The euro area crisis: need for a supranational fiscal risk sharing mechanism?[ϒ]

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Abstract

The aim of this paper is to assess the effectiveness of risk sharing mechanisms in the euro area and whether a supranational fiscal risk sharing mechanism could insure countries against very severe downturns. Using an unbalanced panel of 15 euro area countries over the period 1979-2010, the results of the paper show that: (i) the effectiveness of risk sharing mechanisms in the euro area is significantly lower than in existing federations (such as the U.S. and Germany) and (ii) it falls sharply in severe downturns just when it is needed most; (iii) a supranational fiscal stabilization mechanism, financed by a relatively small contribution, would be able to fully insure euro area countries against very severe, persistent and unanticipated downturns.

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1. Introduction

The euro area, with its centralized monetary policy and decentralized fiscal policy, constitutes a unique case in the history of monetary unions (Bordo et al. 2011). The pros and cons of this arrangement have been widely discussed among economists and policy makers, but the recent financial crisis has added a new impetus to this debate.

This particular set-up and the institutions designed to guarantee fiscal stability (the Maastricht Treaty and the Stability and Growth Pact) have functioned well during normal times, but proved to be inadequate during the *Great Recession*. Indeed, the current sovereign debt crisis has revealed underlying weaknesses of the European arrangement and its fiscal institutions. In order to address these weaknesses, most European leaders signed in March 2012 the "fiscal compact" treaty. However, while the treaty is designed to improve the credibility of fiscal rules and ensure fiscal sustainability, no institutional actions have been taken so far to create a centralized fiscal mechanism to face severe idiosyncratic and common shocks.

The stability of a monetary union depends on the capacity to deal with idiosyncratic shocks affecting its member countries in the absence of independent monetary policy. Furthermore, wage and price rigidities and limited labor mobility across countries, whether due to legal constraints like the immobility of pension benefits, or cultural factors, like language differences, also reduce the ability of a country to adjust to idiosyncratic shocks. In this context, the existence of risk sharing mechanisms for achieving income insurance and consumption smoothing is essential. While this role could be played by cross-border ownership of assets and liabilities and intra European credit, as illustrated by Farhi and Werning (2012), market-based insurance tends to be suboptimal in currency unions as private

agents do not internalize the macroeconomic stabilization effects of the portfolio choices. In addition, the recent financial crisis has shown that shocks hitting a member country's economy are quickly transmitted through the international financial system, and that credit markets tend to freeze up during downturns and, in some cases, contribute to amplify these shocks. The recent experience with recessions has also shown that domestic fiscal policy cannot fully offset output shocks.[1] In addition, counter-cyclical expansionary measures may have significant and long-lasting adverse effects on public debt sustainability (Reinhart and Rogoff, 2009; Furceri and Zdzienicka, 2013), which would, as shown by the recent events in the euro area, threaten the stability of the entire monetary union.

Risk sharing mechanisms among the residents of different regions/countries exposed to idiosyncratic shocks received considerable interest in the start-up phase of the European Monetary Union (EMU) (Commission of the EC, 1977, 1979). Some research has analyzed the role of fiscal frameworks for risk sharing through the budget of the central regional government or through explicit mechanisms of fiscal equalization (e.g., Atkeson and Bayoumi, 1993; Wildasin, 1996; Persson and Tabellini, 1996a,b; Bucovetsky, 1998; Lockwood, 1999; Boadway, 2004). For instance, in their seminal paper, Asdrubali et al. (1996) find that in the United States, 75 percent of shocks to per capita gross state product is smoothed by: (i) federal tax-transfer and grant system (13 percent); (ii) capital markets (39

[1] See Baldacci et al. (2009), Baldacci and Kumar (2010), Hutchison et al. (2010), Furceri and Zdzienicka (2012) for recent work on the effect of fiscal policy in periods of recession.

percent); and (iii) credit markets (23 percent).[2] These results for the U.S. are broadly confirmed by Melitz and Zumer (1999, 2002) and Athanasoulis and van Wincoop (2001).

The effectiveness of risk sharing mechanisms has also been investigated for several other countries. Bayoumi and Klein (1997), using trade-balance data, find a high degree of risk sharing among Canadian provinces. In a similar vein, Crucini (1999) finds substantial risk sharing among Canadian provinces and U.S. states. Melitz and Zumer (1999, 2002) analyze regional data for the U.K. and Italy, and find that the degree of risk sharing provided by capital markets is similar to the U.S., while risk sharing operating through the public sector and credit markets is almost null. For Germany, Hepp and von Hagen (2013) find that in the pre-unification period 91 percent of shocks to per capita state gross product is smoothed by: (i) federal tax-transfer and grant system (54 percent); (ii) factor income flows (20 percent); and (iii) credit markets (17 percent). For the post-unification period, they find that the relative importance of smoothing channels has changed, with factor income flows becoming the most important channel and contributing to about 51 percent of total income smoothing.

Some studies have extended the analysis to international risk sharing mechanisms. Sorensen and Yosha (1998), analyzing income and consumption smoothing patterns among European and among OECD countries, find that only 40 percent of GDP shocks is smoothed, with 50 percent of the smoothing achieved by government saving and 50 percent by private saving. Similarly, Afonso and Furceri (2008), analyzing a panel of 25 European countries, find that only 43 percent of shocks to GDP is smoothed (almost uniquely by private and

[2] The fact that the remaining 25 percent is not smoothed is consistent with related empirical evidence on consumption smoothing showing less than full risk sharing. See, for example, Cochrane (1991), Crucini (1999), French and Poterba (1991), and Canova and Ravn (1996).

public saving) and this share has decreased to 37 percent after the creation of the EMU, suggesting that euro area members have not benefited from additional risk-sharing. The authors also find that the relative importance of the smoothing channels has changed, with factor income flows providing about one-third of total smoothing and saving two-thirds.

Overall, the empirical evidence presented in these studies shows that the effectiveness of risk sharing mechanisms at the international level is lower than at the interregional level, and a significant part of the difference is explained by the absence of a supranational fiscal risk sharing mechanism.

While these studies have typically focused on the effectiveness of risk sharing mechanisms to smooth *normal* business cycle fluctuations, to the best of our knowledge, there is no empirical research[3] testing the ability of these mechanisms in periods when they are most needed, i.e. recessions.

The first contribution of the paper is to extend the empirical approach proposed by Asdrubali et al. (1996) to analyze whether the effectiveness of risk sharing mechanisms is different in periods of recession versus normal times. For this purpose, the paper considers downturns identified by financial crises episodes and peak-to-trough changes in GDP.

Using an unbalanced panel of 15 euro area countries, the results show that the amount of unsmoothed shocks in periods of recession is significantly larger than during normal times, and the increased inability to smooth output shocks is driven by the lack of consumption smoothing provided by private saving via the credit channel. This is consistent with the fact that, in the event of a large shock, citizens and the government of a country

[3] Arreaza et al. (1998) focus on periods of positive versus negative output gaps, rather than periods of significant output contractions.

would need larger amounts of credit which may not be able to obtain. This is particularly true for severe downturns that are persistent and unanticipated. The results also show that while the percentage of unsmoothed shock is larger for symmetric downturns, very severe asymmetric downturns could also lead to a decrease in credit market smoothing and an increase in the cross-sectional average of unsmoothed shocks.

These results have an important implication for the euro zone, since, in the absence of alternative risk sharing mechanisms, the lack of fiscal space associated with current weak fiscal positions (high debts and deficits) could limit the ability of automatic stabilizers to provide insurance against shocks. In this context, a supranational fiscal risk sharing mechanism at the euro area level may provide greater international insurance through a stabilization fund. Thus, two important questions remain: (i) could a centralized fiscal transfer mechanism provide significant risk sharing?; and (ii) what would be the required contribution of each country to the stabilization fund to achieve significant risk sharing as, for example, in the United States and Germany?

The second contribution of the paper is to try to answer the above questions. In particular, after having reviewed the characteristics that an ideal stabilization mechanism should have, the contribution of this mechanism in providing insurance against shocks is simulated. The results show that a centralized transfer mechanism, based on non-regressive temporary transfers and automatic rules, could significantly increase income and consumption smoothing. In particular, a supranational fiscal stabilization mechanism, financed by a gross contribution of 1½ -2½ percent of GNP, could provide significant stabilization on a par with the fiscal risk sharing observed in Germany and other federally organized countries. In addition, a gross (net) contribution, equivalent to about 4½ (1½)

percent of countries' GNP, would be able to fully insure euro area countries against very severe, persistent and unanticipated downturns.

The rest of the paper is organized as follows. The next section describes the data and the empirical methodology used to investigate the effectiveness of risk sharing mechanisms in the euro area, particularly during periods of recession, and presents the results. Section 3 analyzes the properties and the effectiveness of a supranational fiscal stabilization mechanism. Further issues, such as the effect of high spreads and the size of the EMU on the effectiveness of risk sharing mechanisms, are discussed in Section 4. Section 5 concludes summarizing the main findings.

2. Risk sharing in the euro area

2.1 Empirical methodology

The effectiveness of risk sharing mechanisms in the euro area is estimated applying the approach proposed by Asdrubali et al. (1996) for a panel of 15 countries (Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovak Republic, Slovenia and Spain) over the period 1979-2010.

The approach consists in disaggregating Gross Domestic Product (GDP) into different national aggregates: Gross National Product (GNP), Net National Income (NI), Disposable National Income (DNI), and the sum of Government Consumption and Private Consumption (G+C).[4] In particular:

GDP-GNP =*international income transfers (factor income flows),*

GNP-NI = *capital depreciation,*

[4] Data for income variables are taken from the OECD National Accounts database (2012).

NI-DNI = *net international taxes and transfers*,

DNI-(C+G) = *total saving*.

Using these identities, the following chain equation can be considered:

$$GDP_i = \frac{GDP_i}{GNP_i}\frac{GNP_i}{NI_i}\frac{NI_i}{DNI_i}\frac{DNI_i}{(C+G)_i}(C+G)_i \quad (1)$$

GDP shocks propagate through the economic system and affect the other income variables in the identity, unless they are smoothed by some counter-cyclical factor. Full stabilization is obtained if only GDP varies while consumption remains unchanged. In particular, smoothing is provided by capital markets, through the international net transfers of income factors, if after the shock, GDP changes while GNP remains constant. Successively, if GNP varies and NI remains unchanged capital depreciation acts as a smoothing factor. If NI is modified and DNI stays constant smoothing takes place via net transfers from abroad. If DNI moves while C+G remains unchanged, stabilization is obtained by credit markets through private and public saving. Finally, if total consumption also co-moves with GDP, a share of the shock remains unsmoothed.

In principle, all these factors (except capital depreciation) may provide smoothing. The first factor is the international transfers of income earned by foreign entities in each country. Risk sharing through this channel consists in income insurance through an internationally diversified portfolio, and can be interpreted as *ex ante* insurance. The second channel is capital depreciation, usually calculated as a constant proportion of the total amount of capital. Since the capital-to-output ratio is typically counter-cyclical, depreciation constitutes a larger fraction of output in recessions than in booms. This results in a higher cross-sectional variance of NI with respect to GNP. The third factor is the system of net taxes and transfers to/from a supranational government. This channel can be interpreted as *ex ante*

insurance mechanism. In the case of the euro area this incorporates insurance provided by transfers via the EC budget, such as the structural funds. Finally, the fourth channel represents consumption smoothing through saving behavior, which is determined by inter-temporal considerations, and represents the ability of credit markets to smooth consumption relative to income *ex post*.

To measure the contribution of each factor in smoothing shocks to GDP, Asdrubali et al. (1996) derive the following system of independent equations[5]:

$$\Delta \log GDP_{i,t} - \Delta \log GNP_{i,t} = \alpha_t^m + \beta^m \Delta logGDP_{i,t} + \varepsilon_{i,t}^m \quad (2)$$

$$\Delta \log GNP_{i,t} - \Delta \log NI_{i,t} = \alpha_t^d + \beta^d \Delta logGDP_{i,t} + \varepsilon_{i,t}^d \quad (3)$$

$$\Delta \log NI_{i,t} - \Delta \log DNI_{i,t} = \alpha_t^g + \beta^g \Delta logGDP_{i,t} + \varepsilon_{i,t}^g \quad (4)$$

$$\Delta \log DNI_{i,t} - \Delta \log(DNI + G)_{i,t} = \alpha_t^p + \beta^p \Delta logGDP_{i,t} + \varepsilon_{i,t}^p \quad (5.1)$$

$$\Delta \log(DNI + G)_{i,t} - \Delta \log(C + G)_{i,t} = \alpha_t^s + \beta^s \Delta logGDP_{i,t} + \varepsilon_{i,t}^s \quad (5.2)$$

$$\Delta \log(C + G)_{i,t} = \alpha_t^u + \beta^u \Delta logGDP_{i,t} + \varepsilon_{i,t}^u \quad (6)$$

where the α_t are time fixed effects. β measures the incremental percentage of smoothing achieved by each channel of the GDP decomposition. In particular, β^m indicates the percentage of shock smoothed by capital markets, β^d represents smoothing provided by capital depreciation, β^g indicates smoothing from net transfers, and $\beta^p$and β^s the percentages of shock smoothed by the credit market via private and public saving, respectively.[6] If β^u=0 then full stabilization is achieved, if not, a part of a shock remains

[5] See Asdrubali et al. (1996) for details.

[6]The validity of the interpretations of the β coefficients provided by Asdrubali et al. (1996) has been questioned in the literature. In particular, Melitz and Zumer (1999) argue that the interpretation may not necessarily hold for three main reasons. First, changes in interregional (international) consumption may be driven by changes in intertemporal preferences rather than output. Second, the Miller-Modigliani theorem of the irrelevance of

(continued)

unsmoothed. Additionally, since no constraints are imposed on each β coefficient, it could be the case that some of these factors could amplify the shock ($\beta > 1$), or dis-smooth it ($\beta < 0$). By construction, $\sum \beta = 1$.

To assess the effectiveness of these risk sharing mechanisms during periods of recession, and compare it with normal times, equations (2)-(6) have been extended as follows:

$$\Delta \log GDP_{i,t} - \Delta \log GNP_{i,t} = \alpha_t^m + \beta^m(1 - D_{i,t})\Delta logGDP_{i,t} + \delta^m D_{i,t}\Delta logGDP_{i,t} + \gamma^m D_{i,t} + \varepsilon_{i,t}^m \quad (7)$$

$$\Delta \log GNP_{i,t} - \Delta \log NI_{i,t} = \alpha_t^d + \beta^d\left(1 - D_{i,t}\right)\Delta logGDP_{i,t} + \delta^d D_{i,t}\Delta logGDP_{i,t} + \gamma {D_{i,t}}^d + \varepsilon_{i,t}^d \quad (8)$$

$$\Delta \log NI_{i,t} - \Delta \log DNI_{i,t} = \alpha_t^g + \beta^g\left(1 - D_{i,t}\right)\Delta logGDP_{i,t} + \delta^g D_{i,t}\Delta logGDP_{i,t} + \gamma^g D_{i,t} + \varepsilon_{i,t}^g \quad (9)$$

$$\Delta \log DNI_{i,t} - \Delta \log(DNI + G)_{i,t} = \alpha_t^p + \beta^p\left(1 - D_{i,t}\right)\Delta logGDP_{i,t} + \delta^p D_{i,t}\Delta logGDP_{i,t} + \gamma^p D_{i,t} + \varepsilon_{i,t}^p \quad (10.1)$$

$$\Delta \log(DNI + G)_{i,t} - \Delta \log(C + G)_{i,t} = \alpha_t^s + \beta^s\left(1 - D_{i,t}\right)\Delta logGDP_{i,t} + \delta^s D_{i,t}\Delta logGDP_{i,t} + \gamma^s D_{i,t} + \varepsilon_{i,t}^s \quad (10.2)$$

$$\Delta \log(C + G)_{i,t} = \alpha_t^u + \beta^u(1 - D_{i,t})\Delta logGDP_{i,t} + \delta^u D_{i,t}\Delta logGDP_{i,t} + \gamma^u D_{i,t} + \varepsilon_{i,t}^u \quad (11)$$

where D is a dummy variable that takes value one for the occurrence of a downturn and zero otherwise. Downturns are alternatively identified using financial crises (banking, currency and debt crises occurrence - taken from Laeven and Valencia, 2008 and 2010), and by peak-to-trough changes in GDP (applying the approach proposed by Harding and Pagan (2002) to quarterly GDP data). Following this approach, 52 downturns with a median magnitude of 2 percent have been identified (Figure A1 in Annex I).[7]

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dividend policy may apply, and higher corporate saving may induce households to consume more, with β^m and β^smoving in the opposite directions. Third, and perhaps more important, as national account statistics do not measure gains and losses on net foreign assets, β^m accounts only for income flows. While, these arguments suggest that the amount of risk-sharing provided by the capital and credit channels should be interpreted with caution, the main focus of the paper is on the total amount of risk-sharing and on the role of supranational stabilization mechanism operating via international transfers.

[7] Harding and Pagan (2002) find that the average magnitude of the downturns is 2.5 percent for the United Kingdom and the United States, and 2.2 percent for Australia.

Equations (2-11) are estimated using OLS with panel-correlated standards errors (PCSE).[8] As argued by Beck and Katz (1995, 1996), this procedure is better placed to deal with the nature of our data (such as a small N compared to T; panel-specific heteroskedasticity and serial correlation).[9]

2.2 Results

Normal times

Table 1 presents the estimated percentage of shocks to GDP smoothed through each of the channels in the GDP chain decomposition. Looking at the table, it is immediately apparent that a large amount of shocks to GDP (about 66 percent) is not smoothed in the euro area. In particular, factor income flows and international transfers have a negligible effect on income smoothing, as they absorb about 8 and 4 percent of GDP shocks, respectively. Capital depreciation provides dis-smoothing (around 8 percent), and the only operative risk sharing channel is consumption smoothing (about 31 percent). Differentiating between public and private saving, it is possible to notice that the latter is the one providing the largest amount of smoothing (around 22 percent). The results are in line with those obtained by Afonso and Furceri (2008) for a panel of EMU countries over the period 1980-2005.[10]

As a robustness check, equations (2)-(6) are estimated using different approaches: (i) OLS with time trends; (ii) OLS with time and country specific effects; (iii) GLS to control

[8] The PCSE parameters used in the analysis are: (i) an AR1 autocorrelation structure; and (ii) panel-level heteroskedastic errors.

[9] See Hepp and von Hagen (2013) for a similar approach and a more detailed discussion.

[10] Differentiating between different public saving components, Afonso and Furceri (2008) find that the largest amount of risk sharing is provided by social benefits.

for serial autocorrelation within panels; (iv) 2-step GLS, to control for autocorrelation within panels and heteroskedasticity across panels; (v) system-GMM and (vi) IV approach[11], to control for possible endogeneity. Overall, the results obtained with these alternative techniques are qualitatively similar to those obtained in the baseline.

In order to assess whether the ability of risk sharing mechanisms to smooth income fluctuations has changed over time, equations (2)-(6) have been estimated using 20-year rolling windows over the period 1979-2010.[12] The results obtained with this exercise (Figure 1) suggest that, despite an increase in the amount of shock smoothed via international factor income flows (confirming evidence of an increasing capital market integration in the euro area, Lane and Milesi-Ferretti, 2008), the amount of shocks to GDP that remains unsmoothed has increased from about 58 percent in the period 1979-1999 to about 66 percent in the period 1990-2010. This change has been mostly driven by a decline in consumption smoothing, from 42 percent in the period 1979-1999 to about 30 percent in the period 1990-2010.[13] Differentiating between public and private saving, it is possible to notice that the decrease in consumption smoothing is ultimately the result of a lower private consumption smoothing (Figure 2). While, the fact that public consumption smoothing has remained broadly stable may suggest that the Maastricht Treaty and Stability and Growth Pact deficit requirements have not impaired the ability of automatic stabilizers to provide income

[11] Two lags of real GDP growth have been used as instruments.

[12] In detail, equations (2)-(6) have been re-estimated over the following time samples: i) 1979-1999; ii) 1980-2000; iii) 1981-2001; iv) 1982-2002; v) 1983-2003; vi) 1984-2004; vii) 1985-2005; viii) 1986-2006; ix)1987-2007; x) 1988-2008; xi) 1989-2009; and xii) 1990-2010.

[13] The amount of smoothing provided by credit markets has decreased even further after the creation of the EMU (see Table 1, Appendix 1).

smoothing[14], the decrease in private credit smoothing after the creation of the EMU reflects the fact that credit flows have became less counter-cyclical.[15]

Finally, differences in income and consumption smoothing patterns are analyzed across different sets of countries (euro area countries; EU-OECD countries; OECD countries) and compared with those for the United States and Germany (Table 3). While there are no significant differences across country-groups, the results for euro area countries differ sharply from those for the U.S. and Germany.[16] In particular, two striking differences emerge from this comparison. First, the amount of smoothing provided by capital markets is significantly larger across states than across countries (consistent with the "home-bias" puzzle, as documented by French and Poterba (1991) and Tesar and Werner (1995)). Second, while the insurance provided by the EU budget is very negligible, both in the U.S. and in Germany at least 10 percent of shocks to GDP is smoothed via this channel. In contrast, consumption smoothing has been larger in euro area countries, even though the difference is not statistically significant. As a result, while almost 70 percent of shocks to GDP is not smoothed in euro area countries, the share of unsmoothed shocks is only about 25 percent for the U.S. and 20 percent for Germany.[17]

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[14] See, for example, Gali and Perotti (2003) and IMF (2004) for an analysis of the effects of the Maastricht Treaty and Stability and Growth Pact on the effectiveness of automatic stabilizers.

[15] Such a decline in the use of credit market for risk sharing purposes may have arisen from the fall in saving and in the underpricing of risks by markets that characterized the first decade of EMU, in a context of over-optimistic growth expectations.

[16]It is important to highlight the methodological differences between interregional and international risk sharing channels: (i) country-level data are richer than U.S. and Germany state-level data; (ii) capital market smoothing in the U.S. and Germany includes factor income flows and capital depreciation.

[17]The results obtained over shorter but more comparable sample periods, and using the two-step GLS estimates in the comparison with the U.S. (as in Asdrubali et al., 1996), provide similar conclusions (Table A2 in the Appendix 1).

Financial crises and downturns

Table 4 reports the estimates of income and consumption smoothing during normal times (column I) and in periods of financial crisis (column II). The Wald Chi-square statistics of the difference of the estimated coefficients is reported in column III. Looking at the table, it is possible to observe that a lower credit market smoothing (both for private and public saving) occurs in periods of crisis compared to normal times. This finding is not surprising, as credit markets typically collapse during financial crises (Reinhart and Rogoff, 2008). As a result, the amount of shock to GDP that remains unsmoothed is statistically significantly larger during financial crises than in normal times. In addition to the peculiar effect of financial crises on the role of credit markets in providing smoothing, we also find similar results for episodes of downturns (columns IV-VI of Table 4), and episodes of downturns occurring in periods of non-financial crisis (columns VII-IX of Table 4).

Severe downturns

The fact the amount of shock smoothed by the credit market is lower in periods of downturns is consistent with the fact that in the event of a large shock citizens and the government of a country would need larger amounts of credit which may not be able to obtain. This would also imply that the share of shock to GDP smoothed by the credit market would decrease with the size of the shock. To test for this hypothesis, the analysis is replicated for severe and very severe downturns, identified as those shocks with a magnitude corresponding to the top third quartile and fifth percentile of the distribution, respectively. The results presented in Table 5 confirm this hypothesis. In particular, the share of shocks smoothed by credit markets decreases from 35 percent during normal times to 17 percent in the case of severe downturns, and to 11 percent in the case of very severe downturns. Differentiating between

public and private saving, it seems that the fall in credit market smoothing mostly occurs for the private sector. This is also consistent with the idea that private agents are typically more credit constrained than governments. As a result, the amount of unsmoothed shock increases from 62 percent during normal times to 78 percent in periods of severe downturns, and to 88 percent in periods of very severe downturns.

Transitory versus persistent downturns

Another important distinction is whether downturns are transitory or persistent. In fact, while capital markets may, in principle, provide insurance against transitory and persistent shocks, credit markets typically smooth only transitory shocks, since lenders in other countries may be reluctant to grant credit to countries that are hit by shocks that are expected to be long-lasting. Further, shocks that are persistent are also typically larger, therefore requiring a larger amount of credit which may not be available. To test for this hypothesis, we have re-estimated equations (7)-(11) by considering persistent shocks - identified as those severe downturns with a duration corresponding to the top third quartile of the distribution -, and transitory shocks - as all other severe downturns. By focusing only on severe downturns, we are able to partly control for the magnitude of the downturn. The results presented in Table 6 confirm that the share of shocks smoothed by credit markets significantly decreases in the case of persistent shocks, resulting in a larger amount of unsmoothed shocks.

Anticipated versus unanticipated downturns

Another important distinction is whether downturns are anticipated or not. If shocks are anticipated, citizens and government may have more time to insure themselves in the credit market. Therefore, one could expect that the amount of unsmoothed shocks would increase more for unanticipated downturns than for anticipated ones (Del Negro, 1998). To test for

this hypothesis, we have re-estimated equations (7)-(11) by differentiating between anticipated and unanticipated severe downturns. For this purpose, the change in GDP during periods of severe downturns is decomposed into a predictable and unpredictable part, using the lag of the OECD's composite leading indicator (CLI) as a predictor.[18] Equations (7)-(11) are estimated using the fitted values (anticipated part) and the residuals (unanticipated part) of this regression. The results presented in Table 7 confirm the hypothesis that credit markets are better placed to smooth anticipated shocks than unanticipated ones. In particular, while the reduction in the share of shock smoothed by credit markets (from 35 percent to 16 percent) is statistically significant in the case of unanticipated shocks, it is small and not statistically significant in the case of anticipated severe downturns. As a result, the amount of shock that remains unsmoothed increases from 62 percent during normal times to more than 78 percent in the event of unanticipated downturns.

Symmetric versus asymmetric severe downturns

In a monetary union, the effectiveness of risk sharing mechanisms is particularly relevant in the case of asymmetric shocks. At the same time, one would also expect that that a larger amount of shock would remain unsmoothed in the event of symmetric shocks. The results presented in Table 8 confirm this hypothesis,[19] but also show that very severe asymmetric

[18] The CLI is a real-time measure with a proven track record of predicting changes in economic activity, especially turning points, several months in advance. Regressing the change in GDP in periods of downturn against the lag of CLI, we find:

$$\Delta log GDP_{i,t}{}^{D} = \underset{(-14.01)}{-15.6} + \underset{(13.93)}{0.154} * CLI$$

where *t*-statistics are in parenthesis, and R^2 is 0.2.

[19] Similar results are obtained by identifying symmetric severe downturns using quarterly data for euro area aggregate GDP.

downturns can also lead to a reduction in credit market smoothing and to an increase in the share of shock that remains unsmoothed.

The Great Recession

An interesting question is whether the evidence based on past episodes can shed some light on the risk sharing observed during the "Great Recession". To answer this question, we have re-estimated equations (2)-(6) over the period 2008-10. Indeed, the results of this exercise (Figure 3) suggest that "this time is not different", as the share of unsmoothed shocks during the most recent recession (76 percent) is similar to previous episodes of severe downturns (78 percent).[20]

Summarizing, the results presented in this section suggest that: (i) risk sharing mechanisms in the euro area are not able to provide a level of insurance against normal business cycle fluctuations comparable to the one in the United States and Germany; (ii) market-based risk sharing mechanisms are ineffective when they are most needed (i.e. severe downturns), suggesting that further integration in European capital markets, despite enhancing market-based insurance in normal times, it is likely to have limited risk sharing effects during periods of severe downturns. In addition, the results obtained for non-financial downturns may suggest that even if financial mechanisms for banking crisis prevention and resolution may reinforce the role of credit in providing risk sharing in times of financial stress, non-financial severe downturns are likely to remain largely unsmoothed. In light of

[20] The results have to be interpreted with caution given the relatively small number of observations (45).

these findings, and given limited labor mobility across euro area countries[21], it will then be crucial to identify alternative risk sharing mechanisms that could insure countries against severe downturns. The next section analyzes one of these possible mechanisms, such as a supranational fiscal risk sharing mechanism.

3. Risk sharing with a supranational fiscal stabilization mechanism

3.1 Empirical methodology

This section presents a supranational fiscal stabilization mechanism to insure countries against income shocks. We set up a thought experiment in which the fund collects taxes as a share of the GNP of each member state and pay transfers to countries negatively hit by output shocks.[22] Each time a euro area member is hit by a negative shock, it receives a transfer proportional to the size of the shock, the relative size of its economy, and the resources available in the stabilization fund. If no member experiences a negative shock, the contributions are saved in the fund. A mechanism based on smoothing cyclical fluctuations of the GDP of the member states has the characteristic of being close to the fiscal mechanisms in the existing federal states, where part of the contribution of each member is proportional to its GNP.[23]

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[21] Using the same methodology described in Asdrubali et al. (1996), we find that labor market mobility among euro area countries smoothes only around 3 percent of GDP per capita fluctuations.

[22] We use GNP, rather than GDP, as a scaling measure of income to control for consumption smoothing that occurs through international capital markets.

[23] Alternative mechanisms proposed in the literature tie payments to national unemployment. While this approach has the main advantage of being close to the existing national social programs, a mechanism based on unemployment benefits could be pro-cyclical instead of counter-cyclical due to delays in the response of unemployment to output shocks. In addition, a system based on unemployment shocks would provide only partial insurance as it only focuses on one production factor. Moreover, given the wide variation in long-term unemployment levels across the EMU, the focus should be restricted to short-term unemployment which is

(continued)

Following Hammond and Von Hagen (1995), it is possible to put forward certain optimal features of a stabilization mechanism:

- *The mechanism should be simple and automatic*.[24] While simplicity appeals to obtain a more widespread knowledge among citizens and a greater automaticity, it would also reduce strategic behaviors.
- *Contributions to the stabilization fund and transfers should be non-regressive.* The contribution to the stabilization fund and the size of transfers should not decrease as per capita income gets smaller.
- *Transfers should be temporary*. They should only be used in order to provide insurance against temporary shocks or, when permanent, should be used only temporarily. A country in recession should act itself.
- *Transfers should be a function of serially uncorrelated shocks*. Tying payments to serially uncorrelated shocks reduces the risk that transfers can be manipulated by member countries, therefore reducing moral hazard problems.
- *The scheme should be able to offset a large part of the shock.* If not, the implementation costs of the mechanism could overcome the benefits.

Even if these characteristics can serve as practical guidelines in the set-up of a stabilization mechanism, they cannot be satisfied simultaneously. For example, a mechanism based on serially uncorrelated shocks with zero conditional expectation requires econometric techniques that may prevent widespread knowledge among citizens, threatening its viability.

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likely to generate only limited risk sharing (Asdrubali et al. 1996). In fact, providing insurance against long-term unemployment would generate redistribution effects from low-unemployment level countries to high-unemployment countries (Wolf, 2012).

[24] The literature on public finance has long emphasized that transfers and tax system should be simple to be accepted by the general public (Buchanan and Flowers, 1987).

Conversely, simpler techniques to identify shocks and transfers could lead to moral hazard problems and generate *redistributive* instead of stabilizing effects. Thus, a sort of trade-off should be considered.

In the empirical analysis, a transfer mechanism to smooth income shocks that is *non-regressive* and *automatic* is considered. In detail, the designed scheme collects taxes as a share of the GNP of each member state:

$$Stabilization\_budget_t = \sum_i \tau * GNP_{it-1} \tag{12}$$

where "τ " is *gross* contribution rate; and pays transfers to the countries negatively hit by shocks:

$$T_{it} = 0 \qquad if \qquad \epsilon_{it} \geq 0 \tag{13}$$

$$T_{it} = |\epsilon_{it}| * \frac{DNI_{it-1}}{\sum_i DNI_{it-1}} * \sum_i \tau * GNP_{it-1} \qquad if \qquad \epsilon_{it} < 0 \tag{14}$$

where ϵ_{it} are the shocks for the country "*i*" at time "*t*".[25] The transfers are a function of three factors: (i) the size of the shock; (ii) the size of the stabilization fund; and (iii) the relative size of the economy.[26]

Given that we are interested in the stabilization properties of a supranational fiscal mechanism that pays temporary transfers, the analysis will mostly focus on shocks (ϵ_{it}) that are serially uncorrelated. These shocks are derived from the following simple regression model, estimated country-by-country:[27]

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[25] If the required amount of current year transfers exceeds the current year's contributions to the fund, transfers are drawn out of the funds saved from previous years. When there are no saved funds, only a part of the shock can be smoothed.

[26] The size of the country is measured in terms of DNI as this income variable is the one affected by the net international transfers.

[27] A similar income process has been used by Campbell and Mankiw (1987), Asdrubali et al. (1996) and Melitz and Zumer (1999) to estimate the persistence of income shocks.

$$\Delta logGDP_{i,t} = \alpha_i + \sum_{j=1}^{2} \beta_j \Delta logGDP_{i,t-j} + \epsilon_{it} \quad (15)$$

For comparative purposes, two additional measures of shocks are also considered: (i) the output gap;[28] and (ii) growth deviations from historical averages. The main advantage of shocks based on these two measures is that they can be easily implemented, and understood by the general public. In addition, output gaps have the advantage to be already widely used (for example, to estimate cyclically-adjusted structural balances) and to have zero average over a long period.[29]At the same time, however, these measures have major drawbacks as they may lead to moral hazard problems - as they tend to be serially correlated - and generate redistributive effects. Moreover, output gap measures are subject to frequent revisions, which may require ex-post adjustments to the magnitude of transfers made to countries experiencing negative income shocks.

Finally, the ability of this mechanism to provide insurance against shocks is obtained by adjusting the disposable national income for the transfers generated by the mechanism (DNI^*) and estimating the following regression:

$$\Delta \log NI_{i,t} - \Delta \log DNI^*_{i,t} = \alpha^g_t + \beta^g \Delta logGDP_{i,t} + \varepsilon^g_{i,t} \quad (16)$$

3.2 Results

This section focuses on determining the required gross contribution (τ) to achieve a given level of stabilization against normal fluctuations and severe downturns. We begin our analysis considering a full stabilization target, i.e. zero unsmoothed shocks. The results of

[28] Data for output gap are taken from the OECD Economic Outlook (2012).

[29] Output gaps are typically constructed using two-sided filters.

this exercise are reported in Table 10, which includes the estimated amount of income smoothing provided by the stabilization fund, and the associated gross contribution, in normal times (column I) and in periods of severe downturns (columns II-VI).[30] Looking at the table, it is evident that a supranational fiscal risk sharing mechanism financed by a relatively small contribution would be able to provide full insurance. In particular, the required gross contribution ranges from 3.3 percent of GNP in normal times, to 4.5 percent in periods of very severe downturns. A gross contribution equivalent to 4.5 percent would also be sufficient to insure countries against persistent and unanticipated severe downturns (columns IV-VI).

A considerably smaller gross contribution would be required to achieve less ambitious stabilization targets. In particular, the contribution required to achieve a level of stabilization of 20 (25) percent, close to the one in Germany (the U.S.) ranges from 2.2 (2.0) percent in normal times to 3.4 (3.2) percent in periods of very severe downturns (columns I and II, Table 11). While the contribution to the stabilization fund may seem low compared to the size of the central government in existing federations (which is on average near 30 percent of GDP), it has to be kept in mind that this mechanism is uniquely designed for stabilization purposes across countries. As such, it is not directly comparable with the size of the central budget of existing federations, which also covers provision of public services to the sub-national levels.

The required gross contribution remains small for serially correlated shocks identified as deviations of output from potential, and deviations of growth from historical average. In

[30] As a simplifying assumption, we assume that the amount of consumption smoothing remains unchanged when the stabilization fund is operative. This corresponds to the implicit assumption that total consumption growth adjusts proportionally to changes in DNI growth.

particular, the required gross contribution to achieve full stabilization in periods of severe downturns is 2.9 percent for output gap-based shocks and 2.2 percent for growth deviation-based shocks (columns III-VI, Table 11).

The transfers generated by the mechanism vary across countries (Table 12), with larger transfers received by the more volatile economies (typically the smallest).[31] In particular, in the case of serially uncorrelated shocks, the average size of transfers over the period 1979-2010 ranges from 1.5 percent of GNP in the case of France to 2.9 percent of GNP for Greece and Finland.[32] While the ranking of countries in terms of size of transfers remains broadly similar for output gap and growth deviation-based shocks, the average size is typically smaller.

Assuming that extra budgetary savings of the stabilization fund are not invested, the results reported in Table 11 and Table 12 suggest that the average net contribution to fully insure economies against serially uncorrelated shocks is similar to the size of the current EU budget (around 1.3 percent).[33] In addition, over the simulation period, all euro area members would have benefited at some point, showing that risk sharing of this type does not entail redistributive transfers from one part of the euro area to another.

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[31] Furceri and Karras (2007).

[32] The relatively large size of transfers for Finland is driven by the occurrence of the very severe financial crisis in the 90s. The average size of transfers would have been larger over the post-EMU period (see Table A3 in Appendix 1), as mostly of the symmetric severe downturns have occurred in this period (e.g. in 2002 and 2009). In addition, the periphery countries would have contributed relatively more until 2007 than the core countries—as they were growing faster—but would have also received larger net transfers during the Great Recession.

[33] A similar number is also found by applying different transfer mechanisms. For example, a contribution equivalent to 1.9 percent of GNP would be sufficient to fully finance transfers payments to absorb serially uncorrelated shocks on total consumptions (see Annex II for details).

Summarizing, the results suggest that a supranational fiscal risk sharing mechanism like the one investigated in the paper[34], funded by a relatively small contribution would be able to provide full insurance against very severe, persistent and unanticipated downturns. However, it is important to remark that the analysis has also an irresolvable weakness as it is subject the *Lucas' Critique*. The implementation of the stabilization mechanism could alter the structure of the economic system, undermining the robustness for our results. While there is uncertainty about the structural impact (while a supranational stabilization mechanism could lead to moral hazard and reduce incentives to conduct counter-cyclical fiscal policy at the national level, it could also boost confidence and increase the effectiveness of market-based insurance mechanisms), we believe that this analysis presents important implications for the design of the institutional policy framework in the euro area.

4. Further issues

This section analyzes two further issues that have been often discussed in the policy debate: (i) the role of high spreads in reducing the effectiveness of risk sharing mechanisms; (ii) whether the ability of risk sharing mechanism in the euro area depends on the size of the EMU.

Spreads and risk sharing. To examine the impact of high spreads on the effectiveness of risk sharing mechanisms, equations (7)-(11) have been re-estimated by replacing the downturns dummy with the ten-year sovereign yield spread to the U.S. Treasury bonds. The results suggest that the amount of unsmoothed shocks increases with the magnitude of the

[34] See, for example, Melitz and Vori (1992), Italianer and Vanheukelen (1992), Hammond and von Hagen (1998) for different types of insurance mechanisms.

spreads, with credit market being less effective in smoothing shocks. In particular, we find that an increase of 100 basis points in the ten-year sovereign yield spread reduces the share of smoothed shocks by about 5 percent.[35]

Stabilization fund and the size of EMU. An interesting question is whether the required contribution to achieve stabilization is a function of the number of countries participating to the mechanism. To address this issue, we have estimated the required gross contribution rate for alternative different EMU aggregates (EMU14, EMU13, etc). The results, not shown here for brevity, suggest that the required contribution decreases with the number of countries participating to the fund, irrespective of the country excluded from the selection. This is also the case when excluding those countries which would have received the largest transfers (Greece and Finland in Table 12). For example, the contribution required to achieve full stabilization against normal fluctuations would increase from 3.3 percent in the case of EMU15 to about 4.0 percent in the case of an EMU14, excluding Greece.[36]

5. Concluding remarks

Several interesting findings emerge from this analysis. First, the effectiveness of risk sharing mechanisms in the euro area is significantly lower than in existing federations, such as the U.S. and Germany. In particular, while almost 70 percent of GDP fluctuations are not smoothed in euro area countries, the share of unsmoothed fluctuations is only about 25 percent for the U.S. and 20 percent for Germany. Second, risk sharing mechanisms are typically ineffective when they are most needed. In particular, the amount of unsmoothed

[35] The full set of results is available upon request.

[36] The full set of results is available upon request.

shocks in periods of recession is significantly larger than during normal times, and the increased inability to smooth output shocks is driven by the lack of consumption smoothing provided by private saving via the credit channel. This is particularly true for severe downturns that are persistent and unanticipated. Third, a supranational fiscal risk sharing mechanism, based on non-regressive transfers and automatic rules, could significantly increase income and consumption smoothing. In particular, a supranational fiscal stabilization mechanism, financed by a gross contribution of 1½ -2½ percent of GNP, could provide significant stabilization on a par with the fiscal risk sharing seen in Germany and other federally organized countries. In addition, a gross (net) contribution, equivalent to 4½ (1½) percent of countries' GNP, would be able to fully insure euro area countries against very severe, persistent and unanticipated downturns.

While these results highlight the need for a supranational stabilization fund to provide insurance against shocks in the euro area, it is important to remark that the analysis has also an irresolvable weakness as it is subject the *Lucas' Critique*. The implementation of the stabilization mechanism could alter the structure of the economic system, undermining the robustness of our results. In addition, the results abstract from possible moral hazard and commitment problems that may limit the desirability of this insurance mechanism. While there is uncertainty about the structural impact and the possible costs associated with moral hazard problems (while a supranational stabilization mechanism could lead to moral hazard and reduce incentives to conduct counter-cyclical fiscal policy at the national level, it could also boost confidence and increase the effectiveness of market-based insurance mechanisms, particularly in times of stress), we view the analysis presented in the paper as contributing to a greater understanding of possible benefits associated with further fiscal integration.

Finally, it is important to acknowledge that the effectiveness of further fiscal integration, and its political acceptance, depends on its specific design. Deeper integration would provide insurance for euro area members against country-specific adverse income shocks, and thereby help to prevent negative spillovers to the membership at large. Although this means that countries that are doing well support those that are experiencing negative income shocks, it does not mean that the same countries are always net recipients. This observation does not minimize the political difficulties associated with putting in place such a risk sharing mechanism at the current juncture.

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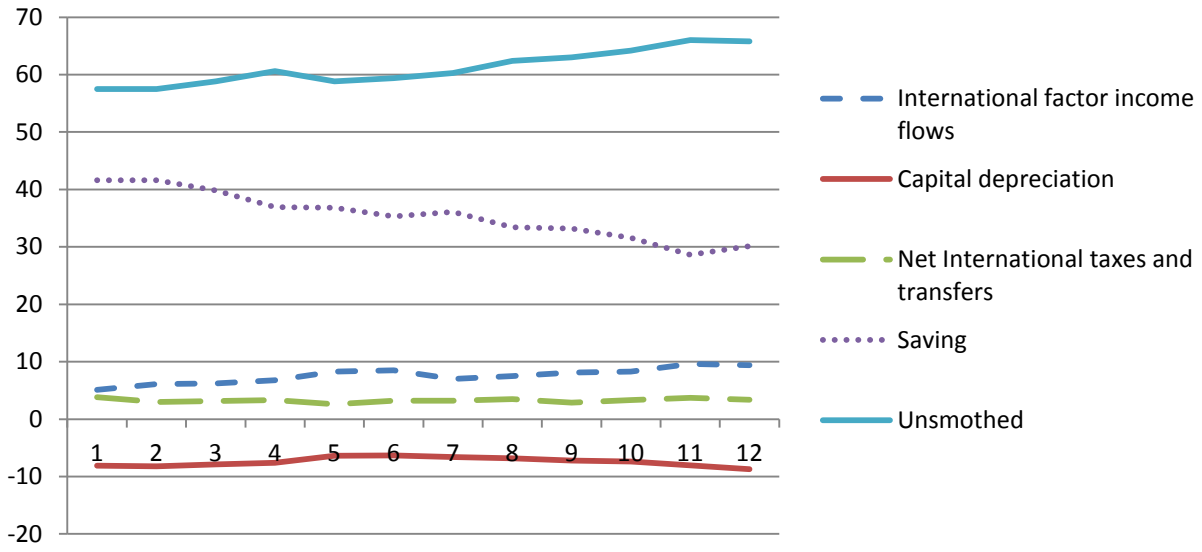
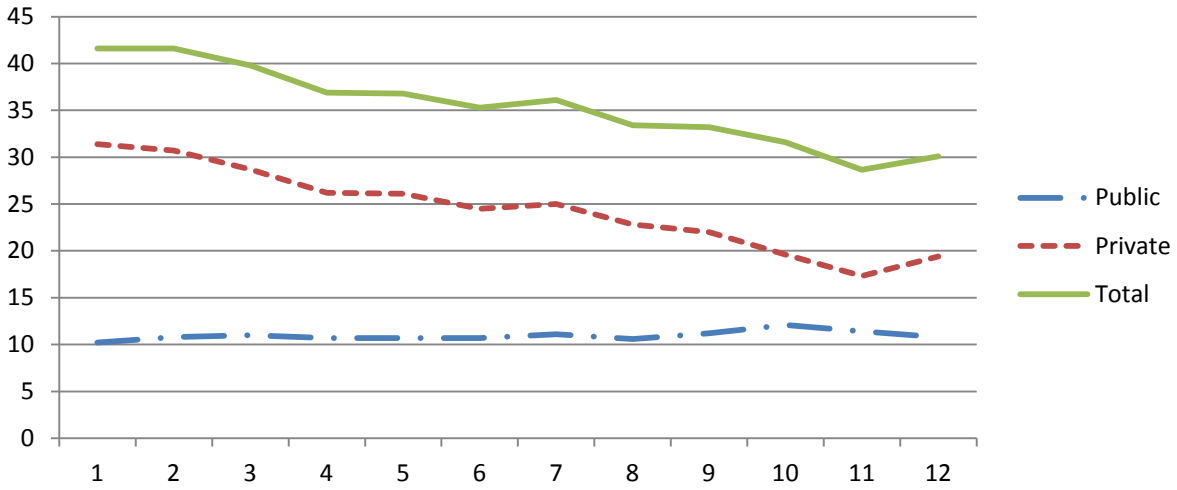
Figure 1: Channels of output smoothing over time



Note: t=1 corresponds to the period 1979-1999; t=2 corresponds to the period 1980-2000, etc..

Figure 2: Channels of consumption smoothing over time



Note: t=1 corresponds to the period 1979-1999; t=2 corresponds to the period 1980-2000, etc..

Figure 3. Risk sharing during the great recession

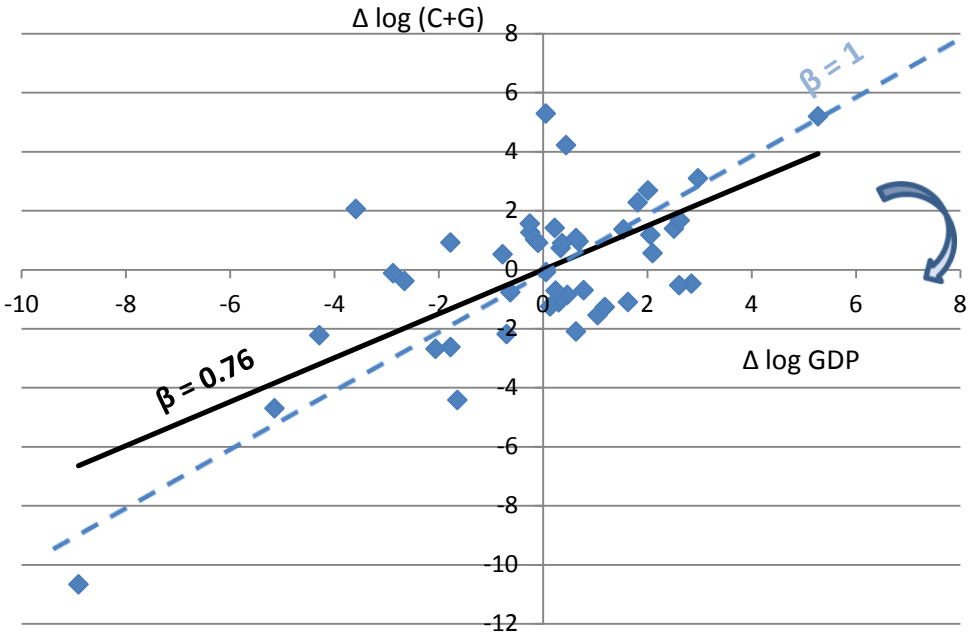


Table 1. Baseline: Channels of output smoothing (OLS with PCSE)

	Coefficient (z-stat)	N	R^2
International factor income flows	0.076** (2.21)	376	0.107
Capital depreciation	-0.084*** (-6.13)	376	0.387
Net international taxes and transfers	0.039*** (3.35)	376	0.140
Saving	0.310*** (5.40)	376	0.512
Public	0.092*** (4.25)	376	0.450
Private	0.218*** (4.48)	376	0.417
Unsmoothed	0.658*** (12.18)	376	0.644

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis.

Table 2. Alternative Techniques: Channels of output smoothing

	(I) Baseline	(II) OLS & time trends	(III) Country & time-FE	(IV) AR (1)	(V) 2-step GLS	(VI) GMM	(VII) IV
International factor income flows	0.076** (2.21)	0.041* (1.63)	0.065 (1.26)	0.032* (1.76)	0.033** (2.49)	0.041* (1.83)	-0.012 (-0.33)
Capital depreciation	-0.084*** (-6.13)	-0.102*** (-8.92)	-0.092*** (-4.31)	-0.114*** (-12.70)	-0.115*** (-13.44)	-0.133*** (-16.52)	-0.069*** (-3.81)
Net international taxes and transfers	0.039*** (3.35)	0.023** (2.45)	0.049*** (3.22)	0.021*** (2.68)	0.003 (0.58)	0.020** (2.10)	0.072*** (4.16)
Saving	0.310*** (5.40)	0.452*** (8.09)	0.351** (2.65)	0.509*** (12.89)	0.512*** (13.26)	0.601*** (16.32)	0.187** (2.22)
Public	0.092*** (4.25)	0.158*** (9.25)	0.096*** (3.08)	0.171*** (11.66)	0.183*** (13.66)	0.205*** (15.28)	0.059* (1.87)
Private	0.218*** (4.48)	0.294*** (6.29)	0.255* (1.82)	0.334*** (10.75)	0.355*** (11.45)	0.385*** (12.72)	0.128** (1.99)
Unsmoothed	0.658*** (12.18)	0.586*** (12.63)	0.627*** (7.28)	0.552*** (17.68)	0.539*** (18.10)	0.586*** (176.64)	0.823*** (12.16)

***, **, * denotes significance at 1%, 5%, 10%, respectively. The number of observation is 376.

Table 3. Channels of output smoothing across countries

	(I)	(II)	(III)	(IV)	(V)	(VI)
	Euro area 1979-2010	**EU 1979-2010**	**OECD 1979-2010**	**US [a] 1963-1990**	**Germany [b] 1970-1994**	**Germany [b] 1995-2006**
Factor income flows [c]	0.076** (2.21)	0.062** (2.16)	0.006 (0.22)	0.390*** (13.00)	0.195** (2.87)	0.505*** (6.82)
Capital depreciation	-0.084*** (-6.13)	-0.110*** (-8.73)	-0.097*** (-6.34)			
Net taxes and transfers [d]	0.039*** (3.35)	0.035*** (3.56)	0.026*** (5.22)	0.130*** (13.00)	0.541*** (5.15)	0.114 (1.58)
Saving	0.310*** (5.40)	0.322*** (6.36)	0.329*** (6.13)	0.230*** (3.83)	0.173** (2.14)	0.175*** (3.13)
Public	0.092*** (4.25)	0.108*** (6.16)	0.085*** (5.59)			
Private	0.218*** (4.48)	0.214*** (5.09)	0.244*** (5.55)			
Unsmoothed	0.658*** (12.18)	0.691*** (15.36)	0.736*** (17.23)	0.250*** (4.17)	0.085** (2.02)	0.208*** (3.014)

***, **, *denotes significance at 1%, 5%, 10%, respectively. [a] refers to estimates reported in Table 1 of Asdrubali et al. (1996) obtained with two-step GLS; [b] refers to estimates reported in Table 5 (column I) of Hepp and von Hagen (2013); [c] international income flows for EU, OECD and euro area, while domestic income flows for the U.S. and Germany; [d] international net taxes and transfers for EU, OECD and euro area, while federal government taxes and transfers for the U.S. and Germany.

Table 4.Channels of output smoothing: normal times vs. crises / downturns

	Normal vs. crises			Normal vs. downturns			Normal vs. non-financial downturns		
	(I) Normal	(II) Financial Crises	**(III) (I)=(II) [a]**	**(IV) Normal**	**(V) Downturns**	**(VI) (IV)=(V)[a]**	**(VII) Normal**	**(VIII) Downturns**	**(IX) (IV)=(V)[a]**
International factor income flows	0.013	-0.065	1.36	0.085**	0.048	0.33	0.090**	0.071	0.08
	(0.49)	(-1.06)	(0.24)	(2.14)	(0.79)	(0.57)	(2.23)	(1.06)	(0.77)
Capital depreciation	-0.094***	-0.123**	0.31	-0.085***	-0.096***	0.15	-0.083***	-0.086***	0.01
	(-6.39)	(-2.29)	(0.58)	(-5.52)	(-3.82)	(0.70)	(-5.08)	(-3.00)	(0.93)
Net international taxes and transfers	0.026***	0.020	0.15	0.040***	0.028	0.31	0.038***	0.031	0.09
	(5.22)	(1.19)	(0.69)	(3.03)	(1.36)	(0.58)	(2.83)	(1.34)	(0.77)
Saving	0.349***	0.146	1.52	0.308***	0.239***	0.40	0.271***	0.107	2.41
	(6.47)	(0.89)	(0.22)	(4.68)	(2.46)	(0.53)	(4.26)	(1.10)	(0.12)
Public	0.088***	0.058	0.33	0.099***	0.083*	0.13	0.087***	0.033	1.22
	(5.83)	(1.12)	(0.57)	(4.19)	(1.94)	(0.72)	(3.75)	(0.71)	(0.27)
Private	0.261***	0.088	1.77	0.208***	0.156*	0.34	0.184***	0.074	1.42
	(5.87)	(0.68)	(0.18)	(3.77)	(1.92)	(0.56)	(3.32)	(0.85)	(0.23)
Unsmoothed	0.705***	1.023***	5.97***	0.652***	0.781***	2.06	0.683***	0.876***	5.61**
	(16.45)	(8.01)	(0.01)	(10.77)	(9.67)	(0.15)	(12.34)	(11.36)	(0.02)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

[a] Chi-square statistics, p-value reported in parenthesis.

Table 5. Channels of output smoothing: normal times vs. severe and very severe downturns

	Normal vs. severe downturns			Normal vs. very severe downturns		
	(I)	(II)	(III)	(IV)	(V)	(VI)
	Normal	Severe downturns	(I)=(II) [a]	Normal	Very severe downturns	(IV)=(V)[a]
International factor income flows	0.072*	0.092	0.08	0.078**	0.067	0.02
	(1.89)	(1.47)	(0.78)	(2.01)	(0.85)	(0.90)
Capital depreciation	-0.081***	-0.093**	0.19	-0.083***	-0.107***	0.44
	(-5.31)	(-3.88)	(0.67)	(-5.41)	(-3.32)	(0.51)
Net international taxes and transfers	0.037***	0.047**	0.24	0.035***	0.050**	0.49
	(2.91)	(2.42)	(0.62)	(2.72)	(2.36)	(0.48)
Saving	0.350***	0.174*	3.09*	0.331***	0.111	3.24*
	(5.57)	(1.94)	(0.08)	(5.28)	(1.00)	(0.07)
Public	0.099***	0.068	0.39	0.100***	0.075*	0.19
	(4.20)	(1.55)	(0.53)	(4.21)	(1.43)	(0.67)
Private	0.251***	0.106	3.31*	0.232***	0.036	3.52*
	(4.71)	(1.46)	(0.07)	(4.43)	(0.37)	(0.06)
Unsmoothed	0.622***	0.780***	3.25*	0.639***	0.878***	5.70**
	(10.55)	(9.81)	(0.07)	(11.02)	(9.41)	(0.02)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

[a] Chi-square statistics, p-value reported in parenthesis.

Table 6. Channels of output smoothing: normal vs. persistent and temporary downturns

	(I)	(II)	(III)	(IV)	(V)
	Normal	Persistent	Temporary	(I)=(II) [a]	(I)=(III) [a]
International factor income flows	0.073*	0.072	0.137	0.00	0.74
	(1.90)	(0.92)	(1.88)	(0.99)	(0.39)
Capital depreciation	-0.081***	-0.105***	-0.064	0.48	0.16
	(-5.26)	(-3.33)	(-1.56)	(0.49)	(0.69)
Net international taxes and transfers	0.037***	0.051**	0.039	0.34	0.01
	(2.90)	(2.32)	(1.28)	(0.56)	(0.93)
Saving	0.353***	0.119	0.308**	3.60**	0.13
	(5.65)	(1.06)	(2.45)	(0.05)	(0.72)
Public	0.098***	0.073	0.057	0.18	0.60
	(4.15)	(1.35)	(1.07)	(0.67)	(0.44)
Private	0.255***	0.046	0.251**	4.08**	0.00
	(4.84)	(0.47)	(2.38)	(0.04)	(0.97)
Unsmoothed	0.617***	0.863***	0.579***	6.00***	0.11
	(10.55)	(9.30)	(5.07)	(0.01)	(0.74)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

[a] Chi-square statistics, p-value reported in parenthesis.

Table 7. Channels of output smoothing: normal vs. anticipated and unanticipated downturns

	(I)	(II)	(III)	(IV)	(V)
	Normal	**Unanticipated**	**Anticipated**	**(I)=(II) [a]**	**(I)=(III) [a]**
International factor income flows	0.075*	0.091	0.106	0.05	0.02
	(1.85)	(1.39)	(0.55)	(0.82)	(0.88)
Capital depreciation	-0.075***	-0.078***	-0.233***	0.02	5.05**
	(-4.92)	(-3.19)	(-3.55)	(0.90)	(0.02)
Net international taxes and transfers	0.037***	0.041**	0.113	0.05	1.26
	(2.98)	(2.11)	(1.69)	(0.83)	(0.93)
Saving	0.348***	0.164*	0.282	3.19*	0.04
	(5.31)	(1.68)	(0.93)	(0.07)	(0.84)
Public	0.095***	0.066*	0.080	0.52	0.01
	(4.34)	(1.79)	(0.67)	(0.47)	(0.90)
Private	0.253***	0.098	0.202	3.66**	0.03
	(4.60)	(1.28)	(0.74)	(0.05)	(0.86)
Unsmoothed	0.616***	0.782***	0.731***	3.46*	0.20
	(10.48)	(9.20)	(2.98)	(0.06)	(0.66)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

[a] Chi-square statistics, p-value reported in parenthesis.

Table 8. Channels of output smoothing: normal vs. symmetric and asymmetric severe downturns

	(I)	(II)	(III)	(IV)	(V)
	Normal	**Symmetric**	**Asymmetric**	**(I)=(II) [a]**	**(I)=(III) [a]**
International factor income flows	0.072*	0.081	0.123	0.02	0.21
	(1.86)	(1.20)	(1.14)	(0.90)	(0.64)
Capital depreciation	-0.084***	-0.092***	-0.097**	0.10	0.08
	(-5.45)	(-3.56)	(-2.13)	(0.76)	(0.78)
Net international taxes and transfers	0.037***	0.062***	0.004	0.24	0.24
	(3.00)	(2.77)	(0.14)	(0.62)	(0.62)
Saving	0.352***	0.166*	0.203	3.41*	0.66
	(5.53)	(1.80)	(1.15)	(0.06)	(0.42)
Public	0.099***	0.073	0.053	0.24	0.36
	(4.28)	(1.45)	(0.76)	(0.63)	(0.55)
Private	0.253***	0.092	0.150	3.86**	0.46
	(4.71)	(1.23)	(1.01)	(0.05)	(0.50)
Unsmoothed	0.622***	0.784***	0.767***	2.94*	0.87
	(10.44)	(9.11)	(5.02)	(0.09)	(0.35)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

[a] Chi-square statistics, p-value reported in parenthesis.

Table 9. Channels of output smoothing: normal vs. symmetric and asymmetric very severe downturns

	(I)	(II)	(III)	(IV)	(V)
	Normal	**Symmetric**	**Asymmetric**	**(I)=(II) [a]**	**(I)=(III) [a]**
International factor income flows	0.072*	0.064	0.208	0.01	0.54
	(1.88)	(0.65)	(1.12)	(0.94)	(0.46)
Capital depreciation	-0.079***	-0.099**	-0.048	0.23	0.18
	(-5.24)	(-2.47)	(-0.66)	(0.64)	(0.67)
Net international taxes and transfers	0.035***	0.067***	-0.020	1.44	1.71
	(2.78)	(2.72)	(-0.47)	(0.23)	(0.19)
Saving	0.327***	-0.034	-0.216	5.52***	4.68**
	(5.45)	(-0.26)	(-0.86)	(0.01)	(0.03)
Public	0.091***	0.067	-0.107	0.11	2.76*
	(4.13)	(1.02)	(-0.93)	(0.74)	(0.10)
Private	0.236***	-0.102	-0.108	7.36***	2.67*
	(4.52)	(-0.85)	(-0.50)	(0.00)	(0.10)
Unsmoothed	0.610***	0.829***	1.055***	3.70**	5.85**
	(9.87)	(8.07)	(5.33)	(0.05)	(0.02)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

[a] Chi-square statistics, p-value reported in parenthesis.

Table 10. Stabilization fund: normal times vs. severe downturns

	(I)	(II)	(III)	(IV)	(V)	(VI)
	Normal	**Severe downturns**	**Very Severe**	**Severe & Persistent**	**Severe & Unanticipated**	**Severe & Symmetric**
τ	3.3	4.0	4.5	4.5	4.0	4.1
Unsmoothed *after* stabilization fund	0	0	0	0	0	0
Unsmoothed *before* stabilization fund	0.658***	0.780***	0.878***	0.863***	0.782***	0.784***
	(12.18)	(7.91)	(9.41)	(9.63)	(9.20)	(9.11)
Net international taxes and transfers	0.696***	0.828***	0.927***	0.921***	0.829***	0.847***
	(3.16)	(3.15)	(3.15)	(3.14)	(3.14)	(3.15)

***, **, * denotes significance at 1%, 5%, 10%, respectively. z-statistics in parenthesis. The number of observation in each estimated equation is 376.

Table 11. Required τ for different targets.

	(I)	(II)	(III)	(IV)	(V)	(VI)
	Uncorrelated shocks		**Output gaps**		**Growth deviations**	
Unsmoothed	**Normal**	**Severe downturns**	**Normal**	**Severe downturns**	**Normal**	**Severe downturns**
0 percent (full stabilization)	3.3	4.5	2.7	3.8	2.1	2.9
20 percent (e.g. Germany)	2.2	3.4	1.9	2.9	1.4	2.2
25 percent (e.g. the U.S.)	2.0	3.2	1.7	2.7	1.3	2.0

Table 12. Average transfers in the case of full stabilization, 1979-2010 (%of country's GNP)

	Uncorrelated shocks	**Output gaps**	**Growth deviations**
Austria	1.7	0.4	1.1
Belgium	1.9	1.4	1.1
Finland	2.9	3.5	2.1
France	1.5	1.5	1.0
Germany	2.1	1.0	1.3
Greece	2.9	1.1	2.3
Ireland	2.3	3.8	2.3
Italy	1.7	1.7	1.2
Netherlands	1.6	1.3	1.4
Portugal	2.6	2.3	2.2
Spain	1.6	1.9	1.6
Average	2.1	1.8	1.6

Annex I. Magnitude of downturns

Figure A1. Magnitude of downturns by quintiles

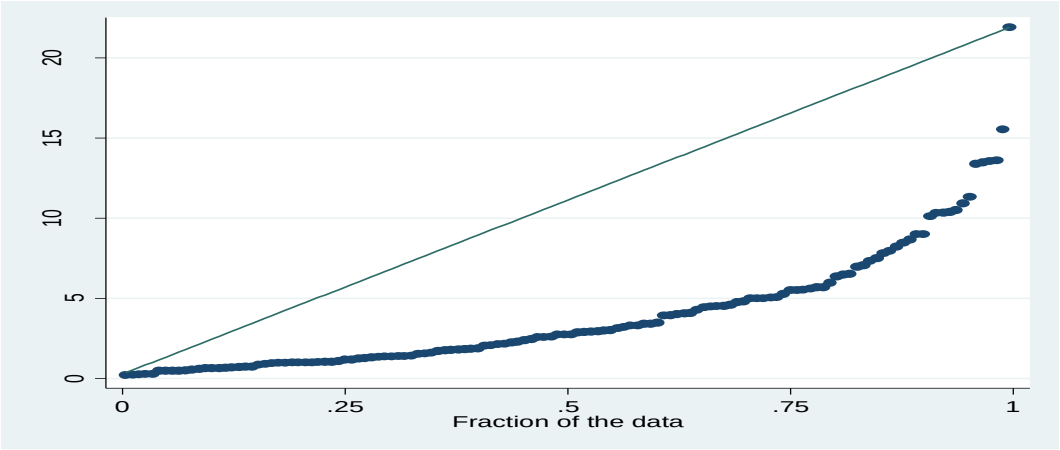


Table A1. Channels of output smoothing across countries- pre-EMU vs. post-EMU

	(I)	(II)	(III)
	Euro area 1979-2010	**pre-EMU (1979-1998)**	**post-EMU (1999-2010)**
Factor income flows [c]	0.076**	0.033	0.109**
	(2.21)	(0.72)	(2.13)
Capital depreciation	-0.084***	-0.085***	-0.083***
	(-6.13)	(-5.29)	(-4.24)
Net taxes and transfers [d]	0.039***	0.047***	0.034**
	(3.35)	(2.67)	(1.99)
Saving	0.310***	0.454***	0.201**
	(5.40)	(7.38)	(2.49)
Public	0.092***	0.114***	0.075***
	(4.25)	(4.04)	(2.59)
Private	0.218***	0.340***	0.127*
	(4.48)	(5.40)	(1.94)
Unsmoothed	0.658***	0.550***	0.739***
	(12.18)	(9.50)	(10.08)

***, **, * denotes significance at 1%, 5%, 10%, respectively.

Table A2. Channels of output smoothing across countries

	(I)	(IV)	(III)	(VI)
	Euro area 1981-1990	**US [a] 1981-1990**	**Euro area 1995-2006**	**Germany [b] 1995-2006**
Factor income flows [c]	-0.002		0.127**	
	(-0.06)	0.48***	(2.52)	0.505***
Capital depreciation	-0.064***	(12.00)	-0.048***	(6.82)
	(-3.12)		(-2.57)	
Net taxes and transfers [d]	0.039*	0.140***	0.009	0.114
	(1.87)	(14.00)	(0.53)	(1.58)
Saving	0.129	0.19**	0.208***	0.175***
	(1.26)	(2.11)	(3.16)	(3.13)
Public	-0.006		0.091***	
	(-0.14)		(3.49)	
Private	0.166**		0.117***	
	(2.02)		(1.98)	
Unsmoothed	0.846***	0.250**	0.703***	0.208***
	(8.31)	(2.38)	(12.28)	(3.014)

***, **, *denotes significance at 1%, 5%, 10%, respectively. [a] refers to estimates reported in Table 3 of Asdrubali et al. (1996); [b] refers to estimates reported in Table 5 (column I) of Hepp and von Hagen (2013); [c] international income flows for euro area, while domestic income flows for the U.S. and Germany; [d] international net taxes and transfers for euro area, while federal government taxes and transfers for the U.S. and Germany.

Table A3. Average transfers in the case of full stabilization, 1999-2010 (% of country's GNP)

	Uncorrelated shocks	**Output gaps**	**Growth deviations**
Austria	2.8	1.7	1.7
Belgium	2.6	1.2	1.4
Finland	3.9	2.9	2.3
France	2.4	2.3	1.7
Germany	3.5	3.8	2.2
Greece	2.7	2.2	2.2
Ireland	5.6	5.2	4.8
Italy	3.3	2.5	2.2
Netherlands	3.0	2.2	2.1
Portugal	3.6	1.7	3.0
Spain	2.0	3.1	1.9
Average	3.2	2.6	2.3

Annex II. Alternative transfer mechanisms

In this section we present an alternative stabilization mechanism that directly links transfers to uncorrelated total consumption shocks. As before, the designed scheme collects taxes as a share of the GNP of each member states:

$$Stabilization\_budget_t = \sum_i \tau * GNP_{it-1} \quad \text{(A.1)}$$

where "τ " is the contribution rate; and pays transfers to the countries negatively hit by shocks:

$$T_{it} = 0 \qquad if \qquad \epsilon_{it} \geq 0 \quad \text{(A.2)}$$

$$T_{it} = \epsilon_{it} \qquad if \qquad \epsilon_{it} < 0 \quad \text{(A.3)}$$

where ϵ_{it} are determined as: $log(C+G)_{i,t} = \alpha_i T_{i,t} + \sum_{j=1}^{2} \beta_j log(C+G)_{i,t-j} + \epsilon_{it}$

Also in this case, a relatively small contribution (equivalent to about 1.9 percent of GNP) would be sufficient to provide full stabilization. [37]

[37]The contribution in this mechanism is determined as the required amount to fully finance $\sum_i T_{it}$ in each period.