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Abstract

In this paper we investigate the interplay between national rainy-day funds and supra-national transfers in a fiscal union. Given that the EU has established rules limiting deficits, national rainy-day funds could in theory provide a way for countries to obey the rules and use fiscal policy, yet avoid using austerity measures during a recession. The rainy-day fund is self-insurance and we examine the funding of a national rainy-day fund for a country in isolation. We then introduce a fiscal union while allowing member countries to retain some fiscal policy control. We find that moral hazard leads to lower contributions to a rainy day fund with a fiscal union present, and further that the higher the fiscal transfer, the lower will be the contributions to the rainy-day fund. The optimal size of the fiscal union trades-off the ex-post insurance provided by the union and the moral hazard which reduces national ex-ante preparation for stabilization policies. Optimally, the insurance provided by the fiscal union should be lower (1) the more effective is own-fiscal policy; (2) the more the presence of the fiscal union reduces rainy-day fund savings; (3) the lower is the relative probability of recession; and (4) the lower is the utility gain of redistribution in the union. We also find that commitment to a transfer policy is essential. A fiscal union that is prone to break the rules on transfers negatively impacts the ex-ante contributions to individual members' rainy day funds.

JEL-Codes: E600, H100, H600, H700.

Keywords: fiscal union, fiscal transfers, federation, rainy-day funds, fiscal stabilization.

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I. Introduction

The European Union is engaged in a debate over whether a Monetary Union requires a Fiscal Union to function properly. A Monetary Union takes monetary policy out of the hand s of individual countries and creates a fixed exchange rate system between them. In times of recession countries of the Union thus have only fiscal policy to rely upon for internal balance. If a country is not part of a fiscal union, it must rely on its own funding for fiscal policy in a recession. A fiscal union, on the other hand, allows countries that are not in a recession to provide transfer payments to those in recession; this is a type of insurance and presumably the transferring country would be the recipient should it be struck by a recession.

Over the long-run, budget balance requires that expenditures in recessionary periods be recouped in good times. If a country is not part of a fiscal union and must rely on its own funds, it needs to self-insure and the budget will balance because of saving in good times. The savings can be set aside in a fund often termed a rainy-day fund for use during a recession. If a country is in a fiscal union it may still self-insure by saving in a rainy day fund and using these funds to fight a recession on its own, but the fiscal union implies some risk-sharing also takes place across the union. This is accomplished via transfers from countries that are part of the union but not in recession to countries that are part of the union and suffering recession.

In this paper we investigate the interplay between a country's self-insurance through a rainy-day fund and risk-sharing across a fiscal union via transfers. We start with a short background discussion of the literature on risk-sharing across a fiscal union

and the experience of rainy day funds in US states. Our theoretical discussion begins by examining a country in autarky and considering its savings and funding decision for a rainy day fund. We then introduce a fiscal union and examine how the introduction of the union affects the rainy day fund accumulations. We find that contributions to a rainy day fund will be lower in a fiscal union, and further that the higher the fiscal transfer, the lower will be the contributions to the rainy-day fund.

Is there an optimal size of the fiscal union in the sense of the size of the transfers involved? We find that there is. The optimal size of the fiscal union trades-off the ex-post insurance provided by the union and the moral hazard which reduces national ex-ante preparation for stabilization policies. Optimally, the insurance provided by the fiscal union should be lower (1) the more effective is own-fiscal policy; (2) the more the presence of the fiscal union reduces rainy-day fund savings; (3) the lower is the relative probability of recession; and (4) the lower is the utility gain of redistribution in the union. We also find that commitment to a transfer policy is important. A fiscal union that is prone to break the rules on transfers negatively impacts the ex-ante contributions to individual members' rainy day funds.

II. Brief Review of the Risk-Sharing Literature and Rainy Day Funds in the United States

The theoretical literature on risk-sharing owes much to the work of Persson and Tabellini (1996a and b). They study an economy characterized by uncertainty about future income in distinct regions of a federation. Simplifying the analysis, they abstract from household mobility, and investigate the trade-off between risk-sharing and moral

hazard. They analyze different sorts of fiscal constitutions and find that in certain cases centralization can mitigate moral hazard problems.

Our theoretical model follows the set-up of Persson and Tabellini in a simplified way. The simple set-up allows us to draw clear policy rules concerning the optimal size of transfers and hence risk-sharing in a fiscal union, the trade-off between this cross-country risk-sharing and self-insurance, and the relationship between the size of the transfers and preferences for redistribution across the fiscal union.

There is also an empirical, mainly macroeconomic, literature on the degree to which shocks are smoothed across regions of a federation, nicely summarized in Furceri and Zdzienicka (2013). This literature includes the early contribution of Sachs and Sala-i-Martin (1991) as well as the important contribution of Asdrubali, Sorensen and Yosha (1996). Von Hagen (1998) points out that the estimates of Sachs and Sala-i-Martin combine both permanent differences between states and temporary differences due to the business cycle. The effect of transfers on the former is considered redistribution, while the effect on the latter is insurance.

The degree to which shocks are found to be smoothed across a federation differs somewhat between study and country, but results suggest significantly less than 100 percent smoothing. For instance, the initial work of Sachs and Sala-iMartin finds on the order of 40 percent for the United States; Von Hagen (1992) differentiates between permanent and temporary differences and finds close to 50 percent permanent and 10 percent temporary smoothing. Asdrubali, Sorensen and Yosha (1996) find a higher estimate of 75 percent smoothing. They also quantify certain mechanisms of smoothing (the results of which also differ between studies), and this particular study of the United

States finds 13 percent of the shock is smoothed by the tax-transfer system, 39 percent by capital markets, and 23 percent by credit markets.

There is also a literature on smoothing of shocks across (rather than within) countries and this literature finds somewhat less smoothing than within a federation. For instance, Sorenson and Yosha (1998) and Afonso and Furceri (2008) find on the order of 40 percent smoothing (through both public and private saving), with the latter finding even less among European countries after the creation of the EMU than before. This is interesting because the theoretical results presented later imply that self-insured saving in the form of contributions to a rainy day fund will be smaller in the presence of a fiscal union.

Bargain, Dolls, Fuest, Neumann, Peichl, Pestel and Siegloch (2012) use a simulation approach to model an EU-level tax and transfer system and a European fiscal equalization system. They find that these systems entail significant redistribution effects between countries, and modest and uncertain insurance effects, particularly for the fiscal equalization option. With significant redistribution effects and modest insurance effects, the authors are not sanguine about the political appeal of either option.

Numerical simulation is also used by Evers (2015) who examines decentralized fiscal systems as opposed to a centralized fiscal union within a monetary union. He finds that the centralized fiscal union is superior but does not consider optimal regional fiscal policy and moral hazard issues, nor the importance of commitment that I discuss below.

Economides, Philippopoulos, and Varthalitis (2016) examine a monetary union with interregional transfers in a DSGE model and compute welfare changes under alternative transfer scenarios. The main finding is that interregional transfers modeled as

insurance have practically zero impact on welfare, and when modeled as redistribution with moral hazard have a large impact on welfare. My modeling of the fiscal union is closest to their insurance modeling of transfers except I include moral hazard and I also examine the consequences of time inconsistency in the transfers which exacerbates moral hazard problems.

A set of case studies of fiscal unions are examined by Bordo, Markiewicz, and Jonung (2011). They identify five conditions necessary for a fiscal union to function effectively. Among the conditions are the following: a credible commitment to a no-bailout rule, a degree of revenue and expenditure independence for the member governments reflecting their preferences, and a well-functioning system of transfers between member states. Our model incorporates these conditions and we analyze the consequences of violating the first condition as we allow the union to break its previously set commitment on transfers.

Turning to the emergence of rainy-day funds in the United States, we first note that most US States have enacted balanced budget laws. While the details and strictness of the rules can differ from state to state, these laws restrict borrowing for current expenditures. Balanced budget rules are however pro-cyclical so that during a recessionary period States may be left without the fiscal ability to combat the recession. Indeed, tax increases and expenditure cuts may be required. Perhaps as a result, all but five US states have enacted an institutional method of savings called a "rainy day fund." These funds are nevertheless a recent phenomenon; 27 states created rainy day funds between 1984 and 1997 according to Knight and Levinson (1999).

Since rainy-day funds are a creation of state law, the details differ from state to state. Some US states have a limit on the size of the rainy day fund. A typical limit is about 5% of expenditures, but some states have no limit. States also have different rules concerning deposits of funds. Some states require a budget surplus to be deposited, some use a formula, and some require a legislative appropriation; deposits are usually invested in liquid, safe, low-return assets. Likewise, states differ with respect to withdrawal rules. Some states allow withdrawals with a revenue shortfall, some use a formula, and some require an appropriation.

A few empirical studies of US state rainy day funds have been conducted. An early finding is that rainy day funds appear to increase state savings (Knight and Levinson, 1999). This may be due to the fact that the central government of the United States, as opposed to the European Union, has established a hard budget reputation over time (for instance, by refusing to bail out states and cities that could not pay back debts). More recently, there is some evidence that states still do not save enough in rainy day funds to fully absorb business cycle shocks (Zhao, 2014).

II. A Simple Model of Rainy Day Savings in Autarky

The idea of countries establishing rainy day funds, or government savings accounts, is applicable to Europe today. Given that the EU has established rules limiting deficits, such funds could in theory provide a way for countries to obey the rules, use fiscal policy, and make austerity measures during a recession moot since accumulations during good times could be used to offset revenue shortfalls during the recession.

Since fiscal policy remains primarily in the hands of national governments in the EU, we start by investigating a simple model of a rainy day fund in a single country when that country is not in a fiscal union. The country has certain income $\bar{Y}$ in period 1 and uncertain income in period 2 resulting from a business cycle shock. Of course, the consequences of the shock depend on how prepared the country is to use fiscal policy. A country can prepare by saving some of its period 1 certain income $\bar{Y}$ leaving it with Y = $\bar{Y}$ - S period 1 income. This saving constitutes a rainy-day fund, which can be used as a fiscal policy lever to combat a recession in period 2. Uncertain income in period 2 can be high, Y_H, with probability P or low, Y_L, with probability (1 – P), but the savings can mitigate the damage of the business cycle shock. Using the savings in this way as a fiscal policy tool is modeled by making P a function of S. We further assume that fiscal policy is subject to diminishing returns, that is, we assume that the first derivative of P(S) is positive, P'(S) > 0, goes to infinity as S goes to zero, P'(0) → ∞, and the second derivative is negative, P''(S) < 0. Utility in period 1 is denoted v(Y) and in period 2 is $P(S)u(Y_H) + (1-P(S))u(Y_L)$. Thus saving in the rainy day fund in period 1 which is used as fiscal policy in period 2 increases the expected income of the country in period 2. Note that the government sector is active in its use of S and the (possibly unobserved) way that S is spent matters. We do not explicitly model this political aspect except through the properties of the function P(S).

From an ex-ante viewpoint a country's optimization problem for rainy day fund savings is

$$(1) \qquad \underset{S}{\text{Max}}\; v(\bar{Y} - S) + P(S)u(Y_H) + (1 - P(S))u(Y_L)$$

The first order condition is

(2) $$\frac{\partial P}{\partial S}\left[u(Y_H) - u(Y_L)\right] = \frac{\partial v}{\partial Y}$$

The country balances the marginal benefit and cost of saving. The cost, on the right hand side, is the loss in current spending power resulting from saving. The marginal benefit on the left hand side results from the fact that increasing saving today allows for an expansionary fiscal policy should a recession occur in the uncertain future and so increases the probability of a high-income outcome and decreases the probability of a low-income outcome.

III. Introducing a Fiscal Union as set of Transfers between States

We next introduce a fiscal union to the model by allowing cross-country transfers in period 2, but national governments retain some power over fiscal policy and can save in a rainy-day fund for use in period 2 as before. Thus we allow for both self-insurance over time and for cross-country insurance in period 2. The model is most easily described by considering the case of two countries.[1] The model set-up is the same as before except that there are now two countries and cross-country transfers. Thus, each of the two countries has certain income in period 1 and uncertain income in period 2 as before. Each can be hit by a shock, the consequences of which will depend on prior rainy-day fund savings. The savings in a country's rainy-day fund can be used as a fiscal policy lever to combat a recession in period 2, increasing the ex-ante probability of a high income outcome and decreasing the ex-ante probability of a low-income outcome. The

[1] Increasing the number of countries may change things quantitatively but not qualitatively.

shocks that hit each member of the union are i.i.d. The joint possibilities for income in the union are:

i. (Y_H, Y^*_H) with probability $P(S)P(S^*)$

ii. (Y_H, Y^*_L) with probability $P(S)(1-P(S^*))$

iii. (Y_L, Y^*_H) with probability $(1-P(S))P(S^*)$

iv. (Y_L, Y^*_L) with probability $(1-P(S))(1-P(S^*))$

where the asterisk differentiates the two countries. We will however assume symmetry across the two countries to simplify.[2]

The cross-country transfers could be implemented in a number of ways. For instance, EU-wide automatic stabilizers such as an EU-level progressive income tax or common EU-level pension or unemployment policies is one type of fiscal union. We model a fiscal union in a simpler way that still captures the essence of the idea that transfers are made from countries in a boom to countries in a recession. In particular, we assume that the country that ends up in the low-income state receives a direct transfer from the country that ends up in the high-income state. We call this transfer T. Other issues with respect to the transfers, such as whether they are payable to governments or directly to citizens are also important, but we abstract from these issues here.

A first question is what happens to each country's ex-ante rainy-day fund contributions when we introduce such a fiscal union. The problem of a representative country becomes:

[2] If countries have different but independent probabilities, this should not change the qualitative nature of the results but could change the optimal pricing of insurance to each country. Of course the extreme case of one country with probability of high income of 1 and the other with probability of high income of 0 would result in no cross-country insurance.

$$
\begin{aligned}
&\underset{S}{\text{Max}}\; v(\bar{Y}-S)+ \\
&+P(S)P(S^*)u\,(Y_H\;) \\
&+P(S)(1-P(S^*)u(Y_H\;-T) \\
&+(1-P(S))P(S^*)\,u(Y_L\;+T) \\
&+(1-P(S))(1-P(S^*))\,u(Y_L\;)
\end{aligned}
\tag{2}
$$

and the first-order condition is:

$$
\frac{\partial P}{\partial S}P(S^*)\left[u(Y_H\;)-u(Y_L\;+T)\right]-\frac{\partial P}{\partial S}(1-P(S^*))\left[u(Y_L\;)-u(Y_H\;-T)\right]=\frac{\partial v}{\partial S} \tag{3}
$$

Once again saving for precautionary reasons in a rainy-day fund has a cost: the country diverts money that could be used today to an uncertain future. This cost, the fall in utility in the present is shown on the right hand side of the first order condition.

The left hand side indicates the marginal benefit of saving the rainy-day fund. This is different when a fiscal union is introduced. In fact, the marginal benefit of savings is lower in a fiscal union, so contributions to a rainy-day fund will be lower. Intuitively, as the cross-country transfer is introduced, saving in a rainy-day fund makes it more likely for a country to be a payer and less likely to be a receiver of a cross-country transfer, thus reducing the own-country marginal benefit of rainy-day savings. This is the moral hazard cost of the fiscal union if member countries retain some power over fiscal policy.

Proposition 1: Rainy-day fund savings are lower in a fiscal union than in autarky.

Proof: The proof proceeds by showing that the marginal benefits of savings in a fiscal union are less than the savings in autarky; since marginal costs are the same, savings will be lower. To see this, rewrite the left-hand side of (3) as

$$(4) \quad \frac{\partial P}{\partial S}\left[Pu(Y_H\ ) + (1-P)u(Y_H\ - T)\right] - \frac{\partial P}{\partial S}\left[Pu(Y_L\ ) + (1-P)u(Y_L\ + T)\right]$$

Recall that the marginal benefit of savings in autarky is

$$(5) \qquad \frac{\partial P}{\partial S}u(Y_H\ ) - \frac{\partial P}{\partial S}u(Y_L)$$

We assume that the transfer does not make income in the high income state lower than in the low income state. Since utility is concave in income the first bracketed term in (4) is less than the first term of (5) and the second bracketed term of (4) is greater than the second term of (5). Hence the positive term of (4) is smaller and the negative term of (4) is bigger so (4) must be smaller than (5).

This is not quite the end of the story however since there are two players in our simple characterization of the fiscal union and we need to think about the Nash equilibrium in this game. But given the assumed symmetry between the members of the union, each will have identical reaction functions as defined implicitly by (3). It is not too difficult to show that the reaction functions are downward sloping, that a Nash equilibrium exists, and (given symmetry) that the level of savings of each member will be identical. Each member of the union will save less than they would in autarky in equilibrium.

Moreover, the savings level will depend on the size of the transfer T.

Proposition 2: The greater is the transfer T in the fiscal union the smaller will be the level of rainy-day fund savings.

Proof: As the transfer T rises, the first bracketed term of the marginal benefit of savings given by (4) falls and the second (negative) bracketed term rises. Thus the marginal benefit of savings falls leading to a lower contribution to the rainy-day fund.

To summarize, a fiscal union leads to lower contributions to a country's rainy-day fund. The larger is the transfer the lower will be members' contributions to their own rainy-day funds. Moving to the Nash equilibrium, each country's reaction function is lower when transfers rise, so the Nash equilibrium level of savings is lower as well.

IV. What is the Optimal Degree of Transfer in a Fiscal Union?

As we have seen, own-country savings will be lower in a fiscal union due to a moral hazard cost. Consequently each member will be less equipped to use their own fiscal policy in times of recession. Yet the fiscal union also has a benefit, namely that members of the union insure each other ex-post if their own fiscal policies are inadequate. As there are benefits and costs, the question naturally arises as to the optimal size of cross-country transfers among members of the union when each member also retains some fiscal power.

To answer this question we consider the size of transfer that maximizes the union members' well-being. This amounts to choosing the transfer size to maximize the sum of utilities across the union, taking into account the effect of the transfer size on savings. The problem is:

$$
\begin{aligned}
&\underset{T}{\text{Max}}\; v(\bar{Y} - S(T)) + v(\bar{Y}^* - S^*(T)) \\
&+ P(S(T))P(S^*(T))u\,(Y_H\;) \\
&+ P(S(T))(1-P(S^*(T))u(Y_H\; - T\;) \\
&+ (1-P(S(T)))P(S^*(T))\,u(Y_L\; + T\;) \\
&+ (1-P(S(T)))(1-P(S^*(T)))\,u(Y_L\;) \\
&+ P(S(T))P(S^*(T))u\,(Y^*_H\;) \\
&+ P(S(T))(1-P(S^*(T))u(Y^*_L\; + T\;) \\
&+ (1-P(S(T)))P(S^*(T))\,u(Y^*_H\; - T\;) \\
&+ (1-P(S(T)))(1-P(S^*(T)))\,u(Y^*_L\;)
\end{aligned}
\tag{6}
$$

where S(T) = S*(T) are the Nash equilibrium saving levels and the FOC for T is:

$$
\begin{aligned}
&P(1-P^*)\frac{\partial u(Y_H - T)}{\partial T} = (1-P^*)P\,\frac{\partial u(Y^*_L + T)}{\partial T} \\
&+ (1-P)P^*\frac{\partial u(Y_L + T)}{\partial T} - P^*(1-P)\,\frac{\partial u(Y^*_H - T)}{\partial T} \\
&+ \left[u(Y_H - T\;) + u(Y^*_L + T\;)\right]\left[\frac{\partial P}{\partial S}\frac{\partial S}{\partial T}(1-P^*) - \frac{\partial P^*}{\partial S^*}\frac{\partial S^*}{\partial T}P\right] \\
&+ \left[u(Y^*_H - T\;) + u(Y_L + T\;)\right]\left[\frac{\partial P^*}{\partial S^*}\frac{\partial S^*}{\partial T^*}(1-P) - \frac{\partial P}{\partial S}\frac{\partial S}{\partial T}P^*\right] \\
&+ \left[u(Y_H) + u(Y^*_H)\right]\left[\frac{\partial P}{\partial S}\frac{\partial S}{\partial T}P^* + \frac{\partial P^*}{\partial S^*}\frac{\partial S^*}{\partial T}P\right] \\
&- \left[u(Y_L) + u(Y^*_L)\right]\left[\frac{\partial P}{\partial S}\frac{\partial S}{\partial T}(1-P^*) + \frac{\partial P^*}{\partial S^*}\frac{\partial S^*}{\partial T}(1-P)\right] \\
&+ \left[\frac{\partial v}{\partial S}\frac{\partial S}{\partial T} + \frac{\partial v}{\partial S^*}\frac{\partial S^*}{\partial T}\right]
\end{aligned}
$$

We can simplify by using (i) the assumed symmetry and (ii) the envelope theorem, which implies that fiscal union members will pick a savings level that satisfies the reaction function (3). The first order condition for T then simplifies to:

$$(7)\quad \frac{\partial u(Y_H - T)}{\partial T} = \frac{\partial u(Y_L + T)}{\partial T} + \left[\frac{\partial P}{\partial S}\frac{\partial S}{\partial T}\right]\left[P\{u(Y_H) - u(Y_H - T)\} + (1-P)\{u(Y_L + T) - u(Y_L)\}\right]$$

$$= \frac{\partial u(Y_L + T)}{\partial T} + \left[\{(1-P)(u(Y_L + T) - u(Y_L)\}\frac{\partial P}{\partial S}\frac{\partial S}{\partial T}\right]\left[\left(\frac{P}{1-P}\right)\left(\frac{u(Y_H) - u(Y_H - T)}{u(Y_L + T) - u(Y_L)}\right) + 1\right]$$

From this first-order condition, we can deduce the following propositions:

Proposition 3: The optimal cross-country transfer T in the fiscal union will be less than the transfer that equalizes the marginal utility of income.

Proof: The proof is simply to show that the second term on the right hand side is negative. To prove that the second term is negative simply note that all terms are positive except $\partial S/\partial T$, which is negative by Proposition 2. Hence the second term is negative, and this implies that the marginal utility income for the low-income state inclusive of the transfer is greater than it otherwise would be. This can only be the case if T is smaller than it otherwise would be.

Proposition 4: The optimal cross-country transfer T in the fiscal union will be greater

(i) the smaller is $\partial P/\partial S$,

(ii) the smaller is $\left|\partial S/\partial T\right|$,

(iii) the smaller is P/(1-P),

(iv) and the smaller is $[U(Y_H) - U(Y_H - T)]/[U(Y_L + T) - U(Y_L)]$.

Proof: The optimal transfer is greater the smaller is the second term of the first order condition. Inspection of the first order condition indicates that smaller values of each of

the above factors implies a smaller second term and hence a larger transfer.

This proposition deserves some elaboration. The first factor is the degree to which savings is effective in combatting a recession. The smaller is the internal impact of fiscal policy, the more need there is for outside transfers, and hence the greater is the optimal transfer. While not explicitly modeled, there is an additional moral hazard issue that could arise at this point. In addition to the effect of cross-country transfers on savings, there is some incentive for each member country to use the savings in a less effective way and so reduce the effect of S on P.

The second factor is the impact of the transfer on savings in the rainy day fund. If the reduction in savings due to the moral hazard effect of cross-country transfers is small, cross-country transfers should be larger, ceteris paribus. If on the other hand the effect of the transfer on contributions to the rainy day fund is large, the transfers have a large moral hazard cost and the optimal transfer is smaller.

The third and fourth factors relate to relative expected utility of a transfer. These can be interpreted as an insurance factor and a redistributive factor. The third factor is the inverse of the relative probability of a recession. If the relative odds of a recession in the future are higher, optimal transfers are higher in order to insure against a greater risk.

The fourth factor is the difference in utility before and after the transfer for the country in a high income position relative to the difference before and after the transfer for the country in a low income position. Given that utility is concave, the gain to the country that is in a lower income position after the shock is greater than the loss to the country that is in a higher income position so that the ratio is less than one. The relative gain depends on the degree of concavity, that is, the third derivative of the utility

function. The larger is the relative utility gain to the country in a low income position after the shock, the smaller will be this term and the greater will be the optimal cross-country fiscal transfer. Another way of saying this is that the greater is the value of redistribution between members of the union after the shock, the greater is the transfer.

V. Breaking the rules: The problem and consequence of time-inconsistency in a fiscal union

One of the difficulties with implementing cross-country transfers in a fiscal union is that the union might feel compelled to break the rules of its own transfer policies after the fact. As discussed above, optimal transfers will be lower the greater is the perceived impact of a transfer on ex-ante contributions to a rainy-day fund. This immediately raises a time consistency issue. The union is effectively committing ex-ante to a policy to treat unequally – meaning less than full insurance - countries that enter a recession in order to encourage more savings in a rainy day fund. But would the union have the will-power to stick to its ex-ante policy or would it bend the rules and rescue a member state? This may depend on a number of factors including the political clout of the particular member and the severity of the recession. Nevertheless, it is worth investigating the consequences of a possible break in the rules.

Suppose the union is not able to keep its commitment, for political or other reasons. What might it do?

Suppose that we continue to assume that the central government's objective function is the sum of countries' utilities, but we consider the problem from an ex-post

perspective, after the recession has occurred. Ex-post, the central government chooses transfers to maximize

$$\text{(12)} \qquad \underset{T}{\text{Max}}\, u(Y_H - T) + u(Y^*_L + T)$$

The first order conditions are:

$$\text{(13)} \qquad \frac{\partial u(Y_H - T)}{\partial T} = \frac{\partial u^*(Y^*_L + T)}{\partial T}$$

Ex-post, the central government's optimal policy is not to implement second-best transfers; rather, it will want to equate the marginal utility across countries, which implies that it wants to equalize incomes ex-post. Ex-post optimal transfers are thus

$$\text{(14)} \qquad T = \frac{Y_H - Y^*_L}{2}$$

If a member state believes that the ex-post transfer will follow (14) instead of (7), it will lower its rainy day fund savings. In fact, members' rainy day fund savings will be the minimum possible.

Proposition 5: Breaking the rules and following the ex-post optimum implies that rainy-day fund savings will be minimized.

Proof: The proof is straight-forward. Assuming that the transfer does not make income in the high income state lower than in the low income state, the transfer in (14) is at its maximum value. From Proposition 2, a higher transfer lowers savings. Since the transfer is at its maximum value, savings must be at its minimum value.

VI. Conclusion

In this paper we have analyzed the role of rainy-day funds and cross-country transfers in a fiscal union. We find first that as long as member countries retain some fiscal policy control, contributions to a rainy day fund will be lower in a fiscal union, and further that the higher the cross-country fiscal transfer, the lower will be the contributions to the rainy-day fund. We also investigate the optimal amount of cross-country transfers that should take place. The optimal size of the fiscal union trades-off the ex-post insurance provided by the union and the moral hazard which reduces national ex-ante preparation for stabilization policies.

As long as member countries retain some fiscal policy control, we find that the optimal size of cross-country transfers in the fiscal union depends on a number of factors, and, in a model of asymmetric countries, could differ between members of the union. In particular, member countries for which (1) own-fiscal policy is more effective should have smaller transfers; (2) savings is highly influenced by moral hazard due to the presence of the transfers should have lower transfers; (3) recession is a higher probability event should, other things equal, obtain more transfers. We also find that (4) when redistribution yields a lower utility gain in the union, cross-country transfers should optimally be lower.

Finally, a worrisome factor is that a union that is prone to break the ex-ante rules on fiscal transfers, even optimal ones, will lead to additional moral hazard problems and negatively affect individual member countries' contributions to their rainy day funds. Thus, the design of fiscal transfers needs to be based on ex-ante criteria that are both time consistent and not easily manipulated by member countries.

The model that we propose to analyze rainy day funds and transfers in a fiscal union is extremely simple. The advantage of this is that it allows us to derive simple and sensible rules with respect to the design of transfers in a fiscal union. Of course the approach can be extended to consider a number of complicating factors. We conclude by briefly listing a few of that may be interesting to investigate.

A first path would be to investigate the effect of different country sizes on the optimal transfer design. Given the findings in the tax competition literature with respect to size, this path may prove interesting. Second, we mentioned earlier the distinction between temporary and permanent effects brought up by von Hagen (1992). This suggests that investigating the case of asymmetry in incomes might be useful. We have also ignored spillover effects, which provides a third promising avenue to investigate. Fourth, we earlier mentioned the investigation by Bargain, Dolls, Fuest, Neumann, Peichl, Pestel and Siegloch (2012) which simulates a fiscal union of direct transfers versus one of a union-level tax. An investigation of different fiscal methods of constructing a fiscal union may also provide additional insights.

All of these possible extensions are worthy of investigation. We hope that the simple model that we have analyzed stimulates additional research on this topic.

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