. The mechanism that we propose is a simple assignment of a proposal weight to each of the countries in the fiscal union, so that the tax rate is decided in line with these specific weights. As indicated above, these weights (or probabilities) are described by a vector $(p_i)_{i=1}^{M}$. Weights must be such that, for all countries, the expected utility in the fiscal union is at least equal to the expected utility in autarky. We are thus incorporating institutions into the picture, in the form of representation rights.

Let us define by p_i the country *i*'s minimum weight compatible with country *i* joining the fiscal union. Following the assumption of unanimity for the formation of the fiscal union, we denote by $\overline{p}_i$ the country *i*'s maximum weight that is compatible with all the other countries joining the fiscal union. In the Appendix A we characterize the expressions $\overline{p}_i$ and p_i as functions of countries' expected utilities in autarky and in the fiscal union. The *consensus bargaining space* (CBS) then corresponds to the difference between these upper and lower bounds, that is, $\overline{p}_i - p_i$. A non-empty CBS (i.e., $\overline{p}_i - p_i > 0$) implies that the fiscal union improves upon autarky for all countries in the union. Observe that if $\overline{p}_i - p_i > 0$ holds for one country, then it must hold for all countries, so the fiscal union improves upon the autarky regime for all countries. Let us now concentrate on the case of a two country union. Our goal is to understand the role of income and size and the correlation of shocks for the formation of a fiscal union. This analysis is useful because we can easily compare our results to existing work, in particular, Alesina and Perotti (1998). Moreover, we can explore when there exist voting weights that preserve the benefits of a common policy while limiting the political risk of entering a fiscal union.

3.3.1. Correlation of shocks and political weights

Our analysis extends both Gordon (1983) and Alesina and Perotti (1998) to the whole range of possible shock correlations ρ and voting weight (p_i) parameters. Gordon (1983) develops the classical one-dimensional analysis highlighting the role of negative cross-correlation of shocks on risk sharing possibilities between countries. He showed that when $\rho < 0$ a fiscal union is a way to provide economic insurance. The more negative the value of ρ, the higher the benefits of common insurance.[35] Alesina and Perotti (1998) extend Gordon's framework by letting one country, which they assume marginally larger than the other, to always decide on the fiscal instrument ("political risk").

Fig. 2 illustrates how the bargaining space between two countries *i* and *j* changes when the correlation between country shocks changes in our model. We remark that this reverses the classical Gordon result, where a perfectly negative cross-correlation between shocks favors the formation of a fiscal union. In our model, the lower is the correlation between shocks, the larger is the bargaining space.[36] *However*, we have non-empty bargaining space even with $\rho > 0$. In the "limiting" context of Alesina and Perotti (1998), where it was always the same country that decided on the common tax rate (corresponding, in our setting, to $p_i = 1$), the fiscal union might not be possible due to the implicit political risk, even if $\rho = -1$ and economic insurance is most attractive. In contrast to these authors, where institutional design was absent, our setup shows how voting weights need to be reassigned for the two countries to join the union. In other words, what this picture brings forward is how a sensible redistribution of voting power, which decreases the likelihood of country *i* deciding, guarantees ex-ante unanimity in favor of the fiscal union. Thus, the addition of the institutional dimension countered the "political risk effect". In a sense, by allowing for variable voting weights, countries in our setup are insured against political risk.

[35] In the same vein of Bolton and Roland's (1997) political economy model of integration, Fidrmuc (2004) considers the impact of region-specific shocks in a dynamic setting, and shows that negatively correlated temporary shocks allow the greatest gains from inter-regional risk sharing.

[36] At $\rho = -1$ the fiscal union is sustainable when $p_i \in [0.45, 0.55]$. The bargaining space becomes empty when $\rho \geq 0.7$.

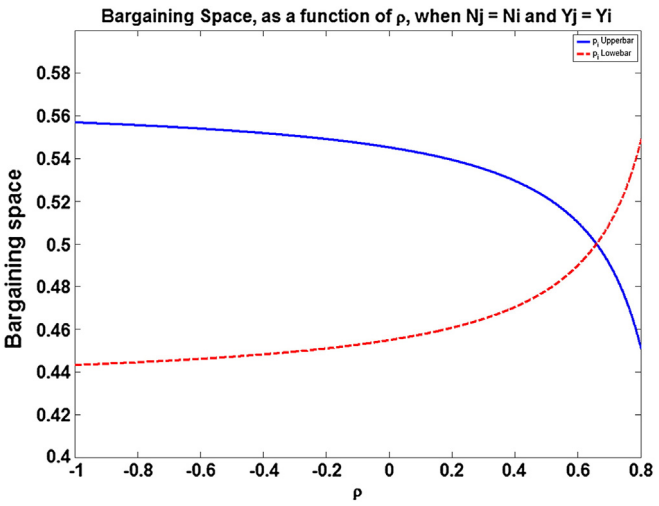

Fig. 2. We set $Y_i/Y_j = 1$, $N_i/N_j = 1$, and $g_i = g_j = 1.45$.

It is easy to see that the threshold at which the bargaining space becomes non empty changes with relative income. For a given correlation of shocks, increasing country *i*'s relative income causes both the minimum and maximum country *i*'s voting weights to increase. The intuition is simple. A country *j* that becomes relatively poorer demands a lower weight in the union since in this new situation the chances to expropriate country *i* through transfers increase. On the other hand, given the higher probability of being partially expropriated, the richer country *i* demands a higher weight in the union in order to keep its expected utility above the autarky level.

3.3.2. Voting weights and asymmetries in income and size

Previous results in the literature have focused on the correlation coefficient between country shocks to analyze the benefits of forming a union, for equal countries' ex-ante income and population. Here, instead, we allow for countries with different incomes and sizes. We pose the following question: Given the unanimous voting rule, what are the income and size parameters that make a fiscal union possible? In our working paper, Luque et al. (2012), we illustrate with a three dimensional graph that the less heterogeneous the countries, the larger the scope for agreements. The reasoning is as follows: as we point out in Subsection 3.1, when countries become dissimilar in income, the country with higher income demands higher weight in the union to avoid expropriation through the common tax. This in turn decreases the bargaining space. On the other hand, when countries become dissimilar in size, the country with a larger population is discouraged from imposing heavy taxes on its richer partners in the union, as this implies imposing deadweight losses on its own, large population.

4. Empirical support for the European case and directions for future research

4.1. Volatility shocks in Europe

At the time of the creation of the Monetary Union in 1999, the context was one where the "great moderation", associated with decreased economic volatility, made most people convinced that the loss of control over monetary policy was a non-issue. And, indeed, until the recent economic and financial crisis, the EU project was seen as the longest lived and deepest institutional agreement among heterogeneous countries.

As our theory suggests, when volatility jumps for some of the countries in a monetary union, a fiscal union may be a necessary and sufficient institution to sustain the common currency and avoid reversion to autarky. When unanimity in favor of the fiscal union is not possible,

some reassignment of political weights may be in order, to convince the low volatility countries to join in. Current developments suggest a clear shift in political weights in favor of lower volatility countries such as Germany.

Here we provide empirical evidence that supports the existence of a jump in volatility for most of the Euro countries. We measure volatility in a period of T years as sample standard deviation, i.e., as the average of the squared differences between the normalized GDP per capita ($GDPPC_t$) and the trend component ($\overline{GDPPC}_t$) of each year t in the period.[37] Let 1985 be the base year, normalizing the GDP per capita of each country to 100 in that year. The trend for each country is computed using the normalized time series 1985–2011. Average fluctuations for each period (composed by 13 years) are with respect to this long term trend. Therefore, fluctuations should be understood as medium to long-term shocks and not yearly fluctuations.

Table 1 documents the average volatility of GDP per capita in the 13 years before (1986–1998) and the 13 years after (1999–2011) the adoption of the euro. Data on GDP per capita was obtained from the ERS International Macroeconomic Data Set website.[38] The period of yearly data covers until 2011.[39] As our model suggests, what ultimately matters to a representative individual in a given country is his consumption ($g_i^k Y_i(1+\varepsilon_i)$, for $k=0,c$), and its associated volatility. For this reason, we also document in Table 2 the average volatility of this alternative variable "individual consumption" in the 13 years before and the 13 years after the adoption of the euro. Data on individual consumption is obtained from the OECD website.[40] The construction of Table 2 follows the same procedure as in Table 1 (see above).

In Tables 1 and 2 we obtain similar insights regarding the pattern of volatility for the EMU countries. First, volatility increases after 1999 for all countries except for Germany and Finland (and Belgium in Table 2) — in the last columns of Tables 1 and 2, one can observe that volatility increased also at the time of the exogenous shock of the 2007 American crisis.[41] Second, EMU countries can roughly be divided into two volatility groups (in "level"): a high volatility group, which includes Greece, Ireland, Portugal, and Spain, and a low volatility group, which includes Austria, Belgium, Finland, France, and Germany. There are differences between the values of the volatilities of GDPpc and the volatilities of individual consumption. These differences can be attributed to several reasons, including (i) international cash flows, both within the EU and between the EU and the rest of the world, and (ii) explicit and implicit intergenerational transfer policies (explicit debt, public pension, and other social welfare systems) that smooth consumption over time.

The interesting confirming facts for us are that there are four countries who display both high levels of output volatility and an increase in such volatility in the wake of EMU. These are Greece, Ireland, Portugal, and Spain. In addition, in these countries there is a noticeable increase in both output and consumption volatility, even when we compare the post-crisis and pre-crisis volatility levels. As our theory suggests, it is precisely in the high volatility countries that experience a jump in their volatilities where we expect the fiscal union or autarky options to become more salient. In particular, we can identify Greece, Ireland, Portugal, and Spain as those countries that will rank a move to fiscal integration as the most preferable option.

4.2. Alternative explanations of fiscal union desirability in Europe

Looking at Table 2, one can find countries whose pattern of individual consumption volatility does not necessarily correlate with the perceived desire of a fiscal union. There are other important economic factors that affect the desirability of a fiscal union that our model does not explicitly consider.[42] Below we discuss these alternative explanations that could be incorporated into a more complete model of fiscal union desirability.

- *International, intertemporal, and interregional risk sharing*: As pointed out in the Introduction, risk sharing can be attained not only through a fiscal union, but also through capital markets and population flows. However, our model only requires some amount of residual risk, and these alternative mechanisms seem to have limited effects:
  - Even for the United States, the role of migration in smoothing shocks to state output is relatively minor, as suggested in Asdrubali et al. (1996) and in Sørensen and Yosha (1998);
  - For the case of risk sharing through capital markets, Sørensen and Yosha (1998) find that, for OECD as well as for EC countries, about 40% of shocks to GDP are smoothed at the one year frequency, with about half the smoothing achieved through national government budget deficits and half by corporate saving. At the three year differencing frequency only 25% of shocks to GDP are smoothed, mainly via government lending and borrowing. Asdrubali et al. (1996) find that federal income smoothing "slightly favors" states that suffer persistent shocks, suggesting that federal actions are insufficient to compensate for persistent economic distress. Both pieces of evidence support two assumptions in this paper: More persistent shocks are less prone to fiscal smoothing and, last but not least, a heavier burden of the longer-run smoothing is on the shoulders of government fiscal policy, with smoothing through private credit markets fading in importance.
- *The debt to output level*: Italy and the Netherlands exhibit similar volatility levels of individual consumption in period 1999–2011 (8.69 and 10.33, respectively). However, these two countries are perceived as having opposite positions on a hypothetical fiscal union implementation (Italy in favor, the Netherlands against). The debt-to-GDP ratio offers one possible explanation. Italy experienced one of the highest levels of public debt as a percentage of GDP (e.g., 106.7% in 1999 and 109.0% in 2010), while the Netherlands exhibits a low ratio (49.2% and 51.8% respectively). In a more elaborate model that incorporates fiscal solvency crisis, highly leveraged countries, such as Italy, are likely to seek transfers from other Eurozone countries, such as the Netherlands, when the interest rates of their sovereign debt rise up to a point where the country's solvency is at risk.
- *Economic growth*: Another important factor to explain countries' support for a fiscal union could be average income growth. For instance, between 1999 and 2007, Italy has experienced the lowest growth of GDP (3.8%), while the Netherlands grew at a substantially higher rate (5.9%).
- *Population aging*: Population aging can be seen as an important variable that could influence the desirability of a fiscal union for a country. There are important differences in population aging among EMU countries — for instance, in 2010 Italy had 20% of the population older than 65 years old, whereas the Netherlands exhibited a 15.6%, the second lowest rate. The intuition here is that differences in population aging among

[37] i.e., $\sqrt{\sum_{t=1}^{T}\left(GDPPC_t-\overline{GDPPC}_t\right)^2/(T-1)}$.

[38] http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx

[39] For our purposes, ERS International Macroeconomic Data Set is the most complete source of data. ERS International Macroeconomic Data Set provides quarterly and yearly data for both GDP per capita. However, quarterly data is not available for all countries and years, and this is the reason why we chose yearly data.

[40] http://stats.oecd.org.

[41] For this exercise, we could not use the trend that goes over the whole period 1986–2011, as our measure to compute average volatility is very biased towards the extreme points (years 1985 and 2011). Since period 2007–2011 has very few observations, we would have that volatility values converge to the trend component as the year approaches to 2011, and as a result, the average volatility for the subperiod 2007–2011 would be underrepresented compared to the subperiod 1999–2006. For this reason, we have decided to compare two symmetric subperiods of the same length, 2002–2006 and 2007–2011, and have constructed the trend for the period 2002–2011 by taking 2002 as the base year. This procedure puts equal weights on the period preceding the crisis (2002–2006) and the crisis period (2007–2011). We find that volatility increases for all countries in the crisis period, for both volatility of GDPpc and volatility of individual consumption.

[42] See Mongelli (2013) for an informal discussion.

countries in a union could result in a situation where countries with high fertility and large tax base end up making transfers towards other countries with low natality.

- *Richer countries in fiscal unions*: The connection between a country leaving the currency union and its collapse provides a powerful incentive for richer countries to consider a fiscal union as an attractive step, an alternative to losing many of the benefits of integration. The reduction of moral hazard and cultural distance among country leaders has also been presented as a strong argument to convince richer country leaders such as Angela Merkel to favor moving towards a fiscal union.[43] Finally, a transfer union provides insurance to any country, which could be enjoying an above average income and consumption today, but could suffer a shock in the future.[44]

4.3. Limitations of the analysis and directions for future research

One limitation of our model, and hence a potential direction for future research, relates to the micro foundations of the sharp changes in volatility documented above. Luque and Taamouti (2013) present empirical evidence on the effect of economic fundamentals on the growth rates of euro countries' GDP volatility, and also tested whether the euro has introduced a structural break in the effect of these fundamentals. The analysis, which controls for country and time fixed effects and for other macroeconomic variables, including exchange rates, identifies increments in government debt as a key variable that experienced a statistically significant structural break. This result survives a battery of robustness checks, such as the exclusion of the recent financial crisis period and comparison with non-euro European countries. In particular, the authors find that before 1999, a 1 percentage point increase in debt reduced uncertainty by more than 10%, while after adoption of the euro, the same increase in government debt led to a more than 12% increase in uncertainty. In other words, Luque and Taamouti's (2013) find that increments in public debt, holding the other fundamentals constant, increase economic uncertainty after countries joined the euro. Roughly speaking, the mere fact of adopting a common currency changes the way economic fundamentals affect volatility. We leave for future research to model an economy where volatility is endogenous and depends on new issuing of government debt, and where the adoption of the common currency changes the effect of government debt on volatility, as empirically demonstrated by Luque and Taamouti's (2013). [45]

The other important limitation of our model is the absence of heterogeneity within countries and the absence of an explicit consideration of the possibility to move across countries. When considering the possibility of mobility across jurisdictions, the "coordination" of fiscal policies or, in the extreme, the intervention of a higher level government, can be welfare improving (see e.g. Wildasin, 1991). We ignore the benefits of fiscal coordination in the presence of labor mobility to concentrate on the role of jurisdictional heterogeneity and political institutions on the feasibility of a fiscal union, and by doing so we are stacking the deck against fiscal union.

These two directions of future research can actually be linked together: as demonstrated in Morelli et al. (2012), in a world of tax competition where mobility is allowed, one should expect more inequality across classes and less effective redistributive systems, and this should intuitively determine higher volatility of disposable incomes.[46] A positive income opportunity shock in one country makes the optimal taxation designers in other countries less able to tax the high productivity types because of the higher mobility outside option towards the country that enjoyed the positive shock, hence the other countries being more constrained in their optimization should induce a higher ex post disparity of utilities, after every shock.

Finally, the most important item for future research is a more realistic description of the kind of transfer systems that could be established in a fiscal union. For example, the simple transfer system described in this paper did not consider at all the possibility to administer limited transfers from a common European budget. Adding this possibility is equivalent to putting upper bounds on the feasible transfers, so that exploitation of richer countries would be kept under control even in the case of the random dictator. The interpretation of weights in terms of proportional representation plus the explicit consideration of this budget could be two ingredients of a more realistic model for the discussion about how to implement the fiscal union. We remark that our results suggest that the political weights should be flexible, and should depend in some prespecified way on the shocks, and we conjecture that this should continue to be true even when allowing for the budget upper bounds.

5. Concluding remarks

This paper provides a volatility-based theory of the formation of a fiscal union when a degree of economic integration and a common monetary policy are already present. Countries that find themselves subjected to a new and higher level of income volatility favor either moving to a fiscal union or reverting to autarky, the status-quo being no longer a desirable option. High-volatility countries may be willing to relinquish decision power and redistribute political weights in favor of low-volatility countries, so that all could unanimously agree to move towards a fiscal union.

We have shown how relative incomes and population size, as well as the cross-country correlation of income shocks, interact with political decision weights to shape the feasibility of reforms. Our perspective allows considering the issues of economic and political risk in a broader framework, showing how bargaining over political weights may substantially enlarge the sustainability of a fiscal union. The existence of a consensus can be guaranteed for a large set of distribution of income shocks and cross-country heterogeneity, a much wider set than what could be achieved with no institutional reform and redistribution of political weights.

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Appendix A

Proof of Lemma 1. First, notice that the expected value is $E(\varepsilon_i) = \overline{\varepsilon}_i Pr(\overline{\varepsilon}_i) + (-\overline{\varepsilon}_i) Pr(-\overline{\varepsilon}_i) = \overline{\varepsilon}_i(1/2) + (-\overline{\varepsilon}_i)(1/2) = 0$. The variance is $Var(\varepsilon_i) = E(\varepsilon_i^2) - E(\varepsilon_i)^2 = \frac{1}{2}\overline{\varepsilon}_i^2 + 1/2(-\overline{\varepsilon}_i)^2 = \overline{\varepsilon}_i^2$, so $\sigma_i = \overline{\varepsilon}_i$. Now, since $\sigma_i = \overline{\varepsilon}_i$ and $Pr(\varepsilon_i = \overline{\varepsilon}_i) = Pr(\varepsilon_i = -\overline{\varepsilon}_i) = 1/2$, we have that $E\left[V_i^c(\varepsilon_i)\right] = \frac{1}{2} ln(Y_i(1+\sigma_i)) + \frac{1}{2} ln(Y_i(1-\sigma_i))$, which can be rewritten

[43] See Guiso et al. (2013) for an extensive analysis of such a motivation.

[44] This point is illustrated by Fig. 2, where the more negative ρ_{ij} is, the larger is the bargaining space.

[45] There may of course be other determinants of volatility shocks. Sørensen and Yosha (1998), Demiank et al. (2008), and Kalemli-Ozcan et al. (2004) study the role of international risk sharing in the European monetary unification.

[46] For a survey of tax competition see Wildasin (2006).

as $E\left[V_i^c(\varepsilon_i)\right] = ln(Y_i) + \frac{1}{2}ln(1-\sigma_i^2)$. With independent policy making, note that the multiplier g is taken out because assumed equal to one, and the other difference is simply the lower σ. ■

Proof of Proposition 1. All items immediately follow using the intermediate value theorem, making use of the single crossing property, which guarantees that the three thresholds are uniquely defined. In particular, to find each threshold, we need to find two values for σ_i, for which the difference between the two functional forms that determine it takes different signs. For example, for $\widetilde{\sigma}_i$, take $\sigma_i = \sigma_i^0 < 1$, so $E^\rho[V_i^c(\varepsilon_i)] - E[V_i^0(\varepsilon_i)] > 0$, and $\sigma_i = 1 - \delta$, with $\delta > 0$ sufficiently small, for which $E^\rho[V_i^c(\varepsilon_i)] - E[V_i^0(\varepsilon_i)] < 0$. Recall that $E[V_i^0(\varepsilon_i)]$ is constant in σ_i (see (6)), and that $E^\rho[V_i^c] \to -\infty$ as $\delta \to 0$ (see (5)). The other two thresholds can be found using the same procedure. ■

Characterization of the bargaining space: Recall that the weights $(p_i)_{i=1}^M$ must satisfy $p_i \in [0, 1]$ for all i, and $\sum_{i=1}^M p_i = 1$. Now, in the instances where country i does not decide, which occurs with probability $1 - p_i$, the other *M-1* countries will decide given some weights, which we denote by $(p'_{ij})_{j \neq i}$, such that $\sum_{j \neq i} p'_{ij} = 1$.[47] Observe that $p_j = (1 - p_i)p'_{ij}$. We thus have that $p_i + (1 - p_i)(\sum_{j \neq i} p'_{ij}) = 1$. Thus, weights (or probabilities) are described by a vector $(p_i, (p'_{ij})_{j \neq i})_{i=1}^M$.

- *Minimum weight of country i compatible with country i joining the fiscal union:* We denote by p_i the minimum weight (or probability) with which country i decides the tax rate, given the vector of weights $(p'_{ij})_{j \neq i}$, that is compatible with the same country i being at least as well off in the union as in autarky. Formally,

$$\underline{p}_i\left(\omega, \left(p'_{ij}\right)_{j\neq i}\right) \in argmin\, p_i \text{ such that}$$

$$p_i E\left[V_i^f(T_i(\varepsilon))\right] + (1-p_i)\sum_{s\neq i} p'_{is} E\left[V_i^f(T_s(\varepsilon))\right] \geq E\left[V_i^0\right] \quad (10)$$

Using equality in (10), we find that

$$\underline{p}_i\left(\omega, \left(p'_{ij}\right)_{j\neq i}\right) = \frac{E\left[V_i^0\right] - \sum_{s\neq i} p'_{is} E\left[V_i^f(T_s(\varepsilon))\right]}{E\left[V_i^f(T_i(\varepsilon))\right] - \sum_{s\neq i} p'_{is} E\left[V_i^f(T_s(\varepsilon))\right]} \quad (11)$$

- *Maximum weight of country i compatible with country j joining the fiscal union:* We denote by p_{ij} the maximum value of country i's weight (p_i), such that country j is at least as well off in the union as in autarky, for given state ω and other country weights $(p'_{ij})_{j \neq i}$. Formally,

$$\overline{p}_{ij}\left(\omega, \left(p'_{ij}\right)_{j\neq i}\right) \in argmax\, p_{ij} \quad \text{such that}$$

$$p_{ij} E\left[V_j^f(T_i(\varepsilon))\right] + \left(1-p_{ij}\right)\sum_{s\neq i} p'_{is} E\left[V_j^f(T_s(\varepsilon))\right] \geq E\left[V_j^0\right] \quad (12)$$

Let us denote by λ_{ij} the country i's shadow value associated with constraint (Bordo et al., 2011).

- *The bargaining space of a two countries union*, for a given realization ω, is the difference $\overline{p}_{ij}\left(\omega, \left(p'_{ij}\right)_{j\neq i}\right) - p_i\left(\omega, \left(p'_{ij}\right)_{j\neq i}\right) > 0$. Notice that unanimity is necessary in a two countries scenario for the bargaining space to be non-empty.[48] However, when there are more than two countries in the union, formation of the fiscal union by some majority rule might be considered (see Luque et al. (2012)). ■

[47] Here, p'_{ij} denotes the weight with which country j chooses the tax rate when country i does not choose it.

[48] We do not address the issue of choosing the majority rule since we think that it would make this paper too cumbersome. Future research on this should be related to the work by Barbera and Jackson (2004).

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